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Objective

CHEMISTRY

Chapterwise & Subtopicwise

MCQ's 50,000

VOLUME-I

Chief Editor

A.K. Mahajan

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Periodic Table of the Elements

1 IA																17 VIIA	18 VIIIA
1 **H** 1.0079	2 IIA											13 IIIA	14 IVA	15 VA	16 VIA	1 **H** 1.0079	2 **He** 4.0026
3 **Li** 6.941	4 **Be** 9.012											5 **B** 10.81	6 **C** 12.011	7 **N** 14.007	8 **O** 15.999	9 **F** 18.998	10 **Ne** 20.179
11 **Na** 22.990	12 **Mg** 24.305	3 IIIB	4 IVB	5 VB	6 VIB	7 VIIB	8 ←	9 VIIIB	10 →	11 IB	12 IIB	13 **Al** 26.982	14 **Si** 28.086	15 **P** 30.974	16 **S** 32.06	17 **Cl** 35.453	18 **Ar** 39.948
19 **K** 39.098	20 **Ca** 40.08	21 **Sc** 44.956	22 **Ti** 47.90	23 **V** 50.941	24 **Cr** 51.996	25 **Mn** 54.938	26 **Fe** 55.847	27 **Co** 58.933	28 **Ni** 58.70	29 **Cu** 63.546	30 **Zn** 65.38	31 **Ga** 69.72	32 **Ge** 72.59	33 **As** 74.922	34 **Se** 78.96	35 **Br** 79.904	36 **Kr** 83.80
37 **Rb** 85.468	38 **Sr** 87.62	39 **Y** 88.906	40 **Zr** 91.22	41 **Nb** 92.906	42 **Mo** 95.94	43 **Tc** [97.91]	44 **Ru** 101.07	45 **Rh** 102.905	46 **Pd** 106.4	47 **Ag** 107.868	48 **Cd** 112.41	49 **In** 114.82	50 **Sn** 118.69	51 **Sb** 121.75	52 **Te** 127.60	53 **I** 126.904	54 **Xe** 131.30
55 **Cs** 132.905	56 **Ba** 137.33	57-71 **La**	72 **Hf** 178.49	73 **Ta** 180.948	74 **W** 183.85	75 **Re** 186.21	76 **Os** 190.2	77 **Ir** 192.22	78 **Pt** 195.05	79 **Au** 196.966	80 **Hg** 200.59	81 **Tl** 204.37	82 **Pb** 207.2	83 **Bi** 208.98	84 **Po** [209]	85 **At** [210]	86 **Rn** [222]
87 **Fr** [223.02]	88 **Ra** [226.03]	89-103 **Ac**	104 **Rf** [265.12]	105 **Db** [268.13]	106 **Sg** [271.13]	107 **Bh** [270]	108 **Hs** [277.15]	109 **Mt** [276.15]	110 **Ds** [281.16]	111 **Rg** [280.16]	112 **Cn** [285.17]	113 **Nh** [284.18]	114 **Fl** [289.19]	115 **Mc** [288.19]	116 **Lv** [293]	117 **Ts** [294]	118 **Og** [294]

Lanthanides	57 **La** 138.905	58 **Ce** 140.12	59 **Pr** 140.907	60 **Nd** 144.24	61 **Pm** [145]	62 **Sm** 150.4	63 **Eu** 151.96	64 **Gd** 157.25	65 **Tb** 158.925	66 **Dy** 162.50	67 **Ho** 164.930	68 **Er** 167.26	69 **Tm** 168.934	70 **Yb** 173.04	71 **Lu** 174.967
Actinides	89 **Ac** [277.03]	90 **Th** 232.038	91 **Pa** 231.035	92 **U** 238.029	93 **Np** [237.05]	94 **Pu** [244.06]	95 **Am** [243.06]	96 **Cm** [247.07]	97 **Bk** [247.07]	98 **Cf** [251.08]	99 **Es** [252.08]	100 **Fm** [257.10]	101 **Md** [258.10]	102 **No** [259.10]	103 **Lr** [262.11]

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01.

Some Basic Concepts of Chemistry

1. Significant figures, Units for Measurement

1. Using the rules for significant figures, the correct answer for the expression $\frac{0.02858 \times 0.112}{0.5702}$ will be

(a) 0.005613 (b) 0.00561
(c) 0.0056 (d) 0.006

JEE Main-29.06.2022, Shift-II

Ans. (b) : $\frac{0.00285 \times 0.112}{0.5702} = \frac{0.003200}{0.5702}$
$= 0.00561$

2. Manganese (VI) has ability to disproportionate in acidic solution. The difference in oxidation states of two ions it forms in acidic solution is_____.

JEE Main-27.06.2022, Shift-I

Ans. (3) : Disproportionation reaction of manganese in acidic solution –

$$3MnO_4^{2-}(aq) + 4H^+(aq) \longrightarrow 2\overset{+7}{Mn}O_4^- + \overset{+4}{Mn}O_2 + 2H_2O$$

So, difference in oxidation state of product ions of-
Mn = (+7) – (+4) = 3

3. The units of surface tension and viscosity of a liquid respectively are

(a) $kg\ m^{-1}\ s^{-1}$, $N\ m^{-1}$ (b) $N\ m^{-1}$, $kg\ m^{-1}\ s^{-1}$
(c) $kg\ m^2\ s^{-1}$, $N\ m^{-2}$ (d) $N\ m^{-1}$, $kg\ m^2\ s^{-1}$

TS-EAMCET 09.08.2021, Shift-I
WB-JEE-2015

Ans. (b)

$$\text{Surface tension } (\gamma) = \frac{F}{L} \text{ or } \frac{W}{A}$$
$$= Nm^{-1}$$

$$\text{Coefficient of viscosity}(\eta) = \frac{F}{A\frac{dV}{dx}} = \frac{N}{m^2\frac{ms^{-1}}{m}}$$
$$\eta = N\,m^{-2}s$$
$$\eta = kg\,ms^{-2}\,m^{-2}s$$
$$\eta = kg\,m^{-1}\,s^{-1}$$

4. Given the numbers : 161 cm, 0.161 cm, 0.0161 cm. The number of significant figures for the three numbers are

(a) 3, 4 and 5 respectively
(b) 3, 3 and 4 respectively
(c) 3, 3 and 3 respectively
(d) 3, 4 and 4 respectively

BITSAT 2009
NEET 1998

Ans. (c) : Each has three significant figures. All non-zero number are significant 161 has 3 significant and leading zero are not significant they are nothing more then place holder, the number 0.161 and 0.0161 has 3 significant figure.

5. The prefix 10^{18} is

(a) giga (b) kilo
(c) Exa (d) nano

BITSAT 2015, 2006

Ans. (c) : Exa is a decimal unit prefix in the matric system.
Exa = 10^{18}, Giga = 10^9
Kilo = 10^3, Nano = 10^{-9}

6. Match List-I with List-II

List-I (Parameter)		**List-II (Unit)**	
A.	Cell constant	1.	$S\ cm^2\ mol^{-1}$
B.	Molar conductivity	2.	Dimension less
C.	Conductivity	3.	m^{-1}
D.	Degree of dissociation of electrolyte	4	Sm^{-1}

Choose the most appropriate answer from the options given below

	A	**B**	**C**	**D**
(a)	3	1	4	2
(b)	3	1	2	4
(c)	1	4	3	2
(d)	2	1	3	4

[JEE Main 2021, 31 Aug Shift-II]

Ans. (a) : Cell Constant = $\frac{\text{Length}}{\text{Area}} = \frac{m}{m^2} = m^{-1}$

Conductivity (K)= $\frac{1}{\rho} = Sm^{-1}$ or ohm^{-1}

Molar conductivity (Λm) =

$$\frac{K}{C} = \frac{Sm^{-1}}{\text{Mol. liter}^{-1}} = \frac{Sm^{-1}}{\text{Mol } m^{-3}}$$
$$= Sm^2mol^{-1}$$
Or
$$= Scm^2\ mol^{-1}$$

Degree of dissociation

$$= \frac{\text{amount of dissociated substance}}{\text{Total amount of Substance}}$$

So, dimensionless quantity.

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7. The number of significant figures in 0.00340 is….. .

[JEE Main 2021, 25 July Shift-II]

Ans. (3) : Significant figure is the digits of a number that are used to express it to the required degree of accuracy, starting from the first non – zero digit.

So, counting these numbers, we find that the number of significant figures in 0.00340 is 3. The significant figures of 0.00340 are '340'

8. For a A + B products the rate of the reaction is given by Rate = K [A] $[B]^2$. The units of rate constant (K) will be______

(a) mol $L^{-1}S^{-1}$ (b) L $mol^{-1}S^{-1}$

(c) mol^2 $L^{-2}S^{-1}$ (d) mol^{-2} L^2S^{-1}

AP EAPCET 20.08.2021 Shift-II

Ans. (d): The rate constant is expressed as relationship between the rate of a chemical reaction and the concentrations of the reacting substance.

$\therefore$ Unit of rate constant for n^{th} order = $(mol)^{1-n}(lit)^{n-1}s^{-1}$

Given rate = K [A] $[B]^2$

$$\therefore n = 1+2 = 3(\text{third order reaction})$$

Unit are $(mol)^{1-3}(lit)^{3-1}s^{-1} = mol^{-2}lit^2s^{-1}$

for zero order rate constant = mol $lit^{-1}.s^{-1}$

First order rate constant = s^{-1}

Second order rate constant = mol^{-1} lit s^{-1}.

9. The number of significant figures in 50000.020×10^{-3} _______.

JEE Main 26.02.2021, Shift-I

Ans. (7) :

No. of significant figure in 50000.020×10^{-3} is 7.

10. The value of which of the following unit of concentration will not change with the change in temperature?

(a) Molarity (b) Molality

(c) Normality (d) Formality

GUJCET-2019

Ans. (b) : Molality = $\dfrac{\text{Moles of solute}}{\text{Mass of solvent in kg}}$

Molality of concentration will not change with the change in temperature because in molality both moles of solute and mass of solvent are independent of temperature.

Thus, molality is independent of temperature.

Molarity (M) is the amount of a substance in a certain volume of solution. Molarity is defined as the moles of a solute per litres of a solution.

Normality is a measure of concentration equal to the gram equivalent weight per litre of solution.

Formality is a substance's total concentration in solution without regard to its specific chemical form.

11. Which of the following is the correct unit of angular momentum of an electron in an orbital of an atom?

(a) J-s (b) J / s

(c) W / s^2 (d) W s

(e) J s^2

Kerala-CEE-2019

Ans. (a) : Angular momentum of an electron in an orbital of an atom (L) = mvr

Now, $L = mv \times r = kg.ms^{-1} \times m$

$= kg\ m^2s^{-1}$ .....(i)

We know that,

$1\ Joule = kgm^2s^{-2}$

So, multiplying and dividing equation (i) by $\dfrac{s^{-1}}{s^{-1}}$ -we get

$$L = kgm^2s^{-1}\times\frac{s^{-1}}{s^{-1}}$$

$$= kgm^2\frac{s^{-2}}{s^{-1}}$$

L = J-s

Hence, the unit of angular momentum of an electron in an orbital in J-sec.

12. The SI unit of electrochemical equivalent is

(a) J s^{-1} (b) kg C^{-1}

(c) kg m s^{-2} (d) kg $m^{-1}s^{-2}$

MHT CET-03.05.2019, SHIFT-I

Ans. (b) : Electrochemical equivalent is the mass of the substance deposited to one of the electrodes when a current of 1 ampere is passed for 1 second.

The SI unit of electrochemical equivalent weight is kg C^{-1}

13. The absolute zero temperature is 0 Kelvin. In ºC unit which one of the following is the absolute zero temperature?

(a) 0ºC (b) –100ºC

(c) –273.15ºC (d) –173.15ºC

NDA (II)-2018

Ans. (c) : Zero Kelvin (–273.15ºC) is defined as absolute zero.

14. What is the SI unit of density?

(a) g cm^{-3} (b) g m^{-3}

(c) kg m^{-3} (d) kg cm^{-3}

MHT CET-2018

Ans. (c) : Mass per unit volume is called density. The SI unit of density is kg m^{-3}.

15. Which symbol replaces the unit of atomic mass, amu?

(a) u (b) A

(c) M (d) n

MHT CET-2018

Ans. (a) : u symbol represent the unit of atomic mass, amu.

Where, a = Atomic mass number

m = Molecular mass of the molecule.

n = Number of atoms

16. Which one of the following statements is not correct?

(a) The hydration enthalpies of alkali metal ions decrease down the group

(b) Lithium halides are some what covalent in nature

(c) Alkali metals react with water liberating oxygen gas

(d) KO_2 is paramagnetic

AP EAMCET-2017

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Ans. (c): Alkali metal reacts with water to give metal hydroxide and hydrogen.

$$\underset{\text{alkali metal}}{2M} + 2H_2O \longrightarrow 2MOH + H_2(g).$$

17. Which of the following has the dimension if $[ML^0T^{-2}]$?

(a) Coefficient of viscosity (b) Surface tension
(c) Vapour pressure (d) Kinetic energy

WB-JEE-2017

Ans. (b) : Surface tension is the tendency of liquid surface at rest to shrink into the minimum surface area possible. The surface tension is given as:

$$\text{Surface tension} = \frac{\text{Force}}{\text{Length}}$$
$$= \frac{MLT^{-2}}{L}$$
$$= [ML^0T^{-2}]$$

18. Which one of the following is not a unit of energy?

(a) lit-atm (b) kg m^2s^{-2}
(c) Nm (d) kg.ms^{-2}

UPTU/UPSEE-2016

Ans. (d): Kg. ms^{-2} is a unit of force and other three options are the units of energy.

19. Consider following unit values of energy

I. 1 L atm II. 1 erg
III. 1 J IV. 1 kcal

Increasing order of these values is–

(a) I = II = III = IV (b) I < II < III < IV
(c) II < III < I < IV (d) IV < I < III < II

BCECE-2013

Ans. (c):

- Energy is the capacity to do work.

$R = 0.0821$ L atm mol^{-1} k^{-1}
$R = 8.314 \times 10^7$ ergs mol^{-1} k^{-1}
$R = 8.314$ mol^{-1} k^{-1}
$R = 0.002$ Kcal mol^{-1} k^{-1}

$$\because\ 1\text{ L atm} = \frac{R}{0.0821}\text{mol K}$$

- $1\text{ erg} = \dfrac{R}{8.314\times10^7}\text{mol K}$
- $1\text{ J} = \dfrac{R}{8.314}\text{mol K}$
- $1\text{ kcal} = \dfrac{R}{0.002}\text{mol K}$

Hence, option (c) is correct answer.

20. Dimension of universal gas constant (R) is

(a) $[VPT^{-1}n^{-1}]$ (b) $[VP^{-1}Tn^{-1}]$
(c) $[VPTn^{-1}]$ (d) $[VPT^{-1}n]$

J & K CET-(2012)

Ans. (a) : From the gas equation,

$$PV = nRT$$
$$R = \frac{P\times V}{n\times T}$$
$$R = [VPT^{-1}n^{-1}]$$

21. Which of the following represents the smallest quantity?

(a) 1230 ng (b) 1.230×10^{-4}g
(c) 1.230×10^{-6}kg (d) 1.230×10^{4}μg

UPTU/UPSEE-2011

Ans. (a) : (a) 1230 ng = 1230×10^{-9}g = 1.230×10^{-6}g
(b) 1.230×10^{-4}g = 1.230×10^{-4}g.
(c) 1.230×10^{-6}kg = $1.230 \times 10^{-6} \times 10^{3}$g
= 1.230×10^{-3}g
(d) 1.230×10^{4}μg = $1.230 \times 10^{4} \times 10^{-6}$g
= 1.230×10^{-2}g
Thus, 1230 ng is the smallest quantity.

22. How is 0.0120 written as a scientific notation?

(a) 120×10^{-4} (b) 1.2×10^{-2}
(c) 12×10^{-3} (d) 12.0×10^{-3}

UPTU/UPSEE-2011

Ans. (b) : 0.0120 is written as 1.2×10^{-2}, ie. decimal is moved two places towards the right so that there is only one non-zero digit before the decimal point and the exponent of 10 is –2 in the scientific notation.
Scientific notation is a form of representing in simpler form.

23. For a reaction of type A + B → products, it is observed that doubling concentration of A causes the reaction rate to be four times as great, but doubling amount of B does not affect the rate. The unit of rate constant is

(a) s^{-1} (b) s^{-1} mol L^{-1}
(c) s^{-1} mol^{-1} L (d) s s^{-1} mol^{-2} L^2

VITEEE- 2010

Ans. (c) : For a reaction -

$$A + B \rightarrow \text{product}$$

Let the initial rate be R
And order with respect to A be x and B be y. Thus, rate law can be written as,

Rate, $R = [A]^x\,[B]^y$ ....(i)

After doubling the concentration of A, rate becomes 4R,

$4R = [2A]^x\,[B]^y$ ....(ii)

After doubling the concentration of B, rate remains R,

$R = [A]^x\,[2B]^y$ ....(iii)

From equation (i) and (ii), we get

$$\frac{R}{4R} = \left(\frac{1}{2}\right)^x \Rightarrow \left(\frac{1}{2}\right)^2 = \left(\frac{1}{2}\right)^x$$

So, x = 2

From equation (i) and (iii), we get

$$\frac{R}{R} = \left[\frac{1}{2}\right]^y \Rightarrow \left(\frac{1}{1}\right)^0 = \left(\frac{1}{2}\right)^y$$

So, Y = 0

Hence, the rate law is, rate $R = [A]^2[B]^0$

This clearly shows that the order of this reaction is 2 and for second order reaction units of rate constant are mol^{-1} Ls^{-1}.

24. The charge on an electron in Coulombs is–

(a) 1.602×10^{-19} (b) 1.062×10^{-19}
(c) 1.620×10^{-19} (d) 1.006×10^{-19}

BCECE-2009

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Ans. (a) : Coulomb is the SI unit of electric charge which is define as the amount of charge delivered by an electric current of one ampere in one second.
The charge on an electron is
$= -1.60217663 \times 10^{-19}$ coulomb.

25. In colloid particles, range of diameter is
(a) 1 to 1000 nm (b) 1 to 1000 cm
(c) 1 to 1000 mm (d) 1 to 100 km

BCECE-2008
UPTU/UPSEE-2006

Ans. (a) : Colloid is a mixture, in which insoluble particles of one substance suspended in another substance, range of diameter in colloid particles is 1 to 1000 nm.
Colloidal particle range in diameter from 1 to 1000 nanometers and can be solid, liquid, or gases.

26. In which of the following number all zeros are significant?
(a) 0.0005 (b) 0.0500
(c) 50.000 (d) 0.0050

BITSAT-2008

Ans. (c) : If zero is used to locate the decimal point it is considered as a significant figure. In 50.000, all zero are significant.

27. Which one of the following set of units represents the smallest and largest amount of energy respectively?
(a) J and erg (b) erg and cal
(c) cal and eV (d) lit-atom and J
(e) eV and lit-atom

Kerala-CEE-2007

Ans. (e) : SI unit of energy is Joule.
Converting other units of energy into joule, we find-
1 eV = 1.6×10^{-19} J
1 cal = 4.186 J
1 erg = 10^{-7} J
1 lit - atom = 101.3 J
Smallest and largest amount of energy are eV and lit-atom respectively.

28. Which of the following, is not a unit of pressure?
(a) Atmosphere (b) Torr
(c) Pascal (d) Newton

JIPMER-2004

Ans. (d) : • The force per unit area is called pressure it is denoted by P. Here, Atmosphere, Torr and Pascal, these three are unit of pressure.
• Newton is not the unit of pressure. It is the unit of force.
So, the correct option is Newton.

29. The value of amu is which of the following?
(a) 1.57×10^{-24} kg (b) 1.66×10^{-24} kg
(c) 1.99×10^{-23} kg (d) 1.66×10^{-27} kg

UP CPMT-2003

Ans. (d) : 1 amu is defined as $\left(\frac{1}{12}\right)^{th}$ of the mass one carbon-12 isotope atom. As per the definition of atomic mass unit,

$$1 \text{ amu} = \frac{1}{12}\frac{12}{N_A} \text{g}$$
$$1 \text{ amu} = \frac{1}{6.023\times10^{23}} \text{g}$$
$$1 \text{ amu} = 1.6 \times 10^{-27} \text{ kg}$$

30. The radius of an atomic nucleus is generally expressed in units of:
(a) Debye (b) Coulomb
(c) Fermi (d) Tesla

AP-EAMCET (Medical), 2001

Ans. (c) : The radius of atomic nucleus is expressed in fermi.
1 Fermi = 10^{-13} cm

31. A colloidal system has particles of which of the following size?
(a) 10^{-9}m to 10^{-12}m (b) 10^{-6}m to 10^{-9}m
(c) 10^{-4}m to 10^{-10}m (d) 10^{-5}m to 10^{-7}m

(NEET-1996)

Ans. (b) : A colloidal system has particles of 10^{-6} m to 10^{-9} m size. Colloidal system consist of dispersed of dispersed phase and dispersion medium.
So, option B is correct.

32. The dimensions of pressure are the same as that of
(a) force per unit volume
(b) energy per unit volume
(c) force
(d) energy

NEET-1995

Ans. (b): Pressure $= \frac{\text{Force}}{\text{Area}} = \frac{\text{Mass}\times\text{acceleration}}{\text{Area}}$
Dimensional formula,
$$= \frac{M\times LT^{-2}}{L^2} = ML^{-1}T^{-2}$$
$\text{Energy} = \text{work} = \text{force}\times\text{displacement}$
Energy per unit volume $= \frac{ML^2T^{-2}}{L^3}$
$= ML^{-1}T^{-2}$
Dimension of pressure is $ML^{-1}T^{-2}$ which is same as the dimension of energy per unit volume.

2. Atomic, Molecular and Equivalent Masses

33. Arrange the following in the order increasing mass (atomic mass O = 16, Cu = 63, N = 14)
I. One molecule of oxygen
II. One atom of nitrogen
III. 1 × 10^{-10} gram molecule of oxygen
IV. 1 × 10^{-10} g of copper
(a) II < I < IV < III (b) I < II < III < IV
(c) III < II < IV < I (d) IV < II < III < I
(e) II < IV < I < III

AIIMS-2016
Kerala-CEE-2011

@apna_pdf

Ans. (a) : Comparing the masses, we get correct order of increasing mass is (II) < (I) < (IV) < (III)

(I) 1 molecule of oxygen = O_2

$\therefore$ Mass of O_2

$$= \frac{16\times2}{N_A} = \frac{32g}{N_A} = \frac{32}{6.22\times10^{23}} = 5.3\times10^{-23}\,g$$

(II) Mass of 1 atom of Nitrogen = $1.66\times10^{-24}\times14$

$= 23.2\times10^{-24}\,g$

(III) 1×10^{-24} gm molecule of oxygen = 1×10^{-10} moles of O_2

Mass of 1×10^{-10} gm molecule of oxygen $1\times10^{-10}\times32$

$= 3.2\times10^{-9}\,g$

(IV) Mass of copper = $1\times10^{-10}\,g$

Comparing the masses in (I), (II), (III) and (IV)

We get, (II), < (I), < (IV), < (III)

Therefore, answer is (II) < (I) < (IV) < (III)

34. 1.520 g of hydroxide of a metal on ignition gave 0.995 g of oxide. The equivalent weight of metal is :

(a) 1.52 (b) 0.995

(c) 19.00 (d) 9.00

BITSAT-2011

BCECE-2008

Ans. (d) : Let E be the equivalent weight of the metal

So, $\frac{E+17}{E+8} = \frac{1.52}{0.995}$

[17 is equivalent weight of OH and 8 is equivalent weight of oxygen]

$\Rightarrow 0.995E + 17\times0.995 = E\times1.52 + 8\times1.52$

$\Rightarrow 0.525E = 16.915 - 12.16 = 4.755$

$\therefore E = \frac{4.755}{0.525} = 9$

35. In acidic medium, the equivalent weight of $K_2Cr_2O_7$ (Mol. wt. = M) is

(a) M (b) $\frac{M}{2}$

(c) $\frac{M}{3}$ (d) $\frac{M}{6}$

WBJEE-2012

UPTU/UPSEE-2009

Ans. (d) : An equivalent weight of a solution is defined as the molecular weight of the solute divided by the valence of the solute. Equivalent weight is used for predicting the mass of substance that react with one atom of hydrogen is acid –base analysis.

Balanced chemical reaction of $K_2Cr_2O_7$ in acidic medium will be-

$$K_2Cr_2O_7 + 14H^+ + 6e^- \rightarrow 2K^+ + 2Cr^{3+} + 7H_2O$$

In the above reaction, oxidation state of chromate ion is changing from +6 to +3, i.e. the transfer of 6 electrons is taking place.

$\therefore$ Equivalent weight = $\frac{M}{6}$

36. Assertion : The normality of 0.3 M aqueous solution of H_3PO_3 is equal to 0.6N.

Reason: Equivalent weight of H_3PO_3

$$= \frac{\text{Molecular weight of } H_3PO_3}{3}$$

(a) If both Assertion and Reason are correct and the Reason is the correct explanation of Assertion.

(b) If both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.

(c) If Assertion is correct but Reason is incorrect.

(d) If both the Assertion and Reason are incorrect.

AIIMS-2018, 2013, 2011

Ans. (c): H_3PO_3 is a divalent. This is because it has two ionizable hydrogen atoms bonded to two oxygen atom and one non-ionizable hydrogen atom bonded directly to phosphorus.

$\therefore$ Equivalent weight = $\frac{\text{Molecular weight}}{\text{Valency factor}}$

(Where, valency factor = no. of replaceable H^+ ions)

equivalent weight = $\frac{M}{q}$, since, no. of replaceable H^+ ions in H_3PO_3 = 2

37. 0.79 gm of a metal oxide is obtained from 0.5 gm of the same metal upon oxidation. Equivalent weight of the metal will be which of the following?

(a) 10 (b) 13.8

(c) 20 (d) 40

Tripura JEE-2022

Ans. (b) : Mass of metal + mass of oxygen = mass of metal oxide

Mass of oxygen = 0.79 – 0.5

= 0.29

$$\frac{\text{Mass of metal}}{\text{Mass of oxygen}} = \frac{\text{Eq. wt. of metal}}{\text{Eq. wt. of oxygen}}$$

$$\text{Eq. wt. of metal} = \frac{0.5}{0.29}\times8$$

$$\text{Eq. wt. of metal} = 13.79 \simeq 13.8$$

38. What amount of conc. H_2SO_4 solution should be used to prepare 500 m*l* of 0.5 M H_2SO_4? (The concentration of H_2SO_4 solution being used is 90% and molecular mass of H_2SO_4 = 98.079 g. mol^{-1})

(a) 22.06 g (b) 24.52 g

(c) 11.03 g (d) 27.24 g

AP-EAPCET-23.08.2021, Shift-I

Ans. (a) : Given that-

V = 500 ml

C = 0.5 M

Concentration of H_2SO_4 solution being used is 90%

So, $C = \frac{0.5\times90}{100} = 0.45\,M$

Molecular weight of H_2SO_4 = 98.079 g/mol

@apna_pdf

$$\therefore\ C = \frac{n(\text{moles})}{V(\text{volume})}$$

$$\text{or } C = \frac{\text{weight}}{\text{m.weight}} \times \frac{1}{V(\text{Volume})}$$

Putting the value we get-

$$0.45 = \frac{\text{weight/amount}}{98.079 \times 0.5}$$

Amount of $H_2SO_4 = 0.45 \times 0.5 \times 98.079 = 22.06$ gm.

39. When 1 : 2 equivalence ratio of the gases X and Y are heated to 573 K – 673 K at 200 – 300 atm in the presence of $ZnO - Cr_2O_3$ catalyst, methanol is formed. Here, the gases X and Y are ____ and ____ respectively.

(a) CO_2 & H_2 (b) CO & H_2

(c) CH_4 & O_2 (d) CH_4 & $H_2O_{(g)}$

AP EAPCET 24.08.2021, Shift-I

Ans. (b) : $CO + 2H_2 \xrightarrow[573K-673K]{ZnO+Cr_2O_3} CH_3OH$

CO and H_2 are heated to 573 K – 673 K at 200 - 300 atm in the presence of $ZnO - Cr_2O_3$ catalyst, methanol is formed. This process is used to prepare methanol on an industrial scale.

40. 3.7 gm of a gas at 25°C occupies some volume. At 17°C, 0.184 gm hydrogen gas occupies same volume when pressures of both gases are same. What will be the molecular weight of the gas?

(a) 41.98 (b) 20.67

(c) 20.94 (d) 41.34

Tripura JEE-2021

Ans. (d) : Given, Amount of gas = 3.7g

Here, volume and pressure of both gases are same.

As we know, PV = nRT

P and V are same for both gases.

So, $n_1T_1 = n_2T_2$

$$\frac{w_1}{M_1}T_1 = \frac{w_2}{M_2}T_2$$

$$\frac{3.7}{M_1} \times 298 = \frac{0.184}{2} \times 290$$

$M_1 = 41.33$ g

41. 12.3 g of 1-bromopropane is treated with alcoholic KOH. What mass of propene is obtained if yield is 50%?

(a) 6.05 g (b) 12.3 g

(c) 4.2 g (d) 2.1 g

Assam CEE-2021

Ans. (d) :

$$\underset{12.3g}{CH_3-CH_2-CH_2-Br} \xrightarrow[KOH]{alc} \underset{50\%\ x\ g?}{CH_3-CH=CH_2}$$

$$121\text{ g} \rightarrow 41\text{ g}(100\%)$$

$$1\text{ g} \rightarrow \frac{41}{121} \times \frac{50}{100}(50\%)$$

$$12.3\text{g} \rightarrow \frac{41}{121} \times \frac{50}{100} \times 12.3$$

$$= 2.06 = 2.1\text{g}$$

42. Vapour density of a metal chloride is 83. If equivalent weight of the metal is 6, its atomic weight will be 1

(a) 12 (b) 24

(c) 18 (d) 60

AP EAMCET (Engg.) 21.09.2020, Shift-I

Ans. (b) : Valency of metal,

$$(n) = \frac{2 \times \text{vapour density}}{\text{Equivalent weight of metal} + 35.5}$$

$$= \frac{2 \times 83}{6 + 35.5} = 4$$

The atomic weight of metal is equal to the product of the equivalent weight of metal and valency.

Atomic weight of metal = n × equivalent weight of metal

⇒ 4 × 6 = 24

Hence, the correct option (b).

43. A 40% by mass sucrose solution is heated till, it becomes 50% by mass. Calculate the mass of water lost from 100 g of the solution is

(a) 10 g (b) 15 g

(c) 20 g (d) 25 g

AP EAMCET (Engg.) 21.09.2020, Shift-II

Ans. (c) : 40% sucrose solution means it contains 60% water. After heating, till 50% by mass sucrose remains.

$$\text{Thus, \% water lost } = \frac{0.4}{0.5} \times 100 = 80$$

Water lost = 100 – 80 = 20 g

Hence, option (c) is correct.

44. What will be the mass of one atom of ^{12}C?

(a) 1 amu (b) 1.9923×10^{-23}g

(c) 1.6603×10^{-22}g (d) 6 amu

WB-JEE-2020

Ans. (b) : Mass of ^{12}C = 12 gm

6.022×10^{23} atoms are present in 12 g of carbon -12 element.

Mass of 6.022×10^{23} atom = 12 gm.

$$\text{Mass of 1 Atom} = \frac{12}{6.023 \times 10^{23}}$$

$$= 1.993 \times 10^{-23}\text{ gm}$$

45. In a flask, the weight ratio of CH_4(g) and SO_2(g) at 298 K and 1 bar is 1:2. The ratio of the number of molecules of SO_2(g) and CH_4(g) is

(a) 1:4 (b) 4:1

(c) 1:2 (d) 2:1

COMEDK-2020

Ans. (c) : Let mass of CH_4(g) =1g

Number of moles of CH_4 (n_{CH_4})= $\frac{1}{16}$

Number of molecules of CH_4(g)= $\frac{1}{16} \times N_A$

Let the mass of SO_2(g)=2g

Number of moles of SO_2(g)(n_{so_2})= $\frac{2}{64}$

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Number of molecules of $SO_2(g)$= $\frac{2}{64}\times N_A$

Ratio of number of molecules of $SO_2(g)$ and number of molecules of $CH_4(g)$ =

$$\frac{2}{64}\times N_A : \frac{1}{16}\times N_A \Rightarrow \frac{1}{32} : \frac{1}{16} \Rightarrow 1:2$$

46. Equivalent mass of $K_2Cr_2O_7$ in acidic solution is equal to

(a) molecular mass/2 (b) molecular mass/4
(c) molecular mass (d) molecular mass/ 6.

COMEDK-2019

Ans. (d) : The given reaction occurred in acidic medium is :

$$K_2Cr_2O_7 + 14H^+ + 6e^- \longrightarrow 2K^+ + 2Cr^{3+} + 7H_2O$$

In the above reaction, you can see that 1 molecule of $K_2Cr_2O_7$ is releasing 6 electrons and molecular weight of $K_2Cr_2O_7$=294 g/mol

∴Calculation of equivalent weight

$$= \frac{\text{Molecular wt. of } K_2Cr_2O_7}{\text{Acidity}}$$

Equivalent weight = $\frac{\text{Molecular wt. of } K_2Cr_2O_7}{6}$

47. Equivalent weight of $KMnO_4$ is equal to

(a) one-sixth its molecular weight
(b) its molecular weight
(c) one-fifth its molecular weight
(d) half is molecular weight.

COMEDK-2019

Ans. (c) : $2KMnO_4 + 3H_2SO_4 \rightarrow$
$K_2SO_4 + 2MnSO_4 + 3H_2O + 5[O]$

Since, mass of oxygen are available from $\frac{2\times 8}{5\times 16} = \frac{1}{5}$ mol. wt. of $KMnO_4$

Therefore, equivalent weight of $KMnO_4$

= $\frac{1}{5}$ × molecular weight.

Thus equivalent weight of $KMnO_4$ is one fifth its molecular weight.

48. Assertion: Molecular weight of a compound is 180, if its vapour density is 90.

Reason: Molecular Weight = $\frac{\text{Vapour density}}{2}$

(a) If both Assertion and Reason are correct and Reason is the correct explanation of Assertion.
(b) If both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.
(c) If Assertion is correct but Reason is incorrect.
(d) If both the Assertion and Reason are incorrect.

AIIMS 25 May 2019 (Morning)

Ans. (c): Relation between molecular weight and vapour density is,

Molecular weight of compound = 2 × vapour density
= 2 × 90
= 180

Hence, assertion is correct but reason is incorrect.

49. In acid medium MnO_4^- is reduced to Mn^{2+}, by a reducing agent. Then the equivalent mass of $KMnO_4$ is given by :
(M = molecular mass)

(a) M/2 (b) M
(c) M/5 (d) M/3

Manipal-2019

Ans. (c) :

$$\underset{\text{O.N.}=+7}{\underset{\downarrow}{MnO_4^-}} + 8H^+ + 5e^- \rightarrow \underset{\text{O.N.}=+2}{\underset{\downarrow}{Mn^{2+}}} + 4H_2O$$

In acidic medium, Mn^{+7} goes to Mn^{+2} state and hence there is a net gain of 5 electrons.

Now, equivalent weight

$$= \frac{\text{molar mass}}{\text{number of electrons gained or lost}}$$

So, equivalent weight = $\frac{M}{5}$

50. The equivalent weight of oxalic acid in $C_2H_2O_4.2H_2O$ is

(a) 45 (b) 63
(c) 90 (d) 126

NDA (I)-2019

Ans : (b) Given, Oxalic Acid ($C_2H_2O_4.2H_2O$)

We know that,

$$\text{Equivalent weight} = \frac{\text{Molecular weight}}{\text{n - factor}}$$

$$= \frac{126}{2} = 63$$

Hence, equivalent weight of oxalic acid ($C_2H_2O_4.2H_2O$) is 63.

51. 1 mol of $FeSO_4$ (atomic weight of Fe is 55.84g mol^{-1}) is oxidised to $Fe_2(SO_4)_3$.
Calculate the equivalent weight of ferrous ion

(a) 55.84 (b) 27. 92
(c) 18.61 (d) 111.68
(e) 83.76

Kerala-CEE-2018

Ans. (a) : 1 mol of $FeSO_4$ is oxidised to $Fe_2(SO_4)_3$.

Change in oxidation number = 1(+2 → +3)

The atomic mass of Fe = 55.84

$$\text{Equivalent mass} = \frac{\text{Atomic mass}}{\text{Change in oxidation state}}$$

For the charge, $Fe^{2+} \rightarrow Fe^{3+}$ i.e. (3 – 2 = 1)

The equivalent mass = $\frac{55.84}{1}$ = 55.84

52. In the standardization of $Na_2S_2O_3$ using $K_2Cr_2O_7$ by iodometry, the equivalent weight of $K_2Cr_2O_7$ is :

(a) Molecular weight/2
(b) Molecular weight/6
(c) Molecular weight/3
(d) Same as molecular weight

Manipal-2018

@apna_pdf

Ans. (b) : The reaction between $Na_2S_2O_3$ and $K_2Cr_2O_7$ is as shown below.

$$26H^+ + 3S_2O_3^{2-} + 4Cr_2O_7^{2-} \rightarrow 6SO_4^{2-} + 8Cr^{3+} + 13H_2O$$

The oxidation state of chromium in $K_2Cr_2O_7$ change from +6 to +3.
The net change in oxidation number per formula unit is 6.
Hence,

$$\text{The equivalent weight of } K_2Cr_2O_7 = \frac{\text{Molecular weight}}{6}$$

53. A certain amount of a metal whose equivalent mass is 28 displaces 0.7 L of H_2 at STP from an acid. Hence, mass of the element is :

(a) 1.75 g (b) 0875 g
(c) 3.50 g (d) 7.00 g

Manipal-2018

Ans. (a) : $\text{Moles of } H_2 = \frac{\text{given volume}}{\text{volume at STP}}$ … (i)

$\text{Equivalent weight} = \frac{\text{molar mass of metal}}{\text{valency}}$ … (ii)

Gram equivalent metal = gram equivalent of H_2
From (i) & (ii) –

$$\frac{\text{Weight of metal}}{\text{Equivalent wt. of metal}} = \text{Moles of } H_2 \times \text{Valency factor}$$

$$\Rightarrow \frac{\text{Weight of metal}}{28} = \frac{\text{given volume}}{22.4} \times 2$$

$$\Rightarrow \frac{\text{Weight of metal}}{28} = \frac{0.7}{22.4} \times 2$$

Weight = 1.75 gm

54. The masses of oxygen which combine with a fixed mass of hydrogen to form H_2O and H_2O_2, respectively, bear the simple ratio 1:2.
The above statement illustrates which of the following laws?

(a) Law of definite composition
(b) Law of multiple proportions
(c) Gay Lussac's law of gaseous volumes
(d) Avogadro's law

COMEDK-2018

Ans. (b) : The masses of oxygen which combine with a fixed mass of hydrogen to form H_2O and H_2O_2, respectively bear the simple ratio 1: 2. It illustrates the law of multiple proportions.
The law of multiple proportions can be defined as if two elements form more than one compound between them, the mass ratios of the second elements that combine with a fixed mass of the first element will always be the ratios of small whole numbers.

55. The number of times the comparative mass of a neutron is heavier than an electron is

(a) ~1842 (b) ~182
(c) ~102 (d) ~4050

J & K CET-(2018)

Ans. (a): Mass of neutron = 1.008665 amu
Mass of electron = 0.00055 amu
Hence, Neutron is 1842 times heavier than an electron.

56. What is the formula mass of anhydrous sodium carbonate? [Given that the atomic masses of sodium, carbon and oxygen are 23u, 12u and 16u respectively]

(a) 286 u (b) 106 u
(c) 83 u (d) 53 u

NDA (II)-2018

Ans. (b) : Chemical formula of anhydrous sodium carbonate- (Na_2CO_3)
= 2 × [Atomic Mass of Na + Atomic mass of C + 3 × Atomic mass of oxygen]
$=2\times23+12+3\times16=106\ \mu$

57. A sample of oxygen contains two isotopes of oxygen with masses 16 u and 18 u respectively. The proportion of these isotopes in the sample is 3 : 1. What will be the average atomic mass of oxygen in this sample?

(a) 17.5 u (b) 17 u
(c) 16 u (d) 16.5 u

NDA (II)-2018

Ans. (d) : Given,
Two isotopes of oxygen with 16u and 18u. The proportion is given, 3:1
∴ Percentage composition of isotopes of oxygen is 75% and 25%.
Now, we know that
Average atomic mass of element=

$$\frac{(\text{Atomic mass of I}^{st}\text{ isotope} \times \text{Percentage Isotop})}{100} +$$

$$\frac{(\text{Atomic mass }2^{nd}\text{ isotope} \times \text{Percentage of }2^{nd})}{100}$$

$$= 16 \times \frac{75}{100} + 18 \times \frac{25}{100}$$

= 16.5u
Hence, the average atomic mass of oxygen is 16.5u .

58. Assertion : Equal moles of different substances contain same number of constituent particles.
Reason: Equal weights of different substance contain the same number of constituent particles.

(a) If both Assertion and Reason are correct and the Reason is the correct explanation of Assertion.
(b) If both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.
(c) If Assertion is correct but Reason is incorrect.
(d) If both the Assertion and Reason are incorrect.

AIIMS-2017

Ans. (c): Equal moles of different substances contain same number of constituent particles. But equal weights of different substances do not contain the same number of constituent particles. Hence, Assertion is correct but reason is incorrect.

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$$\text{Number of moles} = \frac{\text{Weight}}{\text{Molecular weight}}$$

$$\text{Number of moles} = \frac{\text{Number of particle}}{N_A}$$

Where, N_A = Avogadro's number

59. 4 g of copper was dissolved in conc. HNO_3. The copper nitrate thus obtained gave 5 g of its oxide on strong heating the equivalent weight of copper is

(a) 23 (b) 32
(c) 12 (d) 20

BITSAT-2017

Ans. (b) : Given that, 4 g of copper gave 5 g of its oxides means one g of oxygen combines with 4 g of copper.

∵ Eq. wt of oxygen = 8,
Therefore, 8 g of oxygen combine with
= 4 × 8 g of copper = 32 g
Hence, equivalent weight of copper = 32

60. The most abundant elements by mass in the body of a healthy human adult are Oxygen (61.4%); of healthy Carbon (22.9%), Hydrogen (10.0%); and Nitrogen (2.6%). The weight which a 75 kg person would gain if all ^1H atoms are replaced by ^2H atoms is

(a) 15 kg (b) 37.5 kg
(c) 7.5 kg (d) 10 kg

[JEE Main-2017]

Ans. (c) : Given that –
Percentage of mass of oxygen (W_O) = 61.4 %
Percentage of mass of carbon (W_C) = 22.9 %
Percentage of mass of hydrogen (W_H) = 10 %
Percentage of mass of nitrogen (W_N) = 2.6 %
Weight of the person (W) = 75kg.
Mass of H^1, W_H = 10% of 75kg
= 7.5 kg
Since

${}_1H^2$ is double mass of ${}_1H^1$

Mass of H^2, W_{H^2} = 15kg

Increase in mass $\Delta w = W_{H^2} - W_{H^1}$
= 15 kg – 7.5 kg
= 7.5 kg

61. The compound $Na_2CO_3 . xH_2O$ has 50% H_2O by mass. The value of "x" is

(a) 4 (b) 5
(c) 6 (d) 7
(e) 8

Kerala-CEE-2017

Ans. (c) : Molar mass of Na_2CO_3 = 106 unit
(23 × 2) + 12 + (3 × 16)
Number of moles (per unit charge) = 50% of 106 is 106/2 = 53 gm

$\frac{53}{18} = 2.94$ mol

Total moles of H_2O = 2 × 2.94 = 5.89 ≅ 6.00

62. What mass of calcium chloride in grams would be enough to produce 14.35 g of AgCl? (Atomic mass Ca = 40, Ag = 108)

(a) 5.55 g (b) 8.295 g
(c) 11.19 g (d) 16.59 g

Manipal-2017

Ans. (a) : Given, weight of AgCl = 14.35 g
Molecular weight of AgCl = 143.32 g mol^{-1}

$$\underset{111g}{CaCl_2} + 2AgNO_3 \rightarrow Ca(NO_3)_2 + \underset{2\times143.5g}{2AgCl}$$

$CaCl_2$ required to produced 2×143.5g of AgCl = 111g
$CaCl_2$ required to produced 14.35g of AgCl

$$= \frac{111\times14.35}{2\times143.5} = 5.55 \text{ g}$$

63. The mass of oxygen that would be required to produce enough CO which completely reduces 1.6 kg Fe_2O_3 (at. mass Fe = 56), is :

(a) 240 g (b) 480 g
(c) 720 g (d) 960 g

Manipal-2017

Ans. (b) : $3C + \frac{3}{2}O_2 \rightarrow 3CO$

$Fe_2O_3 + 3CO \rightarrow 2Fe + 3CO_2$

1 mol of Fe_2O_3 ≡ 3 mol of CO ≡ $\frac{3}{2}$ mole of O_2

160 g of Fe_2O_3 require $O_2 = \frac{3}{2}\times 32 = 48$ g

1.6 kg of Fe_2O_3 require O_2 = 480 g

64. What is the actual volume occupied by water molecules present in 20 cm^3 of water?

(a) 20 cm^3 (b) 10 cm^3
(c) 40 cm^3 (d) 24.89 dm^3

MHT CET-2017

Ans. (d) : Given,
Density of water = 1 g/cc and volume = 20 cm^3 = 20cc.

$$\text{Density} = \frac{\text{Mass}}{\text{Volume}}$$

Mass = 1× 20 = 20 g

So, no. of moles of water $= \frac{20}{18} = 1.11$ moles

1 moles occupies 22.4L
∴ 1.11 moles occupies 24.89L, i.e.
24.89 dm^3 (1 lt = 1dm^3)

65. 0.126 g of an acid is needed to completely neutralize 20 mL 0.1 (N) NaOH solution. The equivalent weight of the acid is

(a) 53 (b) 40
(c) 45 (d) 63

WB-JEE-2017

Ans. (d) : Gram equivalents weight of Acid = Gram equivalents of weight Base

$$\frac{0.126}{E_{Acid}} = \frac{20}{1000}\times 0.1$$

$$\frac{0.126\times1000}{20\times0.1} = E_{Acid}$$

E_{Acid} = 63 g/equivalent

@apna_pdf

66. When 2.46 g of a hydrated salt (MSO_4xH_2O) is completely dehydrated 1.20 g of anhydrous salt is obtained. If the molecular weight of anhydrous salt is 120 g mol^{-1}, what is the value of x?

(a) 2 (b) 4
(c) 5 (d) 6
(e) 7

Kerala-CEE-2016

Ans. (e) : $\underset{2.46g}{MSO_4.xH_2O} \xrightarrow{\Delta} \underset{1.20g}{MSO_4} + \underset{x\,g}{H_2O}$

Molecular weight of $MSO_4{\cdot}xH_2O$ = 120g + x × 18g

(120g + x.18g) of $MSO_4{\cdot}xH_2O$ on complete dehydration gives 120g of MSO_4

$$1\text{g gives} = \frac{120}{120+18x}$$

Then, 2.46g of $MSO_4{\cdot}xH_2O$ gives $\frac{120\times2.4\text{g}}{120+18x\,\text{g}}$

$$\frac{120\times2.46}{120+18x} = 1.20$$

$$\frac{295.2}{120+18x} = 1.20$$

295.2 = 1.20 × 120 + 1.20 × 18x

295.2 = 144 + 21.6x

295.2 – 144 = 21.6 x

$$x = \frac{151.2}{21.6} = 7$$

67. The following reaction occurs in acidic medium
$KMnO_4 + 8H^+ + 5e^- \rightarrow K^+ + Mn^{2+} + 4H_2O$
What is the equivalent weight of $KMnO_4$?
(Molecular weight of $KMnO_4$ = 158)

(a) 79.0 (b) 31.6
(c) 158.0 (d) 39.5

TS-EAMCET-2016

Ans. (b) : Given that,

$KMnO_4 + 8H^+ + 5e^- \rightarrow K^+ + Mn^{2+} + 4H_2O$

$KMnO_4$ acts as oxidising agent in acidic medium.

$$\therefore \text{Equivalent weight of } KMnO_4 = \frac{158}{5}$$

= 31.6 g/equivalent.

68. A bivalent metal has an equivalent mass of 32. The molecular mass of the metal nitrate is

(a) 124 (b) 156
(c) 64 (d) 188

COMEDK-2016

Ans. (d) : Atomic mass of metal = Eq. mass × valency
=32×2 = 64

As metal M is bivalent, formula of its nitrate will be $M(NO_3)_2$.

Molecular mass of $M(NO_3)_2$= 64 +2(14+48)
= 64+124=188

69. 8.50g of NH_3 is present in 250 mL volume. Its active mass is

(a) 1.5 ML^{-1} (b) 2.0 ML^{-1}
(c) 1.0 ML^{-1} (d) 0.5 ML^{-1}

UPTU/UPSEE-2016

Ans. (b):

$$\text{Acive mass} = \frac{\text{Given mass of compound}}{\text{molecular mass of compound} \times \text{volume of solution}}$$

Active mass is defined as number of g mol per litre. It is also known as molar concentration molarity.

$$[NH_3] = \frac{8.50\,g}{17\,g/mol \times 250mL} \times 1000mL$$

$$[NH_3] = 2.0\,mol/L$$

70. Sulphur forms the chlorides S_2Cl_2 and SCl_2. The equivalent mass of sulphur in SCl_2 is

(a) 8 g/ mol (b) 16 g/mol
(c) 64.8 g/mol (d) 32 g/mol

AIIMS-2015

Ans. (b): Equivalent mass of sulphur

$$\Rightarrow \frac{\text{atomic mass of sulphur}}{\text{valency}}$$

$$\overset{x\,(-1)}{SCl_2} = x + 2(-1) = 0$$

$$x = 2$$

$$\Rightarrow \frac{32}{2} = 16$$

71. 3.011 × 10^{22} atoms of an element weighs 1.15 g. The atomic mass of the element is :

(a) 23 (b) 10
(c) 16 (d) 35.5

AP-EAMCET (Engg.)-2015

Ans. (a) : From Avogadro's law :

∵ 3.011 × 10^{22} atoms contain an element weight 1.15 gm.

Atomic mass → 1 mole of atoms → 6.022 × 10^{23} atoms

$$1\,\text{atom} = \frac{1.15}{3.011\times10^{22}}$$

$$6.022\times10^{23}\,\text{atoms} = \frac{1.15\times6.022\times10^{23}}{3.011\times10^{22}} = 23$$

Thus, the atomic mass of the element is = 23.

72. $KMnO_4$ reacts with ferrous sulphate according to the following equation.

$$MnO_4^- + 5Fe^{2+} + 8H^- \rightarrow Mn^{2+} + 2Fe^{3+} + 4H_2O$$

Here, 10 mL of 0.1 M $KMnO_4$ is equivalent to

(a) 50 mL of 0.1 M $FeSO_4$
(b) 20 mL of 0.1 M $FeSO_4$
(c) 40 mL of 0.1 M $FeSO_4$
(d) 30 mL of 0.1 M $FeSO_4$

JIPMER-2015

Ans. (a) : $KMnO_4$ reacts with ferrous sulphate according to the following equation,

$$2KMnO_4 + 10FeSO_4 + 8H_2SO_4 \rightarrow K_2SO_4 + 2MnSO_4 + 5Fe_2(SO_4)_3 + 8H_2O$$

2 moles of $KMnO_4$ reacts with 10 moles of $FeSO_4$

The number of moles of $KMnO_4$ in 10 ml of 0.1

M = 0.1 × 0.01 = 10^{-3} moles

No. of moles $FeSO_4$ = 5 × 10^{-3}

Volume having 5×10^{-3} mol in 0.1 M$FeSO_4$

@apna_pdf

$$0.1 = \frac{5\times10^{-3}\times1000}{V_{m\ell}}$$
$$V_{m\ell} = \frac{5\times10^{-3}\times1000}{0.1}$$
$$V_{m\ell} = 50\,\text{ml}$$

73. In acidic medium, dichromatic ion oxidizes ferrous ion to 'ferric ion'. If the gram molecular weight of potassium dichromate is 294g, its gram equivalent weight (in grams) is

(a) 24.5 (b) 49
(c) 125 (d) 250

JIPMER-2015

Ans. (b) : In acidic medium $K_2Cr_2O_7$ acts as a strong oxidising agent and itself gets reduced to Cr^{3+}.

$$Cr_2O_7^{-2} + 6e^- \rightarrow 2Cr^{3+}$$

The oxidation state of $K_2Cr_2O_7$

$$2(+1) + 2x + 2(-7) = 0$$
$$2x = +12$$
$$x = +6$$

Equivalent weight of

$$K_2Cr_2O_7 = \frac{\text{Molecular weight}}{\text{Valency}} = \frac{294}{6} = 49$$

74. Which of the following is correctly arranged in order of increasing weight?

(a) 0.0105 equivalent of $H_2C_2O_4$. $2H_2O$ < 0.625 g of Fe < 0.006 g atom of Ag < 6.0×10^{21}atoms of Zn
(b) 0.625 g of Fe < 0.0105 equivalent of $H_2C_2O_4$. $2H_2O$ < 6.0×10^{21} atoms of Zn < 0.006 g atom of Ag
(c) 0.625 g of Fe < 6.0×10^{21} atoms of Zn < 0.006 g atom of Ag < 0.0105 equivalent of $H_2C_2O_4$. .$2H_2O$
(d) 0.0105 equivalent of $H_2C_2O_4$. $2H_2O$ < 0.006 g atom of Ag < 6.0×10^{21} atoms of Zn < 0.625 g of Fe

JIPMER-2015

Ans. (c) : Here, the correct order of increasing weight, - 0.625 g of Fe < 6.0 × 10^{21} atoms of Zn < 0.006 g atom of Ag < 0.0105 equivalent of $H_2C_2O_4$. $2H_2O$.

6.0 × 10^{21} atoms of Zn (atomic weight 65.4 g/mol)

Corresponds to $\frac{6.0\times10^{21}}{6.0\times10^{23}}\times65.4 = 0.654$ g

0.006 g atom of Ag (atomic mass 108 g/mol)

Corresponds to 0.006 × 108 = 0.648 g

0.0105 equivalent of $H_2C_2O_4.2H_2O$ (equivalent mass 63 g/eq)

Corresponds to 0.0105 × 63 = 0.662 g

75. What is the mass of the precipitate formed when 50 mL of 16.9% solution of $AgNO_3$ is mixed with 50mL of 5.8% NaCl Solution?
(Ag = 107.8, N = 14, O = 16 Na = 23, Cl = 35.5)

(a) 3.5 g (b) 7 g
(c) 14 g (d) 28 g

NEET-2015

Ans. (b) : 16.9 g $AgNO_3$ is present in 100 mL solution.
∴ 8.45 g $AgNO_3$ is present in 50 mL solution.
5.8 g NaCl is present in 100 mL solution.
2.9 g NaCl is present in 50 mL solution.
Initial mole

$$\begin{array}{lcccc} & AgNO_3 + & NaCl \rightarrow & AgCl + & NaNO_3 \\ & \frac{8.45}{169.5} & \frac{2.9}{58.5} & 0 & 0 \\ & =0.049 & =0.049 & & \\ \text{After reaction} & 0 & 0 & 0.049 & 0.049 \end{array}$$

Therefore, mass of AgCl precipitated
= 0.049 × 143.5 = 7 g

76. Suppose the elements X and Y combine to form two compounds XY_2 and X_3Y_2. When 0.1 mole of XY_2 weight 10 g and 0.05 mole of X_3Y_2 weights 9 g, the atomic weights of X and Y are

(a) 40, 30 (b) 60, 40
(c) 20, 30 (d) 30, 20

NEET-2015

Ans. (a) : $M_1 \rightarrow$ Molecular mass of xy_2

$M_2 \rightarrow$ Molecular mass of x_3y_2

$a_1 \rightarrow$ Atomic weight of x

$a_2 \rightarrow$ Atomic weight of y

$$\frac{10}{M_1} = 0.1$$
$$m_1 = 100$$
$$a_1 + 2a_2 = 100 \qquad \dots \text{(i)}$$

Similarly

$$\frac{9}{m_2} = 0.05$$
$$n_2 = \frac{900}{5}$$
$$3a_1 + 2a_2 = \frac{900}{5} = 180 \qquad \dots \text{(ii)}$$

Solving (i) & (ii) simultaneously

$$\begin{array}{rl} 3a_1 + 2a_2 &= 180 \\ \underline{-\,a_1 + 2a_2} &\underline{= 100} \\ 2a_1 &= 80 \\ a_1 &= 40 \\ a_2 &= 30 \end{array}$$

Atomic weight of x & y are
40 & 30 respectivily

77. The equivalent weight of $Na_2S_2O_3$ in the following reaction is
$2Na_2S_2O_3 + I_2 \rightarrow Na_2S_4O_6 + 2NaI$

(a) M (b) M/8
(c) M/0.5 (d) M/2

JCECE - 2014

Ans. (a) : $2S_2O_3^{2-} \longrightarrow S_4O_6^{2-} + 2e^-$

$$E_{Na_2S_2O_3} = \frac{2M}{2} = M$$

@apna_pdf

78. The oxide of a metal contains 40% of oxygen. The valency of metal is 2. What is the atomic weight of metal?

(a) 24 (b) 13
(c) 40 (d) 36

AP-EAMCET (Engg.) - 2014

Ans. (a) : 100 gm of metal oxide contain 40 gm oxygen and 60 gm of metal.

∴ 8 gm of oxygen will be combined with =

$$\frac{60\times8}{40} = 12 \text{ gm of metal}$$

∴ Equivalent weight of metal = 12

Thus, atomic weight = Eq. weight × valency

= 12×2

= 24

79. Which has the maximum number of molecules among the following?

(a) 44g CO_2 (b) 48 g O_3
(c) 8 g H_2 (d) 64 g SO_2

AIIMS-2014

Ans. (c): 8g H_2 has the maximum number of molecules.

$$\text{No. of moles} = \frac{\text{weight of the substance}}{\text{Molecular weight of the substance}}$$

$$\text{Moles of } CO_2 = \frac{44}{44} = 1 \text{mol.}$$

$$\text{Moles of } O_3 = \frac{48}{48} = 1 \text{mol.}$$

$$\text{Moles of } H_2 = \frac{8}{2} = 4 \text{mol}$$

$$\text{Moles of } SO_2 = \frac{64}{64} = 1 \text{mol.}$$

Maximum no. of moles will corresponds to maximum number of molecules.

4 moles of H_2 i.e. $4 \times 6.023 \times 10^{23}$ molecules.

80. The ratio of masses of oxygen and nitrogen in a particular gaseous mixture is 1 : 4 The ratio of number of their molecule is

(a) 1:4 (b) 7:32
(c) 1:8 (d) 3:16

[JEE Main-2014]

Ans. (b) : Given ratio of masses of oxygen and Nitrogen = 1 : 4

Let mass of O_2 = x

Mass of N_2 = 4x

Molecular mass of oxygen = 32

Molecular mass of Nitrogen = 28

$$\text{Molecules of } O_2 = \frac{x}{32} N_A$$

$$\text{Molecules of } N_2 = \frac{4x}{28} N_A$$

Ratio of number of molecules = 7:32

81. What is the mass of one molecule of yellow phosphorus? (Atomic mass, P = 30)

(a) 1.993×10^{-22} kg (b) 1.993×10^{-19} mg
(c) 4.983×10^{-20} mg (d) 4.983×10^{-23} g

MHT CET-2014

Ans. (b) : Molecular mass of yellow phosphorus (P_4) = 4 × 30 = 120

According to Avogadro's hypothesis,

Mass of 6.022×10^{23} molecules = 120 g

$$\text{Mass of 1 Molecule} = \frac{120\times1}{6.022\times10^{23}}$$

$$= 19.926\times10^{-23} \text{g}$$

$$= 1.993 \times10^{-22} \text{ g}$$

$$= 1.993 \times 10^{-19} \text{ mg}$$

82. A certain metal sulphide, MS_2, is used extensively as a high temperature lubricant, If MS_2 has 40.96% sulphur by weight, atomic mass of M will be–

(a) 100 amu (b) 96 amu
(c) 60 amu (d) 30 amu

BCECE-2013

Ans. (b) :

Weight percentage of sulphur

$$= \frac{\text{Mass of sulphur}}{\text{Mass of Compound}} \times 100$$

$$\Rightarrow 40.96 = \frac{64}{M+64} \times 100$$

40.96 (M + 64) = 64 × 100

40. 96 M + 64 × 40.96 = 64 × 100

M = 96 amu

Where, M = Atomic mass of metal

83. Equivalent weight of $(NH_4)_2Cr_2O_7$ in the change is

$(NH_4)_2Cr_2O_7 \rightarrow N_2 + Cr_2O_3 + 4H_2O$

(a) Mol. wt./6 (b) Mol. wt./3
(c) Mol. wt./4 (d) Mol. wt./2

UP CPMT-2013

Ans. (a) : 1 mole $(NH_4)_2Cr_2O_7 \equiv$ 1 mole of Cr_2O_3

$\equiv$ 1 × 6 eq. of Cr_2O_3

∴ Reduction of $Cr_2O_7^{2-}$ to Cr^{3+} is a $6e^-$ change.

$$\left[(Cr^{6+})_2 + 6e^- \rightarrow (Cr^{3+})_2\right]$$

Therefore, equivalent weight of $(NH_4)_2Cr_2O_7 = M/6$

84. The equivalent mass of a certain bivalent metal is 20. The molecular mass of its anhydrous chloride is

(a) 111 (b) 55.5
(c) 75.5 (d) 91

Karnataka-CET-2012

Ans. (a) : The equivalent mass of bivalent metal

$$= \frac{\text{molecular mass}}{2}$$

Molecular mass = equivalent mass × 2

= 20 × 2 = 40

The metal is bivalent. So, 1 mole of metal atoms will combine with 2 moles of chlorine atoms.

$M + Cl_2 \rightarrow MCl_2$

The atomic mass of chlorine is 35.5 g

The molecular mass of its anhydrous chloride will be 40 + 2(35.5) = 111 g/mol.

@apna_pdf

85. A 100% pure sample of a divalent metal carbonate weighing 2g on complete thermal decomposition releases 448 cc of carbon dioxide at STP. The equivalent mass of the metal is

(a) 40 (b) 20
(c) 28 (d) 12
(e) 56

Kerala-CEE-2012

Ans. (b) : Formula of Metal carbonate is MCO_3

Molar mass of $MCO_3 = x + 12 + 3 \times 16$

$= (x + 60)$ g /mol

(Let atomic mass of M is x)

448 cc (448mL) CO_2 is produced from

Carbonate = 2 g

22400 cc CO_2 will be obtained from carbonate

$$= \frac{2 \times 22400}{448} = 100\,g$$

$\therefore \quad 100 = x + 60$

$x = 100 - 60 = 40$ g/mol

$$\text{Equivalent mass of metal} = \frac{\text{Atomic mass}}{\text{Valency}}$$

$$= \frac{40}{2} = 20\,g\,equiv^{-1}$$

86. 50 mL of each gas A and of gas B takes 150 and 200 seconds respectively for effusing through a pin hole under the similar conditions. If molecular mass of gas B is 36, the molecular mass of gas A will be

(a) 96 (b) 128
(c) 32 (d) 20.2

NEET-2012

Ans. (d) : Graham's law of effusion states that the rate of effusion of a gas is inversely proportional to the square root the molar mass of its particles.

$V_A = V_B = 50mL$

$T_A = 150s$

$T_B = 200s$

$M_B = 36$

$M_A = ?$

From Graham's law of effusion.

$$\frac{r_B}{r_A} = \sqrt{\frac{M_A}{M_B}} = \frac{V_B T_A}{T_B . V_A}$$

$$\sqrt{\frac{M_A}{36}} = \frac{V_A \times 150}{200 \times V_A}$$

$$\text{or} \sqrt{\frac{M_A}{36}} = \frac{15}{20} = 3/4$$

$$\frac{M_A}{36} = \frac{9}{16}$$

$$M_A = \frac{9 \times 36}{16} = \frac{81}{4} = 20.25 \approx 20.2$$

87. A certain gas takes three times as long to effuse out as helium. Its molecular mass will be

(a) 27 u (b) 36 u
(c) 64 u (d) 9 u

NEET-2012

Ans. (b) : The rate of effusion is inversely proportional to the molecular mass

$$\frac{r_1}{r_2} = \sqrt{\frac{Mw_2}{Mw_1}}$$

The rate of effusion is the ratio of the volume effused to the time taken

$$\frac{v_1}{t_1} \times \frac{t_2}{v_2} = \sqrt{\frac{Mw_2}{Mw_1}}$$

Here, volume is same.

$$\text{So, } \frac{3}{1} = \sqrt{\frac{Mw_2}{4}}$$

$$9 = \frac{Mw_2}{4}$$

$$Mw_2 = 36$$

88. Two gases A and B having the same volume diffuse through a porous partition in 20 and 10 seconds respectively. The molecular mass of A is 49 u. Molecular mass of B will be

(a) 50.00 u (b) 12.25 u
(c) 6.50 u (d) 25.00 u

UP CPMAT-2012
NEET-2011

Ans. (b) : Graham's law of diffusion states that the rate of diffusion of a gas is inversely proportional to the square root of its molecular weight.

According to the Graham's law

$$\text{Rate of diffusion (r)} \propto \frac{1}{\sqrt{M}}$$

$$\text{Rate of diffusion} = \frac{v}{t}$$

Where v is volume and t is time

$$\frac{r_1}{r_2} = \sqrt{\frac{M_2}{M_1}}$$

$$\frac{\frac{v_1}{t_1}}{\frac{v_2}{t_2}} = \sqrt{\frac{M_2}{M_1}} = \frac{t_2}{t_1} = \sqrt{\frac{M_2}{49}}$$

$$\frac{1}{2} = \sqrt{\frac{M_2}{49}}$$

$$M_2 = \frac{49}{4}$$

$M_2 = 12.254$

89. Excess of silver nitrate solution is added to 100 mL of 0.01 M pentaaqua chloro chromium (III) chloride solution. The mass of silver chloride obtained in grams is [Atomic mass of silver is 108].

(a) 287×10^{-3} (b) 143.5×10^{-3}
(c) 143.5×10^{-2} (d) 287×10^{-2}

Karnataka-CET-2011

@apna_pdf

Ans. (a) : The reagent is $[Cr(H_2O)_5Cl]Cl_2$

$$[Cr(H_2O_5)_5Cl]Cl_2 \xrightarrow[AgNO_3]{Excess} [Cr(H_2O_5)_5Cl]^+ NO_3^- + 2AgCl \downarrow$$

$$\text{No. of moles of } Cl^- \text{ ion present} = \frac{2\times100\times0.01}{1000}$$
$$= 0.002$$
$$\therefore \text{ Mass of AgCl} = 0.002 \times 143.5$$
$$= 0.287$$
$$= 287 \times 10^{-3} \text{ g}$$

90. Equivalent and molecular masses are same in
(a) Mohr's salt
(b) potassium permanganate
(c) potassium dichromate
(d) oxalic acid.

COMEDK-2011

Ans. (a) : Mohr's salt is $FeSO_4.(NH_4)_2SO_4.6H_2O$.

$$Fe^{2+} \rightarrow Fe^{3+} + e^-$$

The oxidation state of Fe change from +2 to +3.

$$\therefore \text{ Equivalent wt. of Mohr's salt} = \frac{\text{Mol.wt.}}{1} = \frac{392}{1} = 392$$

91. Two different electrolytic cells filled with molten $Al(NO_3)_3$ respectively are connected in series. When electricity is passed 2.7 gram Al is deposited on electrode. Calculate the weight of Cu deposited on cathode. [Cu = 63.5 ; Al = 27.0 gram. mol^{-1}]
(a) 190.5 gram (b) 9.525 gram
(c) 63.5 gram (d) 31.75 gram

GUJCET-2011

Ans. (b): $Cu^{2+} + 2e^- \rightarrow Cu(s)$
$Al^{3+} + 3e^- \rightarrow Al(s)$

When same current is passed through two electrolytic solution containing copper nitrate $[Cu(NO_2)_2]$ and aluminium nitrate $[Al(NO_3)_3]$ are connected in series.

$$\therefore \frac{\text{Weight of Cu deposited}}{\text{Weight of Al deposited}} = \frac{\text{Equivalent weight of Cu}}{\text{Equivalent weight of Al}}$$

$$\frac{\text{Wt.of Cu}}{2.7} = \frac{31.7}{9}$$

$$\text{Wt.of Cu} = \frac{31.7\times2.7}{9} = 9.5\,\text{gram}$$

So, weight of Cu deposited = 9.525 gm

92. Equivalent weight of crystalline oxalic acid is
(a) 90 (b) 63
(c) 53 (d) 45

BCECE-2011

Ans. (b) : Formula of crystalline oxalic acid $C_2H_2O_4$

$$\text{Equivalent weight} = \frac{\text{Molecular weight}}{\text{valency}}$$

$$\Rightarrow \frac{126}{2} = 63$$

93. The equivalent weight of $MnSO_4$ is half of its molecular weight when it is converted to
(a) Mn_2O_3 (b) MnO_2
(c) MnO_4^- (d) MnO_4^{2-}

CG PET- 2011

Ans. (b) :

$$\text{Equivalent weight in redox system} = \frac{\text{Molar mass}}{\text{n} - \text{factor}}$$

(where, n-factor is net change in oxidation number per formula unit of oxidising or reducing agent.)

In $MnSO_4$. n – Factor is 2 because equivalent weight is equal to its molecular weight.

Here, n-factor –

$MnSO_4 \rightarrow Mn_2O_3$ $1(+2 \rightarrow +3)$
$MnSO_4 \rightarrow MnO_2$ $2(+2 \rightarrow +4)$
$MnSO_4 \rightarrow MnO_4^-$ $5(+2 \rightarrow +7)$
$MnSO_4 \rightarrow MnO_4^{2-}$ $4(+2 \rightarrow +6)$

Therefore, $MnSO_4$ convert to MnO_2. Then the n-factor is to and the equivalent weight of $MnSO_4$ will be half of its molecular weight.

94. If the equivalent weight of a trivalent metal is 32.7, the molecular weight of its chloride is
(a) 68.2 (b) 103.2
(c) 204.6 (d) 32.7

JCECE - 2011

Ans. (c) : Atomic wt. of metal = valency × equivalent weight
= 3 × 32.7

Molecular wt. of metal chloride
$(MCl_3) = (3 \times 32.7) + (3 \times 35.5)$
= 204.6

95. In the disproportionation reaction $3HClO_3 \longrightarrow HClO_4 + Cl_2 + 2O_2 + H_2O$, the equivalent mass of the oxidizing agent is (molar mass of $HClO_3$ = 84.45)
(a) 16.89 (b) 32.22
(c) 84.45 (d) 28.15
(e) 29.7

Kerala-CEE-2011

Ans. (a): $$2H\overset{+5}{Cl}O_3 \longrightarrow H\overset{+7}{Cl}O + \overset{0}{Cl_2} + 2O_2 + H_2O$$

Since oxidation number of Cl decreases from +5 in $HClO_3$ to zero in Cl_2. Therefore, $HClO_3$ acts as an oxidising agent.

Eq. mass of $HClO_3$

$$= \frac{\text{Mol. mass of } HClO_3}{\text{oxidation number change}} = \frac{84.45}{5} = 16.89$$

96. One atomic mass is equal to
(a) 1.66×10^{-27} g (b) 1.66×10^{-24} g
(c) 1.66×10^{-23} g (d) 1.66×10^{-25} kg

MHT CET-2011

Ans. (b) : An atomic unit of mass is defined as accurately $^1/_{12}$ th mass of a C-12 atom.

One, AMU is the average of the proton rest mass and the neutron rest mass. This is approximately 1.67377×10^{-27} kilogram (kg) or 1.67377×10^{-24} gram (g). The mass of an atom in AMU is roughly equal to the sum of the number of protons and neutrons in the nucleus.

@apna_pdf

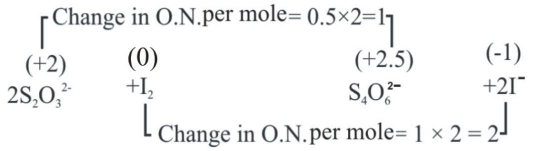
97. If The molecular wt. of $Na_2S_2O_3$ and I_2 are M_1 and M_2 respectively, then what will be the equivalent wt. of $Na_2S_2O_3$ and I_2 in the following reaction?

$$2S_2O_3^{2-} + I_2 \rightarrow S_4O_6^{2-} + 2I^-$$

(a) M_1, M_2 (b) $M_1, M_2/2$
(c) $2M_1, M_2$ (d) $M_1, 2M_2$

WB-JEE-2011

Ans. (b) :



Change in O.N.per mole= 0.5×2=1
(+2)
2S2O3 2-
(0)
+I2
(+2.5)
S4O6 2-
(-1)
+2I-
Change in O.N.per mole= 1 × 2 = 2

Equivalent mass of $S_2O_3^{2-} = \frac{M_1}{1} = M_1$

And equivalent mass of $I_2 = \frac{M_2}{2}$

98. 2g of metal carbonate is neutralized completely by 100 mL of 0.1 N HCl. The equivalent weight of metal carbonate is

(a) 50 (b) 100
(c) 150 (d) 200

WB-JEE-2011

Ans. (d) : As 2 g of metal carbonate is neutralized by 100 mL of 0.1 N HCl

$$\text{Normality} = \frac{\text{Number of gram equivalents of HCl}}{\text{Volume of solution (L)}}$$

$$0.1 = \text{Number of gram equivalents of HCl} \times \frac{100}{1000}$$

$\therefore$ Number of gram – equivalents of HCl

$$\frac{100 \times 0.1}{1000} = 0.01$$

Mass of 0.01 gram equivalent metal carbonate

$= 2g$

Mass of 1 gram equivalents metal carbonate

$$= \frac{2}{0.01} = 200\,g$$

$\therefore$ Equivalent mass of metal carbonate = 200

99. In the reaction of sodium thiosulphate with I_2 in aqueous medium the equivalent weight of sodium thiosulphate is equal to

(a) molar mass of sodium thiosulphate
(b) The average of molar masses of $Na_2S_2O_3$ and I_2
(c) half the molar mass of sodium thiosulphate
(d) molar mass of sodium thiosulphate×2

WB-JEE-2010

Ans. (a) : For two molecules of sodium thiosulphate, 2 electrons are lost by sodium thiosulphate. So, one molecule of sodium thiosulphate will lose one electron eventually.

Therefore, the number of electrons lost is 1.

$$\text{Equivalent weight} = \frac{\text{Molecular weight}}{1}$$

$$I_2 + 2Na_2S_2O_3 \rightarrow 2NaI + Na_2S_4O_6$$

Half reaction occur as :

$$I_2 + 2e^- \rightarrow 2I^-$$

$$2S_2O_3^{2-} \rightarrow S_4O_6^{2-} + 2e^-$$

for 2 electron lost by 2 molecules of $S_2O_3^{2-}$ (Sodium thiosulphate).

So one molecule will lost 1 electron so equivalent weight is equal to molecular weight divided by 1.

Equivalent weight = Molecular weight

100. The number of water molecules differing in molecular mass formed by hydrogen isotopes and oxygen isotopes

(a) 6 (b) 9
(c) 12 (d) 18

SCRA-2010

Ans. (a) : Water molecule mass formed by O^{16} and $_1H^1$, $_1H^2$, $_1H^3$ isotope is–

18, 20, 22, 19, 20, 19, 21, 20, 21

Water molecule mass formed by O^{17} and $_1H^1$, $_1H^2$, $_1H^3$ isotope is–

19, 21, 23, 20, 21, 20, 22, 21, 22

Water molecule mass formed by O^{18} and $_1H^1$, $_1H^2$, $_1H^3$ isotope is–

20, 22, 24, 21, 22, 21, 23, 22, 23

So, total 6 different water molecules can be formed which have mass–

18, 19, 20, 21, 22, 23

101. 0.32 g of metal gave on treatment with an acid 112 mL of hydrogen at NTP. Calculate the equivalent weight of the metal.

(a) 58 (b) 32
(c) 11.2 (d) 24

AMU-2010

Ans. (b) : Given, mass of metal = 0.32 g

volume of hydrogen = 112 ml

Equivalent weight

$$= \frac{\text{Mass of metal} \times 11200}{\text{Volume in mL of hydrogen}}$$

Given, Mass of metal = 0.32 g

Volume of hydrogen at NTP = 112 mL

$$\text{Equivalent weight} = \frac{0.32 \times 11200}{112} = 32g$$

102. The vapour density of ozone is

(a) 16 (b) 32
(c) 24 (d) 48

BITSAT-2010

Ans. (c) : We know that,

$$\text{Vapour density} = \frac{\text{molecular weight}}{2}$$

Molecular weight of O_3 = 16 × 3 = 48

$$\text{Then, Vapour density of ozone} = \frac{48}{2} = 24$$

103. The density of a gas is found to be 1.56g/L at 745 mm pressure and 65ºC. What is the molecular mass of the gas?

(a) 44.2 u (b) 4.42 u
(c) 2.24 u (d) 22.4 u

JIPMER-2010

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Ans. (a): Pressure is P = 745 mm = 0.98 atm (1 atm = 760 mm Hg)

Temperature is T = 65°C = 65 + 273 = 338K

Density is d = 1.56 g/L

From ideal gas equation,

$$PV = nRT$$

$$P = \frac{m}{M \times V} \times R \times T \quad \left\{ \begin{matrix} \text{Where, } m = \text{given mass.} \\ M = \text{molecular mass} \end{matrix} \right\}$$

$$M = \frac{d \times R \times T}{P} \qquad (d = \text{density} = \frac{m}{v})$$

$$M = \frac{1.56 \times 338 \times 0.0821}{0.98} = 44.2u$$

Hence, the molecular mass of the gas is 44.2u

104. A 0.5 g/L solution of glucose is found to be isotonic with a 2.5 g/L solution of an organic compound. What will be the molecular weight of that organic compound?

(a) 300 (b) 600

(c) 900 (d) 200

JIPMER-2009

Ans. (c) : We know, two solutions are said to be isotonic when pressure are equal.

Osmotic pressure is given by (For glucose)

$$\frac{nRT}{V} = \frac{mRT}{MV} = \frac{0.5RT}{M} = \frac{RT}{360}$$

For other organic compound.

$$\frac{nRT}{V} = \frac{mRT}{MV} = \frac{2.5RT}{M_1}$$

n = Moles of solute.

m = mass of solute.

M = Molecular weight of solute.

V = volume of solution.

T = Temperature

When both the pressures are equal.

$$\frac{RT}{360} = \frac{2.5RT}{M_1}$$

$$M_1 = 900$$

105. The equivalent weight of Potassium permanganate ($KMnO_4$) in neutral medium will be

(a) Atomic weight (b) $\frac{\text{Atomic weight}}{2}$

(c) $\frac{\text{Atomic weight}}{3}$ (d) $\frac{\text{Atomic weight}}{5}$

MPPET- 2009

Ans. (c) : In neutral medium–

$$MnO_4^- + 4H^+ + 3e^- \longrightarrow MnO_2 + 2H_2O$$

Here, n = 3

$\because$ Molecular weight = 158.04

$\because$ Equivalent weight $= \frac{\text{Atomic Weight}}{\text{n - factor}}$

$\therefore$ Equivalent weight $= \frac{\text{Atomic Weight}}{3}$

106. 1.5 g of $CdCl_2$ was found to contain 0.9 g of Cd. Calculate the atomic weight of Cd.

(a) 118 (b) 112

(c) 106.5 (d) 53.25

AP EAMCET (Engg.)-2009

Ans. (c): Given that,

$CdCl_2 \rightarrow 1.5g$

$Cd \rightarrow 0.9g$

$Cl_2 \rightarrow$ 0.6 g(1.5–0.9)

$\because$ 0.6 g chlorine combine with 0.9 g Cd

$\therefore$ 71 g chlorine will combine with $\frac{0.9}{0.6} \times 71$ g Cd = 106.5 g Cd

$\therefore$ Atomic weight of Cd = 106.5

107. The standard for atomic mass is

(a) ${}^1_1H$ (b) ${}_6C^{12}$

(c) ${}_6C^{14}$ (d) ${}_8O^{16}$

BCECE-2009

Ans. (b) : Carbon-12 is the standard while measuring the atomic mass. because no other nuclides other than carbon – 12 have exactly whole number masses.

An atomic mass unit is defined as precisely $\frac{1}{12}^{th}$ mass of an atom of carbon-12 The Carbon -12 (C – 12) atom has six protons and six neutrons in its nucleus.

The C – 12 isotope of the carbon is the stable isotope which is not much affected as compared to others elements. Thus it is chosen as the standard for expressing the atomic mass and the molecular mass of the substance.

108. The equivalent mass of potassium permanganate in alkaline medium is its

(a) $\frac{\text{Molar Mass}}{5}$ (b) $\frac{\text{Molar Mass}}{3}$

(c) $\frac{\text{Molar Mass}}{2}$ (d) Molar mass itself

J & K CET-(2009)

Ans. (d) : The reaction in alkaline medium is:

$$K\overset{+7}{Mn}O_4 + 1e^- \rightarrow K_2\overset{+6}{Mn}O_4$$

Thus, n factor = change in oxidation state = 1

The equivalent mass of potassium permanganate in alkaline medium is its molar mass itself

Equivalent weight $= \frac{\text{molar mass}}{\text{n} - \text{factor}} \Rightarrow \frac{\text{molar mass}}{1}$

109. The formula mass of Mohr's salt is 392. The iron present in it is oxidised by $KMnO_4$ in acid medium. The equivalent mass of Mohr's salt is

(a) 392 (b) 31.6

(c) 278 (d) 156

JCECE - 2009

Ans. (a) : We know, Formula of Mohr's salt : $(NH_4)_2SO_4 \cdot FeSO_4 \cdot 6H_2O$

oxidation of Fe^{2+} ions take place as:

$$5Fe^{2+} + MnO_4^- + 8H^+ \rightarrow 5Fe^{3+} + Mn^{2+} + 4H_2O$$

Total change in oxidation number of iron (Fe)

= +3 – (+2) = +1

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Equivalent mass of Mohr's salt

$$= \frac{\text{Molecular mass}}{\text{Change in oxidation number}}$$

$$= \frac{392}{1} = 392$$

110. A bivalent metal has an equivalent mass of 32. The molecular mass of the metal nitrate is

(a) 182 (b) 168

(c) 192 (d) 188

Karnataka-CET, 2009

Ans. (d) : Equivalent mass $= \frac{\text{Atomic mass}}{2}$

$$32 = \frac{\text{Atomic mass}}{2}$$

Atomic mass of the metal = 32 × 2 = 64

Formula of metal nitrate = $M(NO_3)_2$

∴ Molecular mass = 64 + 28 + 96 = 188

111. Copper is a divalent metal. The value of its electrochemical equivalent is 3.29×10^{-4} g. Its atomic mass is

(a) 31.74 g (b) 63.5 g

(c) 126.9 g (d) 15.87 g

MHT CET-2009

Ans. (b) : Electrochemical equivalent is the weight of a substance deposited or evolved during electrolysis by the passage of a specified quantity of electricity and usually expressed in grams per coulomb.

Electrochemical equivalent, $Z = \frac{E}{96500}$

Or, $3.29\times10^{-4} = \frac{E}{96500} = 31.74$

Atomic mass = 2 ×E [∴Cu is divalent]

= 2 × 31.74 = 63.49 gm

112. 0.126 g of an acid is titrated with 0.1 N 20 mL of an base. The equivalent weight of the acid is

(a) 63 (b) 50

(c) 53 (d) 23

UP CPMT-2009

Ans. (a): We know that,

$$w = \frac{E\times NV}{1000}$$

$$\therefore \text{Eq. wt. of acid} = \frac{w\times1000}{NV}$$

$$= \frac{0.126\times1000}{0.1\times20}$$

$$= 63$$

113. Mass of 0.1 mole of methane is

(a) 1g (b) 16g

(c) 1.6 g (d) 0.1 g

Karnataka-CET, 2008

Ans. (c) : Mass of one mole of methane (CH_4) = 16g

Mass of 0.1 mole of methane = 16 × 0.1g = 1.6 g

114. In acidic medium dichromate ion oxidises ferrous ion to ferric ion. If gram molecular weight of potassium dichromate is 294 g, its gram equivalent weight is

(a) 294 g (b) 127 g

(c) 49 g (d) 24.5 g

JCECE - 2008

Ans. (c) : In acidic medium $K_2Cr_2O_7$ acts as a strong oxidizing agent and itself gets reduced to Cr^{3+}

$$\overset{+6}{Cr_2}O_7^{2-} + 6e^- \rightarrow 2Cr^{3+}$$

During the reaction, the oxidation number of Cr decreases from +6 to +3.

Net decrease in the oxidation number of one Cr atom is 6 – 3 = 3 for 2 Cr atoms (in dichromate ion), the total decrease in the oxidation number is 2 × 3 = 6

Equivalent weight of $K_2Cr_2O_7 = \frac{\text{molecular weight}}{6}$

$$= \frac{294}{6} = 49$$

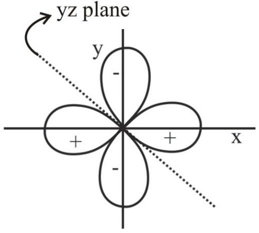
115. Electron density in the yz plane of $3d_{x^2-y^2}$ orbital is

(a) zero (b) 0.50

(c) 0.75 (d) 0.90

J & K CET-(2008)

Ans. (a) : No electron density



Electron density in the yz plane of $3d_{x^2-y^2}$ orbital is zero.

116. Assertion : Equivalent weight of a base

$$= \frac{\textbf{Molecular weight}}{\textbf{Acidity}}$$

Reason : Acidity is the number of replaceable hydrogen atoms in one molecule of the base.

(a) If both Assertion and Reason are correct and the Reason is the correct explanation of Assertion.

(b) If both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.

(c) If Assertion is correct but Reason is incorrect.

(d) If both the Assertion and Reason are incorrect.

AIIMS-2008

Ans. (c):

Equivalent weight of base $= \frac{\text{Molecular weight}}{\text{Acidity}}$

Acidity of base is defined as the number of ionizable hydroxyl group present in base.

So, reason is incorrect.

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117. The number of formula units calcium flouride CaF_2 present in 146.4 g of CaF_2 are (molar mass of CaF_2 is 78.08 g/mol)

(a) 1.129×10^{24} CaF_2 (b) 1.146×10^{24} CaF_2
(c) 7.808×10^{24} CaF_2 (d) 1.877×10^{24} CaF_2

VITEEE- 2008

Ans. (a) : $CaF_2 = 146.4g$
Molecular weight CaF_2 = 78.08 g/mol
Formula unit = no. of molecules of CaF_2.

$$\text{Moles} = \frac{\text{mass in gm}}{\text{molar mass}} = \frac{146.4\,\text{gm}}{78.08\,\text{gm}} = 1.875$$

$$\text{Molecules} = \text{Mole} \times 6.022 \times 10^{23}$$
$$= 1.875 \times 6.022 \times 10^{23}$$
$$= 1.129 \times 10^{24}\ \text{units of } CaF_2$$

118. The mass of $KClO_3$ required to produce 2.4 mol of oxygen by catalytic decomposition will be

(a) 19.6 g (b) 196.0 g
(c) 122.5 g (d) 245.0 g

[Given that : $2KClO_{3(g)} \rightarrow 2KCl_{(g)} + 3O_{2(g)}$; molar mass of $KClO_3$=122.5 g]

AMU – 2007

Ans. (b) : $2KClO_{3(g)} \rightarrow 2KCl_{(g)} + 3O_{2(g)}$
Molar mass of $KClO_3$= 122.5
Now, 3 mol of O_2 is produced by 2 mol of $KClO_3$.

1 mole of O_2 is producd by $\frac{2}{3}$ mole of $KClO_3$

24 mole of O_2 is produced by $\frac{2}{3} \times 2.4$ mole of $KClO_3$

= 1.6 mol of $KClO_3$
Therefore, the mass of $KClO_3$ required to produce 2.4 mol of oxygen is given as
=1.6×122.5 g =196 g

119. The milliequivalent in 60 ml 4M H_2SO_4 is:

(a) 240 (b) 480
(c) 24 (d) 48

[BITSAT – 2007]

Ans. (b) : Relation between normality and molarity is given by the equation
Normality = n × Molarity
Where,
n = number of replaceable hydrogen = 2 (for sulfuric acid)
Given
Molarity of the solution = 4.0M
Then
$N_{H_2SO_4} = 2 \times 4 = 8\,N$
Milliequivalents = Normality × volume (in mL)
= 8 × 60
= 480 m. eq.

120. An oxide of the element contains 20% O_2 by weight. Calculate the equivalent weight of the element.

(a) 8 (b) 16
(c) 32 (d) 12

Karnataka-CET-2007

Ans. (c) : Gram equivalent of element
= Gram equivalent of O_2

$$\frac{80}{E} = \frac{20}{8}$$
E = 32

121. What is the equivalent weight of $SnCl_2$ in the following reaction

$SnCl_2 + Cl_2 \longrightarrow SnCl_4$?

(a) 95 (b) 45
(c) 60 (d) 30

Karnataka-CET-2007

Ans. (a) : $\underset{190}{SnCl_2} + \underset{71}{Cl_2} \longrightarrow SnCl_4$

$$\frac{190}{E_1} = \frac{71}{35.5}$$
$\Rightarrow$ $E_1 = 95$

122. An element, X has the following isotopic composition :

$^{200}X : 90\%$ $^{199}X : 8.0\%$ $^{202}X : 2.0\%$

The weighted average atomic mass of the naturally occurring element X is closed to

(a) 201 amu (b) 202 amu
(c) 199 amu (d) 200 amu

NEET-2007

Ans. (d) : weight of ^{200}X = 0.90 × 200 = 180.00 u
Weight of ^{199}X = 0.08 × 199 = 15.92 u
Weight of ^{202}X = 0.02 × 202 = 4.04 u
Total weight = 199.96 ≈ 200 amu.

123. A 0.5 g/L solution of glucose is found to be isotonic with a 2.5 g/L solution of an organic compound. What will be the molecular weight of that organic compound?

(a) 300 (b) 600
(c) 900 (d) 200

AP-EAMCET (Medical), 2006

Ans. (c) : 0.5 g/L 2.5 g/L
(Glucose) (Organic compound)
Isotone,
$\pi_1 = \pi_2$
$C_1RT = C_2RT$ $\{C_1, C_2 = \text{Molarity}\}$
$C_1 = C_2$

$$\frac{0.5/180}{1} = \frac{2.5/M}{1}$$
$$\frac{0.5}{180} = \frac{2.5}{M}$$
$$\boxed{M = 900\,g/mole}$$

124. The equivalent weight of potassium permanganate when it acts as oxidizing agent in ferrous ion estimation is

(a) 158 (b) 31.6
(c) 79 (d) 39.5

VITEEE- 2006

Ans. (b) : The oxidation of ferrous ion by $KMnO_4$ takes place in acidic medium as per following reaction

@apna_pdf

$2KMnO_4 + 8H_2SO_4 + 10FeSO_4$

$\rightarrow K_2SO_4 + 2MnSO_4 + 8H_2O + 5Fe_2(SO_4)_3$

∴ Eq. mass of $KMnO_4$

$$\frac{\text{Molecular mass}}{\text{change in oxidation number}}$$

$$= \frac{158}{5} = 31.6$$

125. $KMnO_4$ (mol. wt. = 158) oxidizes oxalic acid in acidic medium to CO_2 and water as follows.

$5C_2O_4^{2-} + 2MnO_4^{-} + 16H^{+} \rightarrow 10CO_2 + 2Mn^{2+} + 8H_2O$

What is the equivalent weight of $KMnO_4$?

(a) 158 (b) 31.6
(c) 39.5 (d) 79

J & K CET-(2006)

Ans. (b) : Given that,

Molecular wt. of $KMnO_4$ = 158

$$MnO^{-4} \longrightarrow Mn^{2}_{+}$$

(Oxidation number of M_n = +7) (Oxidation number of M_n = +2)

Equivalent mass of $KMnO_4$ =

$$\frac{\text{molecular mass}}{\text{change in oxidation number}}$$

$$= \frac{158}{5} = 31.6$$

126. 1.520 g of hydroxide a metal on ignition gave 0.995 g of oxide. The equivalent weight of metal is

(a) 1.52 (b) 0.995
(c) 190 (d) 9

UP CPMT-2006

Ans. (d) : Since hydroxide and oxide both are involving in same reaction, the ratio of their molecular weight is equal to the ratio of their equivalent weight.

$$\frac{E_{\text{Hydroxide}}}{E_{\text{metal}} + E_{OH^-}} = \frac{E_{\text{oxide}}}{E_{\text{metal}} + E_O}$$

$$\frac{1.520}{E+17} = \frac{0.995}{E+8}$$

$$E = 9$$

127. The mass of a photon with wave length 3.6 Å is

(a) 6.135×10^{-29} kg (b) 3.60×10^{-29} kg
(c) 6.135×10^{-33} kg (d) 3.60×10^{-27} kg

AMU-2005

Ans. (a) : $\lambda = 3.6 \times 10^{-10}$m

We know, de-Broglie wavelength

$$\lambda = \frac{h}{p} \Rightarrow \lambda = \frac{h}{mv} \Rightarrow m = \frac{h}{\lambda v}$$

λ = 3.6 A° = 3.6×10^{-10}m

Velocity of Photon = velocity of light

$$m = \frac{h}{\lambda v} = \frac{6.626 \times 10^{-34}\, Js^{-1}}{(3.6 \times 10^{-10}\, m)(3 \times 10^{8}\, ms^{-1})}$$

$= 6.135 \times 10^{-29}$kg.

128. The standard adopted for the determination of atomic weight of elements is based on:

(a) H^1 (b) C^{12}
(c) O^{16} (d) S^{32}

JCECE - 2005

Ans. (b) : The standard adopted for the determination of atomic weight of elements is based on C^{12}.

Mass of one atom of an element = atomic mass × $\left(\frac{1}{12}\right)^{th}$ of the mass of one atom of carbon.

129. The mass of carbon anode consumed (giving only carbon dioxide) in the production of 270 kg of aluminium metal from bauxite by the Hall process is

(a) 270 kg (b) 540 kg
(c) 90 kg (d) 180 kg

NEET-2005

Ans. (c): $$\underset{3\times12=36}{2Al_2O_3 + 3C} \longrightarrow \underset{4\times27=108}{4Al + 3CO_2}$$

∴ For 108 g of Al, 36 g of C is required in above reaction

∴ For 270 kg of Al require amount of C

$$= \frac{36}{108} \times 270 = 90 \text{ kg}$$

130. What is the ratio of mass of an electron to the mass of a proton?

(a) 1 : 2 (b) 1 : 1
(c) 1 : 1837 (d) 1 : 3

UPTU/UPSEE-2004

Ans. (c) : It is clear that an electron is 1/1837 times lighter than a proton,

So, ratio between them will be = 1 : 1837

Or

$$\frac{\text{Mass of proton}}{\text{Mass of electron}} = \frac{1.6 \times 10^{-27}}{9.1 \times 10^{-31}} = 1.8 \times 10^{3}$$

131. Equivalent weight of an acid:

(a) Depends on the reaction involved
(b) Depends upon the number of oxygen atoms present
(c) Is always constant
(d) None of the above

UPTU/UPSEE-2004

Ans. (a) : Equivalent Weight – The equivalent of a compound can be calculated by dividing the molecular weight by the number of positive or negative electrical charge that result from the dissolution of the compound (i.e. acidity or basicity).

Example- NaOH

$$\frac{23+16+2}{1} = \frac{\text{Molecular weight}}{\text{Basicity}} = 41$$

Equivalent weight of an acid depends on the reaction involved with the base.

The equivalent weight of an acid does not depend on the number of oxygen atoms presents.

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132. In acidic medium, dichromate ion oxidizes ferrous ion to ferric ion. If the gram molecular weight of potassium dichromate is 294 g, its gram equivalent weight is…. g.

(a) 294 (b) 147
(c) 49 (d) 24.5

AP-EAMCET (Medical), 2003

Ans. (c) : From reaction-

$$Cr_2O_7^{2-} + 14H^+ + 6Fe^{2+} \rightarrow 2Cr^{3+} + 6Fe^{3+} + 7H_2O$$

Potassium dichromate ($K_2Cr_2O_7$) acts as a strong oxidizing agent and itself gets reduced to Cr^{3+}.

$$Cr_2O_7{}^{2-} + 6e^- \longrightarrow 2Cr^{3+}$$

change in oxidation number = 6

Equivalent weight of

$$K_2Cr_2O_7 = \frac{\text{Molecular Weight}}{\text{Total change in oxidation number}}$$

$$= \frac{294}{6} = 49g$$

133. The number of gram equivalent of H_2SO_4 in 1000 mL 3M solution is:

(a) 3 (b) 6
(c) 4 (d) 1.5

JCECE - 2003

$$H_2SO_4 \longrightarrow 2H^+ + SO_4^{2-}$$

Ans. (b):

$\therefore$ 1 mole H_2SO_4 = 2 g - equivalent of H_2SO_4

$\therefore$ 3 mole H_2SO_4 = 2 × 3 g - equivalent of H_2SO_4

= 6 g equivalent of H_2SO_4

134. Assertion: Atoms can neither be created nor destroyed.

Reason: Under similar condition of temperature and pressure, equal volume of gases does not contain equal number of atoms.

(a) If both Assertion and Reason are correct and the Reason is a correct explanation of the Assertion.
(b) If both Assertion and Reason are correct but Reason is not a correct explanation of the Assertion.
(c) If the Assertion is correct but Reason is incorrect.
(d) If both the Assertion and Reason are incorrect.
(e) If the Assertion is incorrect but the Reason is correct.

AIIMS-2002

Ans. (c): Dalton hypothesized the law of conservation of mass. According to this law atoms can neither be created nor destroyed.

Avogadro's law states that under similar condition of temperature and pressure, equal volume of gases contain equal number of atoms.

Therefore Assertion is correct but Reason is incorrect.

135. The equivalent weight of $KMnO_4$ in acidic medium is

(a) 158 (b) 52.67
(c) 31.6 (d) 49

UP CPMT-2002

Ans. (c) : Equivalent weight of $KMnO_4$ = 158

$KMnO_4$ as an oxidizer in acidic media

$$MnO_4^- + 8H^+ + 5e^- \rightarrow Mn^{+2} + 4H_2O$$

In Acidic medium

$$= \frac{\text{Molecular weight}}{\text{No. of electron lost or gained}} = \frac{158}{5} = 31.6$$

$$\text{In Basic Medium} = \frac{\text{Molecular weight}}{3} = \frac{158}{3} = 52.67$$

$$\text{In Neutral Medium} = \frac{\text{Molecular weight}}{1} = 158$$

136. The oxygen obtained from 72 kg water is

(a) 72 kg (b) 46 kg
(c) 50 kg (d) 64 kg

UP CPMT-2002

Ans. (d) : Molecular weight of H_2O = 18

Atomic weight of oxygen = 16

$\because$ 18 gm H_2O contain = 16 gm Oxygen

$$\therefore \text{ 72 kg } H_2O \text{ contain} = \frac{72 \times 16}{18}$$

= 64000 gm or 64 kg.

137. Specific volume of cylindrical virus particle is 6.02×10^{-2} cc/g whose radius and length are 7 Å and 10 Å respectively. If $N_A = 6.02 \times 10^{23}$, find molecular weight of virus.

(a) 15.4 kg/mol (b) 1.54×10^4 kg/mol
(c) 3.08×10^4 kg/mol (d) 3.08×10^4 kg/mol

NEET-2001

Ans. (a) : Given,

$$\text{Radius}(r) = 7\text{Å} = 7 \times 10^{-8}$$

$$\text{Length}(L) = 10\text{Å} = 10 \times 10^{-8}\text{cm}$$

Specific volume (volume of 1g of cylindrical virus)= 6.02×10^{-2} cc/gm

$$\text{Volume of virus } \pi r^2 L = \frac{22}{7} \times (7 \times 10^{-8})^2 \times 10 \times 10^{-8}$$

$$= 154 \times 10^{-23} \text{ cc}$$

$$\text{Wt. of one virus particle } = \frac{\text{Volume}}{\text{Specific volume}}$$

$\therefore$ Molecular wt. of virus = wt. of N_A particle

$$= \frac{154 \times 10^{-23}}{6.02 \times 10^{-2}} \times 6.02 \times 10^{23}$$

= 15400g/mol = 15.4 kg/mol

138. The oxide of an element contains 67.67% oxygen and the vapour density of its volatile chloride is 79. Equivalent weight of the element is

(a) 2.46 (b) 3.82
(c) 4.36 (d) 4.96

AIIMS-1998

Ans. (b): Equivalent weight of an element is its weight which reacts with 8 gm of oxygen to form oxide.

67.67 g of oxygen combines with 32.33 g of the element to form oxide.

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1 g of oxygen will combine with $\frac{32.33}{67.67}$ g of element to form oxide.

8 g of oxygen will combine with $8\times\frac{32.33}{67.67}$ = 3.82 g of element to form oxide.

Hence, the equivalent weight of the element is 3.82 g.

139. The weight of a single atom of oxygen is:

(a) 1.057×10^{23} g (b) 3.556×10^{23} g

(c) 2.656×10^{-23} g (d) 4.538×10^{-23} g

AIIMS-1998

Ans. (c): Molar mass of oxygen atoms = 16 g mol^{-1}

Number of atom in 1 mole = 6.022×10^{23}

Therefore, 1 atom of oxygen weight $=\frac{16}{6.022\times10^{23}}$

$=2.657\times10^{-23}$ g

140. Haemoglobin contains 0.334% of iron by weight. The molecular weight of haemoglobin is approximately 67200. The number of iron atoms (Atomic weight of Fe is 56) present in one molecules of haemoglobin is

(a) 4 (b) 6

(c) 3 (d) 2

NEET-1998

Ans. (a) : Given that,

Molecular weight of haemoglobin = 67200

It contains 0.334% of iron by weight.

Weight of iron = $\frac{0.334}{100}\times67200 = 224.448$

No. of atoms = $\frac{\text{weight of iron in haemoglobin}}{\text{Atomic weight}}$

$=\frac{224.448}{56}$

= 4.008

141. If active mass of a 6% solution of a compound is 2, its molecular weight will be

(a) 30 (b) 15

(c) 60 (d) 22

AIIMS-1996

Ans. (a): Given, 6% of solution contains 6g of Compound in 100 ml of solution.

Then, mass of Compound present in 1 liter of Solution = 60 g

⇒ No. of moles = $\frac{\text{given mass}}{\text{molar mass}}=\frac{60\text{g}}{\text{M}}$

⇒ Active mass is defined as number of moles per litre.

So, Active mass = $\frac{60\text{g}}{\text{M}}$/litre

$2 = \frac{60}{\text{M}}\times\frac{1}{1\text{L}}$

Then, M (molar mass) = 30

142. A bivalent metal has the equivalent weight of 12. The molecular weight of its oxide will be

(a) 36 (b) 24

(c) 40 (d) 32

AIIMS-1994

Ans. (c): Molecular weight = equivalent weight × n-factor

(Where , n-factor of the metal ion = 2.)

So molecular weight = 12 × 2 = 24

Since it is bivalent ion it requires only one oxygen combine to form oxide.

Therefore, the molecular wt. of the oxide is molecular wt. = molecular wt. of metal + molecular wt. of oxygen

i.e. molecular wt. = 24 + 16 = 40

143. The weight to a metal of equivalent weight 12, which will give 0.475 g of its chloride, is

(a) 0.18 g (b) 0. 12 g

(c) 0. 24 g (d) 0. 16 g

AIIMS-1994

Ans. (b) : Equivalent weight of metal chloride = Equivalent weight of Metal + Equivalent wt. of Cl = 12 +35.5 = 47.5

47.5 g of metal chloride will give 12g of metal

Then, 0.475g of metal chloride will give -

$\equiv\frac{12\times0.475}{47.5}$

= 0.12g

144. The molecular mass of a volatile substance may be measured by

(a) Liebig's method

(b) Hofmann's method

(c) Victor Meyer's method

(d) none of these

AIIMS-1994

Ans. (c): The molecular mass of volatile substances can be determined by Victor Meyar. In this method primary, secondary and tertiary alcohols are subjected to a series of chemical analysis and the colour of resulting solution observed. A known mass of the compound is vaporized in an instrument called Victor Meyar tube.

145. What is the weight of oxygen required for the complete combustion of 2.8 kg of ethylene?

(a) 2.8 kg (b) 6.4 kg

(c) 9.6 kg (d) 96 kg

NEET-1989

Ans. (c) : $C_2H_4(\text{ethylene})+3O_2\longrightarrow2CO_2+2H_2O$

To oxidise 1mol of ethylene we required 3 moles of oxygen.

Then,

For oxidising 28g of C_2H_4,

We need 3×32 = 96g of oxygen.

For 2.8kg of C_2H_4,

We need $=\frac{96}{28}\times2.8$ =9.6kg of oxygen.

146. 2.76 g of silver carbonate on being strongly heated yields a residue weighing

(a) 3.54 g (b) 3.0 g

(c) 1.36 g (d) 2.16 g

IIT JEE 1997

Ans. (d) :

$$Ag_2CO_3(s)\longrightarrow2Ag(s)+CO_2(g)+\frac{1}{2}O_2(g)$$

@apna_pdf

Molecular weight of $Ag_2\ CO_3$ = 276 gm
and molecular weight of Ag = 2×108 = 216 gm
$\because$276 gm of Ag_2CO_3 give = 216 gm of Ag

$\therefore$ 1 gm of Ag_2CO_2 give $= \dfrac{216}{276}$ gm of Ag

Then, 2.76 gm Ag_2CO_2 give $= \dfrac{216}{276} \times 2.76$ gm of Ag

= 2.16 gm of Ag

147. The molecular weight of O_2 and SO_2 are 32 and 64 respectively At 15^0C and 150 mmHg pressure, one litre of O_2 contains 'N' molecules. The number of molecules in two litres of SO_2 under the same conditions of temperature and pressure will be

(a) N/2 (b) N
(c) 2N (d) 4N

AIPMT 1990

Ans. (c) : Avogadro's law states, equal volumes of all gases contain equal number of molecules under similar, condition of temperature and pressure.

Given, T = 15°C
P = 759 mm
Volume of $O_2 = v_1$ = 1 lit
No. of O_2 molecules = n_1 = N
Volume of $SO_2 = V_2$ = 2 lit
No. of molecule of $SO_2 = n_2$ =?

From Avogadro's law, $\dfrac{v_1}{n_1} = \dfrac{v_2}{n_2}$ Avogadro's law

$$\frac{1}{N} = \frac{2}{n_2}$$

$n_2 = 2N$

3. Mole Concept and Molar Mass

148. 2.0 g of H_2 gas is adsorbed on 2.5 g of platinum powder at 300 K and 1 bar pressure. The volume of the gas adsorbed per gram of the adsorbent is _____mL.
(Given: R = 0.083 L bar K^{-1} mol^{-1})

JEE Main-26.06.2022, Shift-I

Ans. (9960) : Given,
Mass of H_2 = 2.0g
Mass of platinum (Pt) = 2.5g
Temperature = 300K
Pressure = 1 bar
R = 0.083 L bar K^{-1} mol^{-1}

$$V_{H_2(g)} = \frac{n \times R \times T}{1}$$

$$= \frac{2}{2} \times \frac{0.083 \times 300}{1} = 24.9L$$

$\therefore$ 24.9L H_2(g) adsorbed on 2.5 Pt
$\therefore$ Volume of H_2(g) adsorbed on 1g Pt

$$= \frac{24.9}{2.5} = 9.96L = 9960\ mL$$

149. A commercially cold conc. HCl is 35% HCl by mass. If the density of this commercial acid is 1.46 g/mL, the molarity of this solution is:
(Atomic mass:Cl=35.5 amu, H=1 amu)

(a) 10.2 M (b) 12.5 M
(c) 14.0 M (d) 18.2 M

JEE Main-26.06.2022, Shift-I

Ans. (c) : Given, Concentration of HCl = 35% by mass
Density = 1.46 g/mL
We know that–

$$\text{Molarity} = \frac{(W/W\%) \times d \times 10}{(\text{Molar mass})_{\text{solute}}}$$

$$= \frac{35 \times 1.46 \times 10}{36.5}$$

= 14.0M

150. Which one of the following contains the highest number of oxygen atoms?

(a) One mole of aluminum sulphate
(b) Three moles of ferrous sulphate
(c) Three moles of hydrogen peroxide
(d) Two moles of potassium permanganate
(e) One mole of potassium dichromate

Kerala CEE -03.07.2022

Ans. (a) : One mole of aluminum sulphate =$Al_2\ (SO_4)_3$
It contain 12 mole of oxygen
1 mole of oxygen = N_A atoms
$\therefore$ 12 mole of oxygen = 12 N_A atoms
(b) Three moles of ferrous sulphate = 3 $FeSO_4$
It contain 12 mole of oxygen
$\therefore$ 12 mole of oxygen = 12 N_A atoms.
(c) Three moles of hydrogen peroxide = $3H_2O_2$
It contain 6 mole of oxygen
$\therefore$ 6 mole of oxygen = 6 N_A atoms
(d) Two moles of potassium permanganate =$2KMnO_4$
It contain 8 mole of oxygen
$\therefore$ 8 mole of oxygen =$8N_A$ atoms
(e) One mole of potassium dichromate = $K_2Cr_2O_7$
It contain 7 mole of oxygen
$\therefore$ 7 mole of oxygen =7 N_A atoms
Here, N_A =Avogadro number
So, option (a) one mole of aluminum sulphate contains the highest number of oxygen atoms.

151. Two elements A and B which form 0.15 moles of A_2B and AB_3 type compounds. If both A_2B and AB_3 weigh equally, then the atomic weight of a is _______ times of atomic weight of B.

JEE Main-27.06.2022, Shift-I

Ans. (2) : Given,
Moles of A_2B = 0.15 mole
Moles of AB_3 = 0.15 mole
Weight of A_2B = Weight of AB_3
Let molar mass of element A = x g
and molar mass of element B = y g
We know that –

$$\text{No. of moles} = \frac{\text{given mass}}{\text{molar mass}}$$

@apna_pdf

For compound A_2B –

Molar mass $(2x + y) = \frac{\text{given mass}}{\text{no. of moles}} = \frac{w}{0.15}$

For compound AB_3 –

Molar mass $(x + 3y) = \frac{w}{0.15}$

So,

$$x + 3y = 2x + y$$
$$2x - x = 3y - y$$
$$x = 2y$$

So, atomic weight of A is 2 times of atomic weight of B.

152. Choose the correct answer:
Given below are two statements: one is labelled as
Assertion (A) and the other is labelled as Reason (R).
Assertion (A): At 10°C, the density of a 5 M solution of KCl [atomic masses of K and Cl are 39 and 35.5 g mol^{-1} respectively], is 'X' g mL^{-1}. The solution is cooled to –21°C. The molality of the solution will remain unchanged.
Reason (R): The molality of a solution does not change with temperature as mass remains unaffected with temperature.
In the light of the above statement choose the correct answer from the options given below.

(a) Both (A) and (R) are true and (R) is the correct explanation of (A)
(b) Both (A) and (R) are true but (R) is not the correct explanation of (A)
(c) (A) is true but (R) is false
(d) (A) is false but (R) is true

JEE Main-27.06.2022, Shift-I

Ans. (a) : We know that molality and mass both are temperature independent so, on changing temperature. Molality and mass remain unchanged.

153. If a rocket runs on a fuel ($C_{15}H_{30}$) and liquid oxygen, the weight of oxygen required and CO_2 released for every litre of fuel respectively are: (Given: density of the fuel is 0.756 g/mL)

(a) 1188 g and 1296 g (b) 2376 g and 2592 g
(c) 2592 g and 2376 g (d) 3429 g and 3142 g

JEE Main-24.06.2022, Shift-I

Ans. (c) : Given,
Density of fuel = 0.756 g/mL
Molecular formula of fuel = $C_{15}H_{30}$
Then, molar mass of fuel = 15 × 12 + 30 × 1
= 210 g

$$\text{Density} = \frac{\text{mass}}{\text{volume}}$$

Mass = density × volume
= 0.756 × 1000 = 756 gm.

The reaction is —

$$C_{15}H_{30}\,(l) + \frac{45}{2}O_2\,(g) \longrightarrow 15CO_2\,(g) + 15H_2O$$

Weight of oxygen $= \frac{45}{2}\left[\frac{756}{210}\right] \times 32 = 2592$ g

Weight of $CO_2 = 15\left[\frac{756}{210}\right] \times 44 = 2376$ g.

154. Geraniol, a volatile organic compound, is a component of rose oil. The density of the vapour is 0.46 gL^{-1} at 257°C and 100 mm Hg. The molar mass of geraniol is —— g mol^{-1} (Nearest Integer)
[Given: R = 0.082 L atm K^{-1} mol^{-1}]

JEE Main-29.06.2022, Shift-I

Ans. (152) : $P = \frac{dRT}{M}$

$$P = \frac{100}{760}\text{atm}$$
$$T = 256 + 273 = 530\text{K}$$
$$d = 0.46\frac{g}{L}$$
$$M = \frac{0.46 \times 0.082 \times 530}{100} \times 760$$
$$= 151.92 = 152$$

155. Production of iron in blast furnace follows the following equation:

$$Fe_3O_4(s) + 4CO(g) \rightarrow 3Fe(l) + 4CO_2(g)$$

When 4.640 kg of Fe_3O_4 and 2.520 kg of CO are allowed to react then the amount of iron (in g) produced is:
[Given: Molar Atomic mass (g mol^{-1}): Fe = 56
Molar Atomic mass (g mol^{-1}): O = 16
Molar Atomic mass (g mol^{-1}): C =12]

(a) 1400 (b) 2200
(c) 3360 (d) 4200

JEE Main-29.06.2022, Shift-I

Ans. (c) : Given,
The reaction is ———

$$Fe_3O_4\,(s) + 4CO\,(g) \longrightarrow 3Fe\,(l) + 4CO_2\,(g)$$

Fe_3O_4 = 4.640 kg.
CO = 2.520 kg.

Molar mass of Fe_3O_4 = 3 × 56 + 4 × 16
= 232 g

1 mole of Fe_3O_4 is produced 3 mole of Fe
= 3 × 56 = 168g Fe

∵ 232 g FeO_4 produce 168 g Fe.

∵ 4.640 kg Fe_3O_4 will produce $= \frac{168}{232} \times 4.640$ kg
= 3.36 kg
= 3360 g

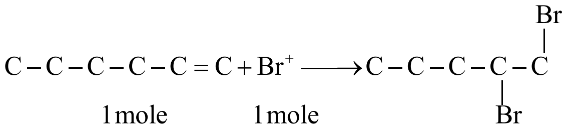
So, the correct option is (c)

156. Number of grams of bromine that will completely react with 5.0 g of pent-1-ene is_____×10^{-2} g.
(Atomic mass of Br= 80 g/mol) [Nearest Integer]

JEE Main-25.06.2022, Shift-I

@apna_pdf

Ans. (1142) :



$$C-C-C-C-C=C+Br^+ \longrightarrow C-C-C-C-\underset{Br}{C}-\overset{Br}{C}$$

$$\underset{1\,mole}{} \qquad \underset{1\,mole}{}$$

Molecular mass of pent -1-ene = 70

Mole of pent -1-ene = $\frac{5}{70}\times\frac{1}{14}$ mole

Required mole of bromine = $\frac{1}{14}\times160$

= 11.42 or 1142 $\times10^{-2}$

157. The number of N atoms in 681 g of $C_7H_5N_3O_6$ is X × 10^{21}. The value of X is____. (N_A= 6.02 × 10^{23} mol^{-1}) (Nearest Integer)

JEE Main-25.06.2022, Shift-I

Ans. (5418) : Molar mass of $C_7H_5N_3O_6$ is 84 + 5 + 42 + 96 = 227

$^nC_6H_5N_3O_6 = \frac{681}{227}$ = 3 moles

$^nN = \frac{681}{227}$ × 3 = 9 moles of N

No. of N atoms = 9 × 6.02 × 10^{23}

= 5418 × 10^{21}

158. CNG is an important transportation fuel. When 100 g CNG is mixed with 208 g oxygen in vehicles, it leads to the formation of CO_2 and H_2O and produced large quantity of heat during this combustion, then the amount of carbon dioxide, produced in grams is———. [nearest integer]

JEE Main-26.06.2022, Shift-II

Ans. (143) : $CH_4 + 2O_2(g) \longrightarrow CO_2(g) + H_2O$

Mass 100 208 moles = 3.25

Moles $\frac{100}{16}$ $\frac{208}{32}$ mass = 143 gram

$\Rightarrow$ 6.25 $\frac{6.5}{2}$3.25 (L.R.)

$$\frac{^nO_2}{2} = \frac{^nCO_2}{1}$$

$$\frac{6.5}{2} = {^nCO_2}$$

Mass of $CO_2 = \frac{6.5}{2}\times44$ = 143 gm.

159. The maximum number of molecules is present in

(a) 15 L of H_2 gas at STP

(b) 5 L of N_2 gas at STP

(c) 0.5 g of H_2 gas

(d) 10 g of H_2 gas

JCECE - 2008
UPTU/UPSEE-2007
NEET-2004

Ans. (a)
1 mole of gas at STP occupies a volume of 22.4 L

Option (a)- 15 L of gas corresponds to

$$\frac{15L}{22.4L} = 0.67\,moles$$

Option (b)- 5L of N_2 gas at STP:

5L of gas corresponds to $\frac{5L}{22.4L}$ =0.22 moles

Option (c)- 0.5g of H_2 gas (molecular weight 2g/mole) corresponds to $\frac{0.5g}{2g/mol}$ = 0.25moles

Option (d)- 10g of O_2 gas (molecular weight 3g/ mol) corresponds to $\frac{10g}{32g/mol}$ =0.3125moles

Higher is the number of moles of a gas, higher will be its number of molecules.

160. 10 gm of hydrogen and 64 g of oxygen were kept in a steel vessel and exploded. Amount of water produced in this reaction will be

(a) 2 mol
(b) 4 mol
(c) 8 mol
(d) 10 mol

UP CPMT-2012
NEET-2009

Ans. (b) : $2H_2 + O_2 \rightarrow 2H_2O$

10g of hydrogen (molar mass 2g /mol) = $\frac{10g}{2g/mol}$

= 5 mol

64g of oxygen (molar mass 32g/mol) = $\frac{64}{32g/mol}$

= 2 mol

2 moles of oxygen will react with 2 × 2 = 4 moles of hydrogen to form 4 moles of water.

161. The mass of one mole of electron is

(a) 9.1 × 10^{-28}g
(b) 0.55 mg
(c) 9.1 × 10^{-24}g
(d) 6 10^{-12}g

UP CPMT-2010
UPTU/UPSEE-2006

Ans. (b): As we know that,
Mass of one electron = 9.1× 10^{-31} kg
= 9.1× 10^{-28} g
1 mole = 6.023×10^{23} electron
So, 1 mole of electron has mass of
= 9.1 × 10^{-28} × 6.023 × 10^{23}
= 5.48×10^{-4}
= 0.55mg

162. The number of moles of oxygen obtained by the electrolytic decomposition of 108 g water is

(a) 2.5
(b) 3
(c) 5
(d) 7.5

JIPMER-2008, JCECE-2007

Ans. (b): $2H_2O \xrightarrow{Electrolysis} 2H_2 + O_2$

$\underset{2\,mole}{}$ $\qquad$ $\underset{1\,mole}{}$

2×18

$=36$

@apna_pdf

$\because$ 36 g of H_2O produce 1 mole of oxygen

$\therefore$ 108 g of water will produce oxygen

$$= \frac{108}{36} = 3\,\text{mole}$$

163. The number of moles of $KMnO_4$ reduced by one mole of KI in alkaline medium is

(a) one fifth (b) five

(c) one (d) two

JCECE-2012

JIPMER-2007

Ans. (d) : In alkaline solution, $KMnO_4$ is reduced to MnO_2 (colourless).

$$2KMnO_4 + 2H_2O \longrightarrow MnO_2 + 2KOH + 3[O]$$

$$KI + 3[O] \longrightarrow KIO_3$$

$$2KMnO_4 + 2H_2O + KI \longrightarrow 2MnO_2 + 2KOH + KIO_3$$

Hence, two moles of $KMnO_4$ are reduced by one mole of KI.

164. In Kjeldahl' s method, ammonia from 5g of food neutralizes 30 cm^3 of 0.1 N acid. The percentage of nitrogen in the food is

(a) 0.84 (b) 8.4

(c) 16.8 (d) 1.68

BCECE-2014

Karnataka-CET, 2010

Ans. (a) : Given, w = 5g, V = 30 cm^3

From Kjedahl's method,

$$\text{percentage of nitrogen} = \frac{1.4 \times N \times V}{w} = \frac{1.4 \times 0.1 \times 30}{5}$$

$$= 0.84\%$$

165. 50 cm^3 of 0.2 N HCl is titrated against 0.1 N NaOH solution. The titration is discontinued after adding 50 cm^3 of NaOH. The remaining titration is completed by adding 0.5 N KOH. The volume of KOH required for completing the titration is

(a) 12 cm^3 (b) 10 cm^3

(c) 25 cm^3 (d) 10.5 cm^3

Karnataka-CET, 2010, 2011

Ans. (b) : (i) Calculation of volume of HCl left often incomplete titration.

When 0.1 N NaOH is used,

$$\underset{\text{(For HCl)}}{N_1V_1} = \underset{\text{(For NaOH)}}{N_2V_2}$$

$0.2\text{ N} \times V_1 = 50 \times 0.1\text{N}$

$$V_1 = \frac{50 \times 0.1}{0.2} = 25\text{cm}^3$$

(ii) Calculation of volume of KOH for completing the titration.

When 0.5 N KOH is used,

$$\underset{\text{(For remaining HCl)}}{N_1V_1} = \underset{\text{(For KOH)}}{N_3V_3}$$

$$0.2\text{ N} \times 25 = 0.5\text{ N} \times V_3$$

$$V_3 = \frac{0.2 \times 25}{0.5}$$

$= 10\ cm^3$

166. A gas is found to have a formula $[CO]_x$. Its vapour density is 70, the x is

(a) 3.0 (b) 3.5

(c) 5.0 (d) 6.5

BCECE-2007

BITSAT-2006

Ans. (c) : $\text{Vapour density} = \dfrac{(\text{molecular weight})}{2}$

Formula mass CO is = 28

Vapour density of the gas = 70

Molecular weight of gas = 2 × vapour density = 2 × 70 = 140

$$x = \frac{\text{molecular weight}}{\text{weight of CO}}$$

$$x = \frac{140}{28} = 5$$

167. Number of atoms of He is 100 amu of He (atomic wt. of He is 4) are :

(a) 25 (b) 100

(c) 50 (d) $100 \times 6 \times 10^{-23}$

BITSAT-2012

BCECE-2008

Ans. (a) : We know formula,

$$\text{No. of atoms} = \frac{\text{Mass of substance}}{\text{Atomic mass}}$$

$$100\text{ amu of He} = \frac{100}{4}\text{ atoms of He}$$

$= 25$ atoms.

[1 AMU = mass of one proton (approx.)]

168. Calculate the mole fraction of aqueous solution of 1 molal urea (NH_2CONH_2)

(a) 0.01878 (b) 0.01768

(c) 0.01800 (d) 0.01698

GUJCET-2022

Ans. (b) : $\text{Molarity} = 1\text{M}$

$$\text{Molarity} = \frac{\text{n solute}}{\text{mass of solvent in kg}}$$

$$\frac{1}{1} = \frac{\text{n solute}}{\text{mass of solvent in kg}}$$

Hence solute in urea and solvent aqueous solution is given

$$X_{\text{urea}} = \frac{n_{\text{urea}}}{n_{\text{urea}} + n_{H_2O}}$$

$n_{\text{urea}} = 1$ and mass of H_2O = 1 kg = 1000 gm

$$\therefore X_{\text{urea}} = \frac{1}{1 + \frac{1000}{18}}$$

@apna_pdf

$$X_{urea} = \frac{1}{1+55.55} \quad \left\{ \begin{array}{l} X_{urea} = \dfrac{w\left(\text{given mass}\right)}{\text{molecular wt.}} \\ \text{and} \\ n_{H_2O} = \dfrac{w}{\text{molecular wt.}} \\ \quad = \dfrac{1000}{18} \end{array} \right.$$

$$X_{urea} = \frac{1}{56.55}$$

$$\simeq 0.0177$$

169. How many numbers of mole ions produced from aqueous solution of 1 mole Iron (III) hexacyano Ferrate (II) complex ?

(a) 4 (b) 7

(c) 5 (d) 6

GUJCET-2022

Ans. (b): Co-ordination compounds donot completely dissociate in water into all its cationic and anionic components.

Chemical formula of, Ferric hexacynoferrate (II)

$Fe_4[Fe(CN)_6]_3$

Its co-ordination sphere does not get dissociated in aqueous solution,

by adding Ferric hexacynoferrate (II) to water, it will produce 4 Fe^{+3} ion and $3[Fe(CN)_6]^{-4}$ ion

So, it will produce total 7 ions in aqueous solution.

170. The number of electron present in 2.3g of NO_2 is

(a) 6.92×10^{23} (b) 6.92×10^{22}

(c) 138×10^{23} (d) 6.023×10^{23}

Assam CEE-2021

Ans. (a) : Number of molecule = mole × N_A

$$= \frac{\text{mass}}{\text{molar mass}} \times N_A$$

$$= \frac{2.3g}{46} \times N_A$$

$$= 0.05 \times N_A$$

Molecular of weight of NO_2 = 7 + 16 = 23

1 molecule = 23 e^- of NO_2

Total number of e^- = $23 \times 0.05 \times N_A = 6.92 \times 10^{23}$

171. Number of atom in 5.586 g Fe ($M = 55.86\ g\ mol^{-1}$) is

(a) Twice of 60.0 g of C (b) Twice of 0.6 g of C

(c) Twice of 6.0 g of C (d) Twice of 600g of C

Assam CEE-2021

Ans. (b) : Number of atom = mole × N_A

$$= \frac{\text{Mass}}{\text{atomic mass}} \times N_A$$

$$= \frac{5.586}{55.86} \times N_A$$

$$= 0.1\ N_A$$

0.6g C Number of atom $= \dfrac{0.6}{12} \times N_A$

$$= 0.05\ N_A$$

172. A reaction of 0.1 mole of benzylamine with bromomethane gave 23 g of benzyle trimethyl ammonium bromide. The number of moles of bromomethane consumed in this reaction are $n \times 10^{-1}$, when n = ... (Round off to the nearest integer)

(Given : Atomic masses : C = 12.0 u, H = 1.0 u. N = 14.0 u, Br = 80.0 u)

[JEE Main 2021, 18 March Shift-I]

Ans. Number of moles of benzyl trimethyl

Ammonium bromide formed = $\dfrac{23}{230} = 0.1$

No. of moles of bromomethane consumed

$= 3 \times 0.1$

$= 3 \times 10^{-1}$

173. The number of moles of CuO, that will be utilised in Dumas method for estimation nitrogen in a sample of 57.5 g of N, N-dimethylaminopentane is...... $x10^{-2}$ (Nearest integer)

[JEE Main 2021, 27 Aug Shift-II]

Ans. Moles of N in N, N– dimethylaminopentane = $\left(\dfrac{57.5}{115}\right) = 0.5\text{mol}$

$$\frac{n_{CuO}\text{reacted}}{\left(\dfrac{45}{2}\right)} = \frac{n_{C_7H_{17}N}\text{ reacted}}{1}$$

$$\Rightarrow\ n_{CuO}\text{reacted} = \left(\frac{45}{2}\right) \times 0.5 = 11.25$$

174. The ratio of the mass percentages of 'C' and H' and 'C and O' of a saturated acyclic organic compound 'X' are 4:1 and 3:4 respectively. Then, the moles of oxygen gas required for complete combustion of two moles of organic compound 'X' is............

[JEE Main 2021, 2 Sep Shift-II]

Ans. Mass ratio of C : H is 4 : 1 ⇒ 12 : 3 &

C : O is 3 : 4 ⇒ 12 : 16

So,

	Mass	Mole	Mole ratio
C	12	1	1
H	3	3	3
O	16	1	1

Empirical formula ⇒ CH_3O

As compound is saturated acyclic so molecular Formula is $C_2H_6O_2$

$$C_2H_6O_2 + \frac{5}{2}O_2(g) \rightarrow 2CO_2(g) + 3H_2O(g)$$

So, required moles of O_2 is 5.

175. The minimum number of moles of O_2 required for complete combustion of 1 mole of propane and 2 moles of butane is.......

[JEE Main 2021, 5 Sep Shift-I]

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Ans. $C_3H_8 + SO_2 \rightarrow CO_2 + 4H_2O$

1 mole 5 mole

For 1 mole propane Combustion 5 mole O_2 required

$C_4H_{10} + \frac{13}{2}O_2 \rightarrow 4CO_2 + 5H_2O$

1 mole $\rightarrow$ 6.5 mole

2 mole $\rightarrow$ 13 mole

For 2 moles of butane 13 mole of O_2 is required

total moles = 13 + 5 = 18

176. The ammonia (NH_3) released on quantitative reaction of 0.6 g urea (NH_2CONH_2) with sodium hydroxide (NaOH) can be neutralised by

[JEE Main 2021, 7 Jan Shift-II]

Ans. $NH_2CONH_2 + 2NaOH \rightarrow 2NH_3 + Na_2CO_3$

1 mole urea gives 2 moles ammonia as per the balance reaction.

$n_{urea} = \frac{0.6}{60} = 0.01$ mole

$\therefore$ $n_{ammonia} = 2 \times 0.01 = 0.02$ mole

Now,

0.02 moles of NH_3 reacts with 0.02 moles of HCl.

Mole of HCl $= \frac{100 \times 0.2}{1000} = 0.02$ mole

177. A chloro compound A,

(i) Forms aldehydes on ozonolysis followed by the hydrolysis,

(ii) When vaporised completely, 1.53 g of A gives 448 mL of vapour at STP.

The number of carbon atoms in a molecule of compound A is……. .

[JEE Main 2021, 26 Aug Shift-II]

Ans. 448 ml of A $\Rightarrow$ 1.53 gm A

1ml of A = 1.53/448gm of A

22400 ml of A $\Rightarrow \frac{1.53}{448} \times 22400$ gm A = 76.5 A gm

$$\underset{\text{It has 3 Carbon atoms}}{H_3CHC-CH-Cl} \xrightarrow[Zn/H_2O]{O_3} \underset{\text{Aldehyde}}{CH_3-CH=0}$$

& mm is 36 + 5 + 35.5 = 76.5

178. 4g equimolar mixture of NaOH and Na_2CO_3 contains x g of NaOH and y g of Na_2CO_3. The value of x is…….g. (Nearest integer)

[JEE Main 2021, 20 July Shift-II]

Ans. Mass of NaOH = x

Moles of NaOH = $\frac{x}{40}$

Mass of Na_2CO_3 = y

Moles of Na_2CO_3 = $\frac{y}{106}$

$\frac{x}{40} = \frac{y}{106} = K$

x + y = 4

40K + 106K = 4

K = 4/146

Now, x = 40K

$x = 40 \times \frac{4}{146}$ g

So,

x = 1.1, y = 2.9

x = 1.1 ≈ 1 (nearest integer)

179. The hardness of a water sample (in terms of equivalents of $CaCO_3$) containing 10^{-3} M $CaSO_4$ is

(Molar mass of $CaSO_4$ = 136 g mol^{-1})

(a) 100 ppm (b) 10 ppm

(c) 50 ppm (d) 90 ppm

[JEE Main 2021, 12 Jan Shift-I]

Ans. (a) : The hardness of water sample (in terms of equivalents of $CaCO_3$) containing 10^{-3}M $CaSO_4$

Mole of $CaSO_4$ = 10^{-3} moles

Mass of water = 1000g

DOH (in terms of $CaCO_3$) = $10^{-3} \times 100/1000$ g

Hardness = $(10^{-3} \times 100/1000) \times 10^6$

Hardness of water = 100 ppm

180. The $NaNO_3$ weighed out to make 50 mL of an aqueous solution containing 70.0 mg Na^+ per mL is…..g. (Rounded off to the nearest integer) [Given : Atomic weight in g mol^{-1}, Na : 23 ; N : 14 ; O : 16].

[JEE Main 2021, 26 Feb Shift-II]

Ans. Given that,

Na^+ present in 50ml

Na^+ = 70 mg/mL

W_{Na^+} in 50 mL solution

= 70 × 50 mg

= 3500 mg

= 3.5 mg

Moles of Na^+ in 50 mL solution = $\frac{3.5}{23}$

Moles of $NaNO_3$ = moles of Na^+

$= \frac{3.5}{23}$ mol

Mass of $NaNO_3 = \frac{3.5}{23} \times 85 = 12.934 \simeq 13$ gm

181. The number of atoms in 8 g of sodium is X $\times 10^{23}$. The value of X is…….

(nearest integer)

[Given : $N_A = 6.02 \times 10^{23}$ mol^{-1} Atomic mass of Na = 23.0 u]

[JEE Main 2021, 1 Sep Shift-II]

Ans. We know that,

$$\frac{\text{Weight of sodium atom}}{\text{Molecular mass of sodium atom}} = \frac{\text{Number of atoms}}{\text{Avogadro's number}}$$

$$\frac{8\,g}{23\,g} = \frac{\text{Number of atoms}}{6.02 \times 10^{23}}$$

Number of atoms = $\frac{8 \times 6.02 \times 10^{23}}{23}$

Number of atoms = 2.09×10^{23}

x ≈ 2

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182. 10.0 mL of 0.05 M $KMnO_4$ solution was consumed in a titration with 10.0 mL of given oxalic acid dihydrate solution. The strength of given oxalic acid solution is……x10^{-2} g/L. (Round off to the nearest integer)

[JEE Main 2021, 27 July Shift-II]

Ans.(1575). $n_{eq}\ KMnO_4 = n_{eq} H_2C_2O_4 . 2H_2O$

then $\frac{10\times0.05}{1000}\times5=\frac{10\times m}{1000}\times2$

∴ Conc. of oxalic acid solution = 0.125 M

0.125 × 126 g/L = 15.75 g/L

1575×10^{-2} g/L

183. When 10 mL of an aqueous solution of Fe^{2+} ions was titrated in the presence of dil. H_2SO_4 using diphenylamine indicator, 15 mL of 0.02 M solution of $K_2Cr_2O_7$ was required to get the end point. The morality of the solution containing Fe^{2+} ions is x $\times10^{-2}$ M. The value of x is….. . (Nearest integer)

[JEE Main 2021, 25 July Shift-I]

Ans.(18)

$Cr_2O_7^{2-} + 6Fe^{2+} + 14H^+ \rightarrow 2Cr^{3+} + 6Fe^{3+} + 7H_2O$

$Cr_2O_7^{2-}$: 15 mL 0.02 M and 1 mole used in reaction

Fe^{2+} : 10 mL M_2 ? and 6 mole used in reaction

$(Cr_2O_7^{2-})$ (Fe^{2+})

Now, $\frac{M_1V_1}{n_1} = \frac{M_2V_2}{n_2}$

$$\frac{0.02M\times15\,mL}{1\text{ mole}}=\frac{M_2\times10\,mL}{6\text{ mole}}$$

$$M_2=\frac{0.02\times15\times6}{10}=0.18\text{ M}=18\times10^{-2}M$$

184. Calculate the amount of lime, Ca $(OH)_2$ required to remove hardness of 50,000 litres of well water which contains 1.62 g of calcium bicarbonate per 10 liters. [Given, atomic masses : Ca→40, H →1, C → 12, O → 16]

(a) 1.5 kg (b) 3.7 kg

(c) 2.8 kg (d) 4.2 kg

AP- EAPCET- 07-09-2021, Shift-I

Ans. (b) : Ca (HCO_3) + $Ca(OH)_2 \rightarrow$ 2 $CaCO_3$ + $2H_2O$

well water contain 1.62 gm of calcium bicarbonate per 10 litres of water so, 50,000 litres of well water contain

$=\frac{1.62\times50,000}{10}=162\times50$ gm of calcium carbonate

∴ No. of moles of calcium bicarbonate $=\frac{162\times50}{162}$

= 50 mole

The mass of calcium hydroxide required is $\frac{74\times50}{1000}$

= 3.7 kg

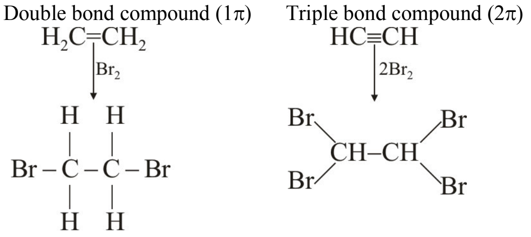
185. One mole of an organic compound with a double bond and a triple bond is reacted with Br_2/CCl_4. The amount of Br_2 required to completely brominates all π-bonds in the compounds is (Given Br mass is 80 amu)

(a) 480 g (b) 160 g

(c) 320 g (d) 240 g

TS-EAMCET 09.08.2021, Shift-I

Ans. (a) :



Since, weight of Br of 1mole = 80gm

Then, weight of 6 mole of Br atom is = 80 × 6

= 480 gm.

186. Number of moles of dichromate needed to oxidizes one mole of Sn^{2+} is

(a) 3 (b) 2

(c) $\frac{1}{3}$ (d) $\frac{1}{2}$

TS-EAMCET 09.08.2021, Shift-I

Ans. (c) : The overall oxidation reaction is given below–

$$\overset{+6}{Cr_2}O_7^{2-}+14H^++3Sn^{+2}\rightarrow2Cr^{3+}+3Sn^{4+}+7H_2O$$

Thus, 3 mole of Sn^{+2} will reduce 1 mole of $K_2Cr_2O_7$.

Therefore, 1 moles of Sn^{2+} will reduce 1/3 moles of $K_2Cr_2O_7$.

187. 20 g of $CaCO_3$ on heating produces x amount of CO_2. If the final weight of $CaCO_3$ after the reaction is 5 g. the amount of CO_2 liberated in L at STP is

(a) 44 (b) 3.36

(c) 22 (d) 6.66

TS-EAMCET 09.08.2021, Shift-I

Ans. (b) : The balanced equation is–

$$CaCO_3\rightarrow \underset{\downarrow}{CO_2}+CaO$$

1mole 1mole = 22.4 litre at STP

∵ 100 gm of $CaCO_3$ evolve CO_2 = 22.4 litre

1gm of $CaCO_3$ evolve $CO_2=\frac{22.4}{100}$

∴ 15 gm of $CaCO_3$ evolve $CO_2=\frac{22.4}{100}\times15$

= 3.36 litre

188. $KMnO_4$ oxidises oxalic acid in acidic medium. The number of CO_2 molecules produced per mole of $KMnO_4$ is

(a) 5 (b) 4

(c) 3 (d) 1.5

TS EAMCET 05.08.2021, Shift-I

Ans. (a) : for 2 mole →

$2KMnO_4 + 5H_2C_2O_4 + 3H_2SO_4 \rightarrow 2\ MnSO_4 + 10\ CO_2 + K_2SO_4 + 8\ H_2O$

For one mole 10/2 = 5 CO_2 molecule are formed.

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189. Salts of A (atomic weight 8), B (atomic weight 18) and C (atomic weight 50) were electrolysed under identical conditions using the same quantity of electricity. It was found that 2.4g of A was deposited, the weight of B and C deposited are 1.8 g and 7.5 g respectively. The valences of A, B and C are, respectively,

(a) 3, 1 and 2 (b) 1, 2 and 3
(c) 1, 3 and 2 (d) 3, 2 and 1

TS EAMCET 04.08.2021, Shift-I

Ans. (c) : According to Faraday law–

$$W = Z.Q = \frac{E.Q}{96500}$$

For A,

$$2.4 = \frac{(8/x)Q}{96500}$$

$$x = \frac{8Q}{96500 \times 2.4}$$

For B,

$$1.8 = \frac{(18/y)Q}{96500}$$

$$y = \frac{18Q}{96500 \times 1.8}$$

For C,

$$7.5 = \frac{(50/z)Q}{96500}$$

$$z = \frac{50Q}{96500 \times 7.5}$$

Hence, $x : y : z = \left(\frac{8}{2.4}\right) : \left(\frac{18}{1.8}\right) : \left(\frac{50}{7.5}\right)$

$= 3.33 : 10 : 6.66$

$= 1 : 3 : 2$

By solving equation,

A = 1, B = 3 and C = 2

So, valence of A, B and C are 1, 3 and 2.

190. The number of grams of oxygen in 32.2g of $Na_2SO_4 . 10H_2O$ is approximately

(a) 32.2 g (b) 22.4 g
(c) 11.2 g (d) 64.4 g

TS EAMCET 04.08.2021, Shift-I

Ans. (b) : No. of oxygen atoms in one molecule of $Na_2SO_4.10\ H_2O = 4 + 10 = 14$

Thus, moles of oxygen in n moles of compound = 14n

Molar mass of $Na_2SO_4.\ 10\ H_2O = 46 + 32 + 64 + 180$
$= 322$ g/mol

Since, $32.2g = \frac{32.2}{322} = 0.1$ moles

Thus, moles of oxygen = 0.1 × 14 = 1.4

So, weight is 16 × 1.4 = 22.4 g

191. KBr is doped with 10^{-5} mole percent of $SrBr_2$. The number of cationic vacancies in 1 g of KBr crystal is _______ 10^{14}. (Round off to the Nearest Integer).
[Atomic Mass: K: 39.1 u, Br: 79.9u
$N_A = 6.023 \times 10^{23}$]

JEE Main 17.03.2021, Shift-II

Ans. (5).

100 mole of KBr is doped with 10^{-5} mole of $SrBr_2$.

1 mole KBr contain $= \frac{10^{-5}}{100} = 10^{-7}$ mol of $SrBr_2$

Hence, 10^{-7} moles cation vacancy (as $1Sr^{2+}$ will result 1 cation vacancy)

119g KBr contains 10^{-7} mol of $SrBr_2$

1g KBr contains $\frac{10^{-7}}{119}$ mol of $SrBr_2$

∴ Required number of cation vacancy

$$= \frac{10^{-7} \times 6.023 \times 10^{23}}{119}$$

$= 5.06 \times 10^{14}$

$\approx 5 \times 10^{14}$

192. A gas X is dissolved in water at 2 bar pressure. Its mole fraction in the solution is 0.02. Find the mole fraction of water in the solution when the pressure of the gas is doubled at the same temperature.

(a) 0.04 (b) 0.98
(c) 0.96 (d) 0.02

AP EAPCET 24.08.2021, Shift-I

Ans. (c) : According to the Raoult's law –

$P_1 = X_1 P_0$

Where –

P_1 = Vapour pressure of the solvent.
P_0 = Vapour pressure in pure state.
X_1 = mole fraction

Given – $P_1 = 2$ Bar

$X_1 = 0.02$

and

$P_2 = 2P_1 = 2 \times 2 = 4$ Bar

$X_2 = ?$

∴ $P_1 = X_1 P_0$

$2 = 0.02 \times P_0$ ... (I)

and

$P_2 = X_1 P_0$

$4 = X_2\ P_0$ ... (II)

From (I) and (II) we get

$$\frac{0.02}{X_2} = \frac{1}{2}$$

or $X_2 = 0.04$

So, Mole fraction of water = $1 - X_2 = 1 - 0.04 = 0.96$

193. How many moles of electrons weighs one kg?

(a) 3×10^4 (b) 6×10^{23}
(c) 1×10^8 (d) 1.8×10^6

TS EAMCET 10.08.2021, Shift-II

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Ans.(d) :

$$1\,\text{mole}\,e^- = 6.023\times10^{23}\,e^-$$

$$\text{Mass 1 mole of electron} = 6.023\times10^{23}\times9.108\times10^{-31}\,\text{kg}$$

$$= 6.023\times9.108\times10^{-8}\,\text{kg}$$

$$\text{No. of mole in one kg} = \frac{1}{9.108\times6.023\times10^{-8}}$$

$$= \frac{10^8}{9.108\times6.023}$$

$$= \frac{100}{9.108\times6.023}\times10^6$$

$$= 1.82\times10^6$$

194. 3.011×10^{22} atoms of an element weighs 1.5gm. The atomic mass of the element is ———

(a) 10 amu (b) 2.3 amu

(c) 35.5 amu (d) 23 amu

AP EAPCET 25.08.2021, Shift-II

Ans. (d) : Given that –

Weigh = 1.15gm

Atoms = 3.011×10^{22}

$$\text{Atomic mass} = \frac{\text{Mass}}{\text{No. of atoms}}$$

$$= \frac{1.15\,\text{gm}}{3.011\times10^{22}}$$

$= 0.38\times10^{-22}$ gm

We know,

1amu = 1.66×10^{-24} gm

Then,

$$= \frac{0.38\times10^{-22}}{1.66\times10^{-24}}$$

= 23 amu.

195. If $Fe_{0.96}O$, Fe is present in +2 and +3 oxidation state, what is the mole-fraction of Fe^{2+} in the compound?

(a) 12/25 (b) 25/12

(c) 1/12 (d) 11/12

AP EAPCET 25.08.2021, Shift-II

Ans. (d) : Given $Fe_{0.96}O$, Fe is present +2 and +3 oxidation state

Let 'x' molecule fraction of Fe^{+2} and (0.96 – x) molecular fraction of Fe^{+3}

Now,

$$x(+2) + (0.96 - x)(+3) - 2 = 0$$

$$2x - 3x + 2.88 - 2 = 0$$

$$x = 0.88$$

Fraction of Fe^{+2} = 0.88 and fraction of Fe^{+3} = 0.12

$$\text{Mole fraction of } Fe^{+2} = \frac{0.88}{0.88+0.12}$$

$$= \frac{11}{12}$$

196. When oxalic acid is oxidised with acidified $KMnO_4$, the number of moles of CO_2 liberated is (consider balancing the reaction)

(a) 2 (b) 4

(c) 6 **(d) 10**

TS EAMCET 10.08.2021, Shift-I

Ans. (d) : Balance chemical reaction

$2KMnO_4 + 5H_2C_2O_4 + 3H_2SO_4 \rightarrow 2MnO_4 + K_2SO_4 + 8H_2O$ + 10 mole of CO_2 liberate.

197. The strength of 50 volume of H_2O_2 solution is approximately.

(a) 50% (b) 25%

(c) 10% (d) 15%

TS EAMCET 10.08.2021, Shift-I

Ans. (d) : $2H_2O_2 \rightarrow 2H_2O + O_2$

$2(34) = 68g$ $\qquad$ $22.4\,L\,at\,NTP$

50 volume H_2O_2 means 1L of 50 volume of H_2O_2 give 50L O_2 at STP

∴ 22.4 liter of O_2 produced from = 68 gm H_2O_2

∴ 50 liter of

$$O_2 \text{ produced from} = \frac{68}{22.4}\times50 = 151.7\,g\ of\ H_2O_2$$

$$\text{Percentage strength of } H_2O_2 \text{ Solution} = \frac{151.7}{1000}\times100$$

$$= 15.17\%\ or \approx 15\%$$

198. 100 ml of 0.2 M acetic acid is completely neutralized using a standard solution of NaOH. The volume of ethane obtained at STP after complete electrolysis of the resulting solution is ———

(a) 11.2 L (b) 2.24 L

(c) 0.224 L (d) 22.4 L

AP EAPCET 23-08-2021 Shift-I

Ans. (c) : $CH_3COOH + NaOH \rightarrow CH_3COONa + H_2O$

Number of moles of sodium acetate

$$= \frac{100\,\text{ml}}{1000\,\text{ml/lit}}\times0.2\,\text{mol/lit} = 0.02 \text{ moles}$$

$$2CH_3COONa \xrightarrow[\text{electrolysis}]{\text{hydrolysis}} CH_3-H_3+2CO_2+2NaOH+H_2\uparrow$$

Number of moles of ethane are one half the number of moles of sodium acetate(CH_3COONa).

$$\text{No. of moles of ethane} = \frac{0.02}{2} = 0.01 \text{ moles.}$$

At STP, 1 mole of ethane occupies = 22.4 liter.

0.01 mole of ethane =?

0.01×22.4= 0.224 liter.

199. The number of sodium ions present in 0.5 mole of sodium ferrocyanide is

(a) 2×10^{23} (b) 0.5×10^{23}

(c) 12×10^{23} (d) 4×10^{23}

TS-EAMCET (Engg.), 05.08.2021 Shift-II

Ans. (c) : Formula of sodium ferrocyanide $Na_4[Fe(CN)_6]$ contains 4 Na atoms.

Number of Na atoms = Number of moles × Number of atom per molecule × Avogadro number

$= 0.5\times4\times6.023\times10^{23}$

$= 12.046\times10^{23}$

$\approx 12\times10^{23}$

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200. 56 g of CaO has been mixed with 63 g of HNO_3, the amount of $Ca(NO_3)_2$ formed is
$Ca(NO_3)_2$ 63g$HNO_3$56gCaO

(a) 4g (b) 8.28g
(c) 164 g (d) 82 g

TS-EAMCET (Engg.), 07.08.2021 Shift-II

Ans. (d) : $\underset{\text{Calcium oxide}}{CaO} + \underset{\text{Nitric acid}}{2HNO_3} \rightarrow \underset{\text{Calcium nitrate}}{Ca(NO_3)_2} + H_2O$

Molar mass of CaO = 56 gm/mol
Molar mass of HNO_3 = 63 gm/mol
Molar mass of $Ca(NO_3)_2$ = 164 gm/mol
Molar mass of H_2O = 18 gm/mol
∵ 126 gm Nitric acid forms = 164 gm $Ca(NO_3)_2$

$$\therefore 1 \text{ gm Nitric acid forms} = \frac{164}{126} \text{gm} Ca(NO_3)_2$$

$$\therefore 63\text{gm Nitric acid forms} = 63 \times \frac{164}{126} \text{gm} Ca(NO_3)_2$$

$= 82$ gm $Ca(NO_3)_2$

201. When 35 mL of 0.15 M lead nitrate solution is mised with 20 mL of 0.12 M chromic sulphate solution,-------$\times 10^{-5}$ moles of lead sulphate precipitate out. (Round off to the Nearest Integer).

JEE Main 16.03.2021, Shift-II

Ans. The following reaction take place -

$3Pb(NO_3)_2 + Cr_2(SO_4)_3 \longrightarrow 3PbSO_4 + 2Cr(NO_3)_3$
lead nitrate chromic sulphate lead sulphate chromic nitrate.

Volume of lead nitrate solution = 35mL
concentration of lead nitrate = 0.15M
∴Number of moles of $Pb(NO_3)_2 = 0.15 \times 35 \times 10^{-3}$mol
$= 5.25 \times 10^{-3}$mol
Similarly, number of moles of $Cr_2(SO_4)_3$
$= 0.12 \times 20 \times 10^{-3}$mol
$= 2.4 \times 10^{-3}$mol
therefore moles of $PbSO_4$ formed $= 5.25 \times 10^{-3}$
$= 525 \times 10^{-5}$

202. The volume strength (in L) of 3N H_2O_2 is approximately ____

(a) 3 (b) 8
(c) 17 (d) 9

AP EAPCET 24.08.2021 Shift-II

Ans. (c): Given, normality = 3N
Volume strength = ?
∴ We known,
Volume strength = 5.6 × Normality
= 5.6 × 3
= 16.8
Volume strength ≈ 17

203. A cylinder contains a mixture of 5 g of N_2 and 6 g of Ar gases. If the total pressure of the mixture of the gases in the cylinder is 30 bar, then the partial pressure of N_2 gas is ___ (Molecular mass of N_2 = 28 g mol^{-1}. Atomic mass of Ar = 40u)

(a) 16.36 bar (b) 0.545 bar
(c) 30 bar (d) 0.180 bar

AP EAPCET 24.08.2021 Shift-II

Ans. (a) : Given that,
$W_{N_2} = 5$ gm
$W_{A_r} = 6$ gm

$$n_{N_2} = \frac{\text{weight}}{\text{m. weight}} = \frac{5}{28} = 0.18$$

$$n_{A_r} = \frac{\text{weight}}{\text{m. weight}} = \frac{6}{40} = 0.15$$

$$\text{Mole fraction of } N_2 = \frac{0.18}{0.18+0.15} = 0.5454$$

$\therefore$ Partial pressure of $(P_{N_2}) = X_{N_2} \times P_{total}$
$= 0.5454 \times 30$
$= 16.36$ bar

204. The molal elevation constant is the ratio of Elevation in boiling point to ——

(a) Molarity
(b) Molality
(c) Mole fraction of solute
(d) Mole fraction of solvent

AP EAPCET 19-08-2021 Shift-I

Ans. (b): Due to solute presence in the solution the solution's boiling point is greater than the pure solvents boiling point. This is called as deviation in boiling point and it can be represented as-

$\Delta T_b = K_b \times$ molality

or $K_b = \dfrac{\Delta T_b}{\text{molality}}$

205. When 10 g of copper and 10 g of iodine are mixed, calculate the theorctical yield of CuI according to the equation,

$2Cu + I_2 \rightarrow 2CuI$

(a) 30 g (b) 10 g
(c) 15 g (d) 20 g

AP EAMCET (Engg.) 21.09.2020, Shift-II

Ans. (c) : I_2 is limiting reagent,
mole of I_2 = mole of CuI

$$\text{Mole of CuI} = \frac{10}{127}$$

$$\text{Mass of CuI} = \frac{10}{127} \times 190.5 = 15\text{g}$$

Hence, the correct option is (c).

206. One mole of oxygen gas at STP is equal to

(a) 6.022×10^{23} molecules of oxygen
(b) 6.022×10^{23} atoms of oxygen
(c) 16 g of oxygen
(d) 32 g of oxygen

AP EAMCET (Engg.) 17.09.2020 Shift-I

Ans. (a) : 1 mole of $O_2(g)$ at STP contains Avogadro number ($N_a = 6.022 \times 10^{23}$ mol^{-1}) of O_2 molecules, which will occupy its molar volume, i.e, 22.4 L.

207. Which of the following units is useful in relating concentration of solution with its vapour pressure ?

(a) Mole fraction (b) Parts per million
(c) Mass percentage (d) Molality

AP EAMCET (Engg.) 21.09.2020, Shift-I

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Ans. (a) : According to Raoult's law, relative lowering of vapour pressure is directly proportional to mole fraction of solute. So, mole fraction is used in relating concentration of solution with its vapour pressure.

Raoult's law Can be expressed as;

$$\frac{P^0 - P_s}{P^0} = \frac{n_2}{n_1 + n_2} = x_2$$

Where, x_2= Mole fraction of solute

n_1= Moles of solvent

n_2= Moles of solute

p_s= Vapour pressure of the solution

p^0= Vapour pressure of pure solvent

208. Calculate the energy required to convert all atoms 4.8 g of Mg to Mg^{2+} in the vapour state. IE_1 and IE_2 of Mg are 740 kJ/mol and 1450 kJ/mol respectively.

(a) + 740 kJ/mol (b) –740 kJ/mol

(c) –1450 kJ/mol (d) +438 kJ/mol

AP EAMCET (Engg.) 21.09.2020, Shift-I

Ans. (d) : For 1 mole of $(Mg \rightarrow Mg^{2+})$ $1E = 1E_1 + 1E_2$ = (740 + 1450) = 2190 kJ/mol. Number of mole in 4.8g of Mg = 4.8/24 = 0.2 mol.

For 1 mole energy required = 2190 kJ/mol.

For 0.2 mole energy required = 2190 0 × 0.2 = 438 kJ.

Thus, for 4.8 g of Mg to Mg^{2+} conversion, energy required is 438 kJ. Hence, the correct option is (d).

209. An excess of $AgNO_3$ is added to 100 mL of 0.01 M solution of dichlorotetraaquachromium (III) chloride. The number of moles of AgCl precipitated would be

(a) 0.001 (b) 0.002

(c) 0.003 (d) 0.01

Assam CEE-2020

Ans. (a): Molecular formula of dichlorotetraaqua chromium (III)

chloride is $[Cr(H_2O)_4 Cl_2] Cl$.

On ionisation it generate only one Cl^- ion

$$[Cr(H_2O)_4Cl_2]Cl \xrightarrow{\text{exces } AgNO_3} [Cr(H_2O)_4Cl_2]^+ + AgCl\downarrow$$

$$\text{Using formula, molarity} = \frac{\text{No. of moles}}{\text{Volume}} \times 1000$$

$$0.01 = \frac{\text{No. of moles}}{100} \times 1000$$

No. of moles of AgCl = 0.001 mol AgCl

210. The volume (in mL) of 0.1 NaOH required to neutralise 10mL of 0.1 N phophonic acid is …

[JEE Main 2020, 3 Sep Shift-II]

Ans. $H_3PO_2 + NaOH \rightarrow NaH_2PO_2 + H_2O$

$$\frac{\text{Moles of } H_3PO_2 \text{ reacted}}{1} = \frac{\text{Moles of NaOH reacted}}{1}$$

$$\frac{0.1 \times 10}{1} = 0.1 \times V_{NaOH}$$

$$V_{NaOH} = 10 \text{ ml}$$

211. The mass of ammonia in grams produced when 2.8 kg of dinitrogen quantitatively reacts with 1 kg of dihydrogen is…..

[JEE Main 2020, 4 Sep Shift-I]

Ans. $N_2(g) + 3H_2(g) \rightarrow 2NH_3(g)$

$$\text{Number of moles of } N_2 = \frac{2.8 \times 10^3}{28} = 100$$

$$\text{Number of moles of } H_2 = \frac{1000}{2} = 500$$

∴ Number of moles of NH_3 produced = 2 × 100

= 200

Mass of NH_3 Produced = 200 × 17 = 3400 gm

212. The volume, in mL, of 0.02 M $K_2Cr_2O_7$ solution required to react with 0.288 g of ferrous oxalate in acidic medium is…….

(Molar mass of Fe = 56 g mol^{-1})

[JEE Main 2020, 5 Sep Shift-II]

Ans. $K_2Cr_2O_7 + FeC_2O_4 \rightarrow Cr^{+3} + Fe^{+3} + CO_2$

n_{factor} of $K_2Cr_2O_7 = 3 \times 2 = 6$

n_{factor} of $FeC_2O_4 = 1 + 2 = 3$

$$\frac{0.02 \times 6 \times V(mL)}{1000} = \frac{0.288}{144} \times 3$$

$$V = 50 \text{ mL}$$

213. The volume (in mL) of 0.125 M $AgNO_3$ required to quantitatively precipitate chloride ions in 0.3 g of $[Co(NH_3)_6]Cl_3$ is…….

$$M_{[co(NH_3)_6]Cl_3} = 267.46 g/mol$$

$$M_{AgNO_3} = 169.87 g/mol$$

[JEE Main 2020, 8 Jan Shift-I]

Ans. $[CO(NH_3)_6]Cl_3 + 3AgNO_3 \rightarrow 3AgCl_3$

0.3 gm v ml, 0.125m

$$\frac{\text{wt.}}{\text{mol.wt.}} \times (\text{n} - \text{factor}) = \text{Molarity} \times \text{volume}$$

$$\frac{0.3}{267.46} \times 3 = 0.125 \times v \times 10^{-3}$$

$$v = \frac{0.3 \times 3 \times 1000}{267.46 \times 0.125} = 26.92 \text{ mL}$$

214. $NaClO_3$ is used, even in spacecrafts, to produce O_2. The daily consumption of pure O_2 by a person is 492 L at 1 atm 300 K. How much amount of $NaClO_3$ in grams, is required to produce O_2 for the daily consumption of a person at 1 atm, 300 K……?

$NaClO_3(s) + Fe(s) \rightarrow O_2(g) + NaCl(s) + FeO(s)$

R = 0.082 L atm mol^{-1} K^{-1}

[JEE Main 2020, 8 Jan Shift-II]

Ans.

$$NaClO_{3(S)} + Fe_{(s)} \rightarrow O_{2(g)} + NaCl_{(s)} + FeO(s)$$

Moles of $NaClO_3$ = moles of O_2

$$\text{Moles of } O_2 = \frac{PV}{RT} = \frac{1 \times 492}{0.082 \times 300}$$

= 20 mol

Molar mass of $NaClO_3$ = 23 + 35.5 + 3 × 16

= 106.5 g

Mass of $NaClO_3$ = 20 × 106.5 = 2130 g

@apna_pdf

215. Ferrous sulfate heptahydrate is used to fortify foods with iron. The amount (in grams) of the salt required to achieve 10 ppm of iron in 100 kg of wheat is….. .
Atomic weight : Fe = 55.85; S=32.00, O=16.00
[JEE Main 2020, 8 Jan Shift-I]

Ans. $FeSO_4.\ 7H_2O$ (m = 277.85)

$$PPM = \frac{\text{Mass of iron}}{\text{Mass of wheat}}\times10^6$$

$$\Rightarrow 10 = \frac{\text{Mass of iron}}{100\times10^3}\times10^6$$

⇒ Mass of iron = 1 gm

Molecular mass of $FeSO_4\ 7H_2O$ is 277.85

55.85 gm iron is present in 277.85 gm of salt

$$1 \text{ gm iron is present in} = \frac{277.85}{55.85} = 4.97 \text{ gm of salt}$$

216. Which one of the following will have the largest number of atoms?

(a) 1g Au(s)
(b) 1g Na(s)
(c) 1g Li(s)
(d) 1g of Cl_2(g)
(e) 1g of O_2(g)

Kerala-CEE-2020

Ans. (c) : $\text{No. of moles} = \dfrac{\text{weight in gram}}{\text{molecular weight}}$

(i) 1 g Au (s) $= \dfrac{1}{197}$ mol atom of Au

$= \dfrac{1}{197}\times6.022\times10^{23}$
$= 0.005076 \times 6.022 \times 10^{23}$
$= 0.005076 \times 6.0 \times 10^{23}$
$\approx 0.0305 \times 10^{23} = 3.05\times10^{21}$

(ii) 1 g Na (s) $= \dfrac{1}{23}$ mol atom of Na

$= \dfrac{1}{23}\times6.022\times10^{23}$
$= 0.0434 \times 6.022 \times 10^{23}$
$= 0.26 \times 10^{23} = 2.6\times10^{22}$

(iii) 1 g Li (s) $= \dfrac{1}{7}$ mol atom of Li

$= \dfrac{1}{7}\times6.022\times10^{23}$
$= 0.1428 \times 6.022 \times 10^{23}$
$= 0.860 \times 10^{23} = 8.61\times10^{22}$

(iv) 1 g Cl_2 (g) $= \dfrac{1}{71}$ mol atom of Cl_2

$= \dfrac{1}{71}\times6.022\times10^{23} = 8.48\times10^{21}$

(v) 1 g O_2 (g) $= \dfrac{1}{32}$ mol atom of O_2

$= \dfrac{1}{32}\times6.022\times10^{23} = 1.188\times10^{22}$

So, 1 g Li(s) has the largest no, of atoms.

217. Which one of the following has maximum number of atoms?

(a) 1 g of $Ag_{(s)}$ [Atomic mass of Ag = 108]
(b) 1 g of $Mg_{(s)}$ [Atomic mass of Mg = 24]
(c) 1 g of $O_{2(s)}$ [Atomic mass of O = 16]
(d) 1 g of $Li_{(s)}$ [Atomic mass of Li = 7]

NEET-2020

Ans. (d):

Number of atoms in 1g of Li $= \dfrac{1}{7}\times N_A$

$= \dfrac{1}{7}\times6.023\times10^{23}$
$= 0.86\times10^{23}$

Number of atoms in 1g of Ag $= \dfrac{1}{108}\times N_A$
$= 0.056\times10^{23}$

Number of atoms in 1g of Mg $= \dfrac{1}{24}\times N_A$
$= 0.25\times10^{23}$

Number of atoms in 1g of O_2 $= \dfrac{1}{32}\times N_A\times2$
$= \dfrac{N_A}{16} = 0.37\times10^{23}$

Max. number of atoms are present in 1g of Li.

218. $2KHCO_3 \rightarrow$ …+ CO_2 + H_2O find amount of gases formed (in lit).
When amount of $KHCO_3$ is 33 gm.

(a) 5.6
(b) 11.2
(c) 7.39
(d) 22.4

JIPMER-2019

Ans. (c) :

$$\underset{n=\frac{33}{100}}{2KHCO_3(s)} \longrightarrow \underset{0.165}{K_2CO_3(s)} + \underset{0.166}{CO_2(g)} + H_2O$$

Total moles of gas (0.165 + 0.165) mol
Total volume of gas = 0.33 × 22.4 L
= 7.39 L

219. The mass of AgCl precipitated when a solution containing 11.70g of NaCl is added to a solution containing 3.4 g of $AgNO_3$ is
[Atomic mass of Ag = 108, Atomic mass of Na = 23]

(a) 5.74g
(b) 1.17g
(c) 2.87g
(d) 6.8 g

Karnataka-CET-2019

Ans. (c):

$$\begin{array}{lccccc} & NaCl + & AgNO_3 & \longrightarrow & NaNO_3 + & AgCl \\ \text{m.wt.}\Rightarrow & 58.5g & 170g & & 85g & 143.5g \\ \text{G.wf.}\Rightarrow & 11.72g & 3.4g & & & \end{array}$$

170g $AgNO_3$ will give 143.5g AgCl
Then, 3.4 g $AgNO_3$ will give x g AgCl

$$x = \frac{3.4\times143.5}{170}$$

$$x = 2.87\,g$$

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220. 0.1 mole of XeF_6 is treated with 1.8 g of water. The product obtained is

(a) XeO_3 (b) XeO_2F_2

(c) $XeOF_4$ (d) $Xe + XeO_3$

Karnataka-CET-2019

Ans. (c) : When 0.1 mole of XeF_6 is treated with 1.8 g of water. The product obtained is XeF_4

∴ moles of water = $\frac{\text{Given mass of water}}{\text{molecular mass}} = \frac{1.8}{18} = 0.1\text{mole}$

When 0.1 mole of XeF_6 react with 0.1 mole of H_2O then $XeOF_4$ and HF are formed

reaction involved as follows:

$$XeF_6 + H_2O \rightarrow XeOF_4 + 2HF$$

221. The number of moles of electron required to reduce 0.2 mole of $Cr_2O_7^{-2}$ to Cr^{+3} is

(a) 1.2 (b) 6

(c) 12 (d) 0.6

Karnataka-CET-2019

Ans. (a) : From given reaction:-

$$\overset{+6}{Cr_2}O_7^{2-} \rightarrow 2Cr^{+3}$$

1 mole required 6 mole of electrons 0.2 mole requires

$\frac{0.2 \times 6}{1}$ =1.2 mole of electrons.

222. In a lead-acid battery, if 1 A current is passed to charge the battery for 1 h, what is the amount of $PbSO_4$ converted to PbO_2? (Given data: 1F = 96500 C mol^{-1})

(a) 0.0373 moles (b) 0.0186 moles

(c) 0.0093 moles (d) 0.0268 moles

(e) 0.0400 moles

Kerala-CEE-2019

Ans. (b) : Given,

i = 1A, T = 1h = 60 × 60 = 3600sec

Charge = 1 × 3600 = 3600 C

$PbSO_4 + 2e^- \times PbO_2$

$$\text{Moles} = \frac{\text{Charge}}{2 \times 96500}$$

$$= \frac{3600}{193000}$$

= 0.0186 moles.

223. On passing silent electric discharge through oxygen in an ozonizer, 5.5 mol% of oxygen is converted to ozone. How many moles of O_2 and O_3 result when 35 moles of O_2 is originally present?

(a) 33.0 (b) 34.4

(c) 35.0 (d) 31.8

(e) 31.0

Kerala-CEE-2019

Ans. (b) : Given, 5.5 mol% of O_2 is converted into O_3.

$$\therefore 35 - \frac{35 \times 5.5}{100} \text{ moles of } O_2$$

$$= \frac{35 \times 5.5}{100} \times \frac{2}{3} \text{ mole of } O_3$$

33.05 moles of O_2 = 1.28 moles of O_3

Thus the total no. of moles present originally was

= 33.05 of O_2 + 1.28 of O_3

= 34.4 moles.

224. In a mixture of 1 g H_2 and 8 g O_2 the mole fraction of hydrogen is :

(a) 0.667 (b) 0.5

(c) 0.33 (d) None of the above

Manipal-2019

Ans. (a) :

- No. of moles of $H_2 = \frac{1}{2} = 0.5$
- No. of moles of $O_2 = \frac{8}{32} = 0.25$
- Total moles of H_2 and O_2 = 0.5 + 0.25 = 0.75
- Mole fraction of $H_2 = \frac{\text{No.of mass of } H_2}{\text{Total moles}}$
- $= \frac{0.50}{0.75} = 0.667$

225. Two electrolytic cells are connected in series containing $CuSO_4$ solution and molten $AlCl_3$. If in electrolysis 0.4 moles of 'Cu' are deposited on cathode of first cell. The number of moles of 'Al' deposited on cathode of the second cell is

(a) 0.6 moles (b) 0.27 moles

(c) 0.18 moles (d) 0.4 moles

MHT CET-02.05.2019, Shift-III

Ans. (b) : Given,

Number of moles of Cu deposited = 0.4 moles

According to Faraday's second law.

$$\frac{\text{Weight of Cu deposited}}{\text{Weigth of Al deposited}} = \frac{E_4 \text{ wt.of Cu}}{E_4 \text{ wt.of Al}} --- (i)$$

$$\because \quad \text{No. of moles} = \frac{\text{weight}}{\text{molecular weight}}$$

$$\therefore \quad \text{weight of Cu} = 0.4 \times 63.5$$

Now, from E_q (i), $\frac{0.4 \times 63.5}{\text{weight fo Al deposited}} = \frac{\frac{63.5}{2}}{\frac{27}{3}}$

$$\therefore \text{ weight of Al deposited} = \frac{0.4 \times 63.5 \times 9}{31.75} = 7.2\text{g}$$

Number of moles of Al deposited = $\frac{7.2}{27} = 0.27\text{moles}$

226. A cold drink bottle contains 200 mL liquid, in which CO_2 is 0.1 molar. Considering CO_2 as an ideal gas the volume of the dissolved CO_2 at S.T.P is

(a) 22.4 L (b) 0.224 L

(c) 2.24 L (d) 0.448 L

MHT CET-02.05.2019, Shift-III

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Ans. (d) : Number of moles of CO_2 in 200 ml solution

$= \text{molarity} \times \text{volume (in L)}$

$$= 0.1 \times \frac{200}{1000} = 0.02$$

volume of 0.02 mole of CO_2 at STP $= 22.4 \times 0.02$

$= 0.448$ L

227. How many gram of sodium (atomic mass 23 u) is required to prepare one mole of ethane from methyl chloride by Wurtz reaction?

(a) 2 (b) 23

(c) 11.5 (d) 46

MHT CET-02.05.2019, Shift-II

Ans. (d): Wurtz reaction–

$$2CH_3Cl + 2Na \xrightarrow{\text{Dry ether}} \underset{\text{Ethane}}{CH_3 - CH_3} + 2NaCl$$

⇒2 moles of sodium metal reacts to give 1 mole of ethane.

weight of 2 moles of Na = 23 × 2 = 46 g

228. The volume of 1 mole of any pure gas at standard temperature and pressure is always equal to

(a) 0.022414 m^3 (b) 22.414 m^3

(c) 2.2414 m^3 (d) 0.22414 m^3

MHT CET-02.05.2019, Shift-II

Ans. (a) : The volume of 1 mole of any pure gas at standard temp. and pressure (STP) is equal to 22.414 L

$1\text{L} = 0.001\text{m}^3$

$\therefore$ 22.414 L $= 0.022414 \text{ m}^3$

229. Which of the following gases has the density 1.8 gm/lit at 27 °C temperature and 760 Torr pressure?

(a) O_2 (b) CO_2

(c) NH_3 (d) SO_2

Tripura JEE-2019

Ans. (b) : Given,

$$P = 760 \text{ Torr} = \frac{760}{760} = 1\text{atm}$$

$T = 27^\circ\text{C} = 27 + 273 = 300$ K

d = 1.8 g/L

$$PV = \frac{m}{M}RT$$

$$M = \frac{mRT}{VP} \Rightarrow M = \frac{dRT}{P}$$

$$M = \frac{1.8 \times 0.0821 \times 300}{1}$$

$$M = 44\text{g/mole}$$

Molar mass of gas = 44g/mole

So, gas is CO_2 molar mass 44 g/mole.

230. 20 gm of a metal produces 0.504 gm H_2(g) on reaction with dilute H_2SO_4. Calculate the receivable amount of metal oxide from 2 gm of same metal.

(a) 2.4gm (b) 2.2gm

(c) 2.8gm (d) 2.6gm

Tripura JEE-2019

Ans. (a) : Given,

0.504g of H_2 is liberated by 20g of the metal

So, 1.008g H_2 is liberated by $\dfrac{20 \times 1.008}{0.504}$

= 40g of the metal.

40g metal combines with 8g of oxygen

So, 2.0g of metal combines with $= \dfrac{8 \times 2}{40}$g

= 0.4g of oxygen

Amount of metal oxide = Mass of metal + Mass of oxygen = (2.0 + 0.4) = 2.4 g

231. At S.T.P. the volume of 7.5 g of a gas is 5.6L. The gas is

(a) NO (b) N_2O

(c) CO (d) CO_2

WB-JEE-2019

Ans. (a) : We know,

22.4 L volume of S.T.P. contain 1 mole

Then, 5.6 L volume at S.T.P contain

$$= \frac{1}{22.4} \times 5.6 = 0.25\text{mole}$$

And,

$$\text{No. of mole} = \frac{\text{Mass}}{\text{Molecular weight}}$$

$$\text{Molecular weight} = \frac{7.5}{0.25} = 30$$

From the given option NO has molecular weight 30. Hence, correct option is 'a'

232. 1.2 g of Mg is treated with 100mL of 1M H_2SO_4. Molar concentration of the H_2SO_4 solution after complete reaction will be

(a) 0.20 M (b) 0.005 M

(c) 0.10 M (d) 0.5 M

CG PET -2019

Ans. (d) : $Mg + H_2SO_4 \rightarrow MgSO_4 + H_2$

24g (98g = 1 mol)

1.2g Mg reacts with = 0.5 mol H_2SO_4

H_2SO_4 taken = 100 mL of 1 M H_2SO_4

= 0.1 mol

H_2SO_4 left = 0.1 – 0.05

= 0.05 mol in 100 mL solution

$[H_2SO_4] = 0.05 \times 10 = 0.5$ M

233. The volume of ' 10 vol' of H_2O_2 required to liberate 500mL O_2 at NTP is

(a) 125mL (b) 500mL

(c) 50mL (d) 100mL

CG PET -2019

Ans. (c) : 10 vol of H_2O_2 means that

10 L O_2 can be liberated from 1 L H_2O_2

1 L O_2 liberated from $\dfrac{1}{10}$L H_2O_2

500 mL O_2 liberated from $= \dfrac{500}{10}$mL H_2O_2

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$= 50$ mL H_2O_2

10 vol. H_2O_2 means that 1 mL H_2O_2 gives 10 mL O_2.

Thus, 50 mL H_2O_2 will give 500 mL O_2.

234. The volume strength of 1 M H_2O_2 is (Molar mass of H_2O_2 = 34 g mol^{-1})

(a) 16.8 (b) 22.4

(c) 11.35 (d) 5.6

[JEE Main-2019, 12 Jan Shift-II]

Ans. (c) : The balanced reaction

$$2H_2O_2 \rightarrow 2H_2O + O_2$$

$$-1 \qquad -2 \qquad 0\,(\text{Oxidation state of O})$$

2 moles of H_2O_2 give 1 mole of O_2

1 mole of H_2O_2 will give 11.2L of O_2 gas

Volume strength of H_2O_2 = 11.2 × molarity

For 1 M H_2O_2 volume strength is 11. 2 L.

235. A solution of $Ni(NO_3)_2$ is electrolysed between platinum electrodes using 0.1 Faraday electricity. How many moles of Ni will be deposited at the cathode?

(a) 0.20 (b) 0.10

(c) 0.15 (d) 0.05

[JEE Main 2019, 9 April Shift-II]

Ans. (d) : $Ni(NO_3)_2 \rightarrow Ni^{2+} + 2NO_3^-$

$$Ni^{2+} + 2e^- \rightarrow Ni$$

2. eq. of Ni^{2+} will be discharged from 2F

0.1 eq. of Ni^{2+} will be discharged from 0.1 F

No. of eq. = No of moles × (n – factor)

0.1 = No. of moles × 2

No. of moles of Ni = $\frac{0.1}{2} = 0.05\,\text{mol.}$

236. In order to oxidise a mixture of one mole of each of FeC_2O_4, $Fe_2(C_2O_4)_3$, $FeSO_4$ and $Fe_2(SO_4)_3$ in acidic medium, the number of moles of $KMnO_4$ required is

(a) 2 (b) 1

(c) 3 (d) 1.5

[JEE Main 2019, 8 April Shift-I]

Ans. (a) :

$FeC_2O_4 + KMnO_4 \rightarrow Fe^{3+} + CO_2 + Mn^{2+}$

v.f. = 3 v.f = 5

1× 3 = mole × 5

Mole = $\frac{3}{5}$

$Fe_2(C_2O_4)_3 + KMnO_4 \rightarrow Fe^{3+} + CO_2 + Mn^{2+}$

v.f. = 6 v.f = 5

1× 6 = mole × 5

Mole = $\frac{6}{5}$

$FeSO_4 + KMnO_4 \rightarrow Fe^{3+} + SO_4^{2-} + Mn^{2+}$

v.f. = 1 v.f = 5

1× 1 = mole × 5

Mole = $\frac{1}{5}$

$Fe(SO_4)_3$ doesn't oxidize

Total moles of $KMnO_4$ = $\frac{3}{5} + \frac{6}{5} + \frac{1}{5} = 2$

237. In the reaction of oxalate with permanganate in acidic medium, the number of electrons involved in producing one molecule of CO_2 is

(a) 2 (b) 5

(c) 1 (d) 10

[JEE Main 2019, 10 Jan Shift-II]

Ans. (c) : As given in question, Reaction of oxalate with permanganate in acidic medium

$5C_2O_4^{2-} + 2MnO_4^- \rightarrow 10CO_2 + 2Mn^{2+} + 8H$

N factor (4 – 3) × 2 = 2 – (7–2) = 5

$5C_2O_4^{2-}$ ions transfer $10e^-$ to produce to molecules of CO_2

So, number of electron involved in producing 10 molecule of CO_2 is 10.

Thus, number of electron involed in producing 1 molecules of CO_2 is 1.

238. For the following reaction , the mass of water produced from 445 g of $C_{57}H_{110}O_6$ is :

$2C_{57}H_{110}O_6(s) + 163O_2(g) \rightarrow 114CO_2(g) + 110H_2O(l)$

(a) 490 g (b) 495 g

(c) 445 g (d) 890 g

[JEE Main 2019, 10 Jan Shift-II]

Ans. (b) : Given equation

$2C_{57}H_{110}O_6(s) + 163O_2(g) \rightarrow 114CO_2(g) + 110H_2O(l)$

Moles of $C_{57}H_{110}O_6(s) = \frac{445}{890} = 0.5$ moles

$$2C_{57}H_{110}O_6(s) + 163O_2 \rightarrow 114CO_2(g) + 110H_2O(I)$$

$$nH_2O = \frac{110}{4} = \frac{55}{2}$$

No. of moles of H_2O = $\frac{\text{given mass}}{\text{molar mass}}$

Given mass = No. of moles × molar mass

$= \frac{55}{2} \times 18$

= 495 g

239. 5 moles of AB_2 weight 125×10^{-3} kg and 10 moles of A_2B_2 weight 300×10^{-3} kg. The molar mass of $A(M_A)$ and molar mass of $B(M_B)$ in kg mol^{-1} are

(a) $M_A = 10 \times 10^{-3}$ and $M_B = 5 \times 10^{-3}$

(b) $M_A = 50 \times 10^{-3}$ and $M_B = 25 \times 10^{-3}$

(c) $M_A = 25 \times 10^{-3}$ and $M_B = 50 \times 10^{-3}$

(d) $M_A = 5 \times 10^{-3}$ and $M_B = 10 \times 10^{-3}$

[JEE Main 2019,12 April Shift-I]

Ans. (d) : 5 moles of AB_2 weight 125 g

$$= \frac{\text{weight in g}}{\text{number of moles}} = \frac{125}{5} = 25$$

∴ AB_2 = 25 g/mol

$$5 = \frac{125}{M_A + 2M_B}$$

$M_A + 2M_B = 25$

10 mole of A_2B_2 weight 300 g

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$$= \frac{\text{weight in g}}{\text{number of moles}} = \frac{300}{10} = 30$$

$\therefore A_2B_2 = 30 \text{ g / mole}$

$$10 = \frac{300}{2M_A + 2M_B}$$

$2M_A + 2M_B = 30$

$\therefore$ Molar mass of A, $(M_A) = 5$ g or 5×10^{-3}kg

$\therefore$ Molar mass of B, $(M_B) = 10$ g or 10×10^{-3}kg

240. Total number of atoms in 44 g of CO_2 is

(a) 6.02×10^{23} (b) 6.02×10^{24}

(c) 1.806×10^{24} (d) 18.06×10^{22}

J & K CET-(2019)

Ans. (c) : 44 gram CO_2 mean 44/44 = 1 mole of the CO_2.

1 mole CO_2 implies total of 6.022×10^{23} molecules of CO_2. 1 molecules of CO_2 has 3 atoms.

Therefore total atoms in 44 grams of CO_2 has $(6.022\times10^{23}) \times 3 = 18.066 \times 10^{23}$ atoms $= 1.806 \times 10^{24}$ atoms

241. The amount of water (g) produced by the combustion of 32 g of methane is

(a) 18 g (b) 36 g

(c) 54 g (d) 72 g

Assam CEE-2019

Ans. (d) : $CH_4(g) + 2O_2 \rightarrow CO_2 + 2H_2O$

As per stoichiometric equation, 16 g of methane produces 36 g of H_2O

$$\therefore 32 \text{ g of methane will produce} = \frac{36}{16} \times 32 = 72 \text{ g } H_2O.$$

242. Which one of the following is the lightest?

(a) 0.2 mole of hydrogen gas

(b) 6.023×10^{22} molecules of nitrogen

(c) 0.1 g of silver

(d) 0.1 mole of oxygen gas

AIIMS 25 May 2019 (Evening)

Ans. (c):

$$\text{(a) Moles} = \frac{\text{Weight}}{\text{Molecular weight}}$$

Weight of H_2 = mole × molecular wt.

$= 0.2 \times 2 = 0.4$ g

(b) 6.023×10^{23} represents 1 mole

Thus 6.023×10^{22} will represent 0.1 mole

Weight of $N_2 = 0.1 \times 28 = 2.8$ g

(c) Weight of Silver = 0.1 g

(d) Weight of oxygen = $32 \times 0.1 = 3.2$ g

Thus from the above, silver is lightest.

243. Calculate molarity of a 63% w/w HNO_3 solution if density is 1.4g/mL:

(a) 14 M (b) 12 M

(c) 10 M (d) 8 M

AIIMS 26 May 2019 (Evening)

Ans. (a):

HNO_3 solution = 63 % w/w

Density = 1.4 g / mL

$$\text{Molarity} = \frac{\% \text{ w/w} \times d \times 10}{M_{\text{Solute}}}$$

$$M = \frac{63 \times 1.4 \times 10}{63} = 14 \text{M}$$

244. Haemoglobin contains 0.33% of iron by weight. The molecular weight of haemoglobin is approximately 67200. The number of iron atoms (at. Wt. of Fe= 56) present in one molecule of haemoglobin is

(a) 6 (b) 1

(c) 2 (d) 4

AIIMS-27 May, 2018 (E)

Ans. (d) : Given,

% of Iron = 0.334 %

Molecular weight of the haemoglobin = 67200 g / mol

Weight of the Iron = 56 g

The number of iron atoms =

$$\frac{\text{Molecular Weight of haemoglobin} \times \% \text{ of iron}}{100 \times \text{Atomic weight of Iron}}$$

$$= \frac{67200 \times 0.334}{100 \times 56} = 4$$

245. 100 mL brandy contains 40 mL ethanol. The mole fraction of water is

(a) 0.6 (b) 0.667

(c) 0.26 (d) 0.425

CG PET -2018

Ans. (a) : Volume of water = 100 – 40 = 60 mL and

Volume fraction $\propto$ mole fraction

$$\text{Volume fraction of water} = \frac{\text{Volume of water}}{\text{Total volume}}$$

$$= \frac{60}{100} = 0.6$$

246. If 0.05g of urea is dissolved in 5 g of water, then

(a) Its molarity will be greater than molality

(b) Its molality will be greater than molarity

(c) Molarity and molality will be same

(d) Its normality will be 50/60

CG PET -2018

$$\textbf{Ans. (b) :} \text{ Molarity} = \frac{\text{Number of moles of solute}}{\text{Volume of solution (in L)}}$$

$$\text{And Molality} = \frac{\text{Number of moles of solute}}{\text{Mass of solution (in kg)}}$$

$\therefore$Mass of solute (urea) and solvent (water) remain in changed, during the calculations of molarity and molality.

Then volume of solution and contain water molecules.

($\therefore$ In case of volume of solution, it has both solute and solvent)

Thus, molality will be greater than that of molarity.

@apna_pdf

247. How many grams of Cl_2 gas will be obtained by the complete reaction of 31.6 gm of potassium permanganate with hydrochloric acid?
[Mole mass of $KMnO_4$ = 316 gm/mol]

(a) 71 (b) 17.75
(c) 35.5 (d) 142

GUJCET-2018

Ans. (b) :
$$2KMnO_4 + 16HCL \rightarrow 2KCl + 2MnCl_2 + 8H_2O + 5Cl_2$$
Moles of 31.6 gm of potassium permanganate
$$= \frac{31.6\,gm}{316\,gm/mol} = 0.1 \text{ mole}$$
0.1 moles of potassium permanganate will give
$$\frac{5}{2} \times 0.1 = 0.250 \text{ moles of chlorine.}$$
The molar mass of Cl_2 = 71 g/mole
The mass of Cl_2 = 71 g/mole × 0.250 mol = 17.75 g

248. Two solutions NaCl and CH_3COOH are prepared separately. The molarity of both is 0.1 m and osmotic pressure p_1 and p_2 respectively. The correct relationship between osmotic pressure is

(a) $p_1 = p_2$ (b) $p_1 > p_2$
(c) $p_2 > p_1$ (d) $p_1 \neq p_2$

JCECE - 2018

Ans. (b) : NaCl is a salt made up of strong acid and strong base that completely dissociates to give 2 ions. As we know osmotic pressure is directly proportional to i (Van't Hoff factor) i.e. $\pi \propto i$. So, $P_1 > P_2$.

249. 1.0 g of Mg is burnt with 0.28 g of O_2 in a closed vessel. Which reactant is left in excess and how much?

(a) Mg, 5.8 g (b) Mg, 0.58 g
(c) O_2, 0.24 g (d) O_2, 2.4 g

Karnataka-CET-2018

Ans. (b) : The burning of Mg occurs as follows:
$2Mg + O_2 \rightarrow 2MgO$
Moles 212
Molar mass of Mg = 48g and O_2 = 32g
32 g of oxygen, needs 48 g of Mg
$$0.28 \text{ g of oxygen, needs} = \frac{48 \times 0.28}{32}$$
$$= 0.42\,g \text{ of Mg}$$
Mg left (in excess) = 1– 0.42 = 0.58g

250. Mass % of carbon in ethanol is

(a) 52 (b) 13
(c) 34 (d) 90
(e) 80

Kerala-CEE-2018

Ans. (a) : Molecular mass of C_2H_5OH = 46.00
[Atomic mass of C = 12, H = 1, O = 16]
46.00 of C_2H_5OH is contain, C = 24g
$$\text{Mass \% of Carbon} = \frac{\text{Molar mass of carbon}}{\text{Molar mass of ethanol}} \times 100$$
$$= \frac{24 \times 100}{46}$$
$$= 52.17\% \approx 52\%$$

251. 1.2 g of Mg (at. mass 24) will produce MgO equal to :

(a) 0.05 mol (b) 40 g
(c) 40 mg (d) 4 g

Manipal-2018

Ans. (a) : $Mg + \frac{1}{2}O_2 \rightarrow MgO$
From the above equation
1 mol of Mg reacts to give 1 mol of MgO.
Number of moles of Mg in
$$1.2 \text{ g} = \frac{1 \times 1.2}{24} = 0.05 \text{ mol of Mg}$$
The number of moles of MgO = 0.05 mol

252. The Avogadro number or a mole represents :

(a) 6.02×10^{23} ions
(b) 6.02×10^{23} atoms
(c) 6.02×10^{23} molecules
(d) 6.02×10^{23} entities

HP CET-2018

Ans. (b): Avogadro's number is the number of particles/atom in one mole of any substance.
$N_a = 6.023 \times 10^{23}$ atom.

253. To a 4 L of 0.2 M solution of NaOH 2 L of 0.5 M NaOH are added. The molarity of resulting solution is :

(a) 0.9 M (b) 0.3 M
(c) 1.8 M (d) 0.18 M

Manipal-2018

Ans. (b) : Given,
$M_1 = 0.2$ M ; $V_s = 4$ L
$M_2 = 0.5$ M ; $V_s' = 2$ L
$$M_{total} = \frac{M_1V_s + M_2V_s'}{V_s + V_s'} = \frac{0.2 \times 4 + 0.5 \times 2}{4 + 2}$$
$$= \frac{0.8 + 1.0}{6} = \frac{1.8}{6} = 0.3M$$

254. If 20 g of $CaCO_3$ is treated with 100 mL of 20% HCl solution, the amount of CO_2 produced is :

(a) 22.4 L (b) 8.80 g
(c) 4.40 g (d) 2.24 L

Manipal-2018

Ans. (b) :
$CaCO_3 + 2HCl \rightarrow CaCl + CO_2 + H_2O$
100g 73g 44g
100 mL of 20% HCl solution = 20g HCl
$CaCO_3$ is the limiting reactant 100g of $CaCO_3$ gives 44g CO_2
$$20g\ CaCO_3 \text{ gives } \frac{44}{100} \times 20 = 8.80\,g \text{ of } CO_2.$$

255. A mixture of 2.3 g formic acid and 4.5 g oxalic acid is treated with conc. H_2SO_4. The evolved gaseous mixture is passed through KOH pellets. Weight (in) g of the remaining product at STP will be

(a) 1.4 (b) 3.0
(c) 2.8 (d) 4.4

NEET-2018

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Ans. (c)

$$HCOOH \xrightarrow{H_2SO_4} CO + H_2O \qquad ....(i)$$

$$(COOH)_2 \xrightarrow{H_2SO_4} CO + CO_2 + H_2O \qquad ....(ii)$$

Conc. H_2SO_4 is a strong dehydrating agent

Moles of HCOOH = $\frac{2.3}{46} = 0.05$ mole

Moles of $(COOH)_2$ = $\frac{2.3}{46} = 0.05$ mole

From reaction (i),
Number of CO formed = 0.05 mole
From reaction (ii),
Number of CO formed = 0.05 mole
Number of CO_2 formed = 0.05 mole
Hence, Total CO formed = 0.05 + 0.05 = 0.1 mole
KOH pellets absorbs all CO_2, H_2O absorbed by H_2SO_4 thus CO is remaining product.
Thus the weight of the remaining product = 0.1 × 28 = 2.8g

256. In which case is number of molecules of water maximum?

(a) 18 mL of water
(b) 0.18 g of water
(c) 0.00224 L of water vapours at 1 atm and 273 K
(d) 10^{-3} mol of water

NEET-2018

Ans. (a) : 1 moles of water contain = 6.023×10^{23} atom

(i) Mass of water = 18×1 = 18g (H_2O = 18)
Molecules of water

$$= \text{mole} \times N_A = \frac{18}{18} \times 6.023 \times 10^{23} = 6.023 \times 10^{23}$$

(ii) Molecules of water = mole × N_A

$$= \frac{18}{18} \times 6.023 \times 10^{23}$$
$$= 6.023 \times 10^{21}$$

(iii) Molecules of water = mole × 6.023×10^{23}
$$= 10^{-4} \times 6.023 \times 10^{23}$$
$$= 6.023 \times 10^{-19}$$

(iv) Molecules of water = mole × N_A = $6.023 \times 10^{23} \times 10^{-3}$
$$= 6.023 \times 10^{20}$$

From above, It is clear that 18 mL of water has maximum molecules.

257. One litre of an acidified solution of $KMnO_4$ containing 15.8 g $KMnO_4$ is decolourised by passing sufficient amount of SO_2. If SO_2 is produced by roasting of iron pyrite (FeS_2). The amount of pyrite required to produce the necessary amount of SO_2 will be

(a) 15.8 g FeS_2
(b) 15.0 g FeS_2
(c) 7.5 g FeS_2
(d) 7.9 g FeS_2

UPTU/UPSEE-2018

Ans. (b) $2\,KMnO_4 + 5SO_2 + 2H_2O \rightarrow K_2SO_4 + 2MnSO_4 + 2H_2SO_4$

Molar mass of $KMnO_4$ is 158.034 g/mol

Moles of $KMnO_4$ = $\frac{15.8g}{158.034\,g/mol} = 0.10$ moles

According to given equation, 2 moles of $KMnO_4$ reacts with 5 moles of SO_2

∴ 0.10 moles of $KMnO_4$ will react with $\frac{5}{2} \times 0.10$ moles of SO_2 i.e. 0.25 moles of SO_2

Given, SO_2 is produced by roasting of iron pyrite (FeS_2) as:

$4FeS_2 + 11O_2 \rightarrow 2Fe_2O_3 + 8SO_2$

So, 8 moles of SO_2 will be formed by 4 moles of FeS_2

∴ 0.25 moles of SO_2 will be formed by $\frac{4}{8} \times 0.25$ moles of FeS_2 = 0.125 moles of FeS_2

molecular mass of FeS_2 = 119.98 g mol^{-1}

∴ Amount of FeS_2 required to give necessary SO_2
= 119.98g mol^{-1} × 0.125 mol.
= 14.99g ≈ 15g of FeS_2

258. What will be the correct number of total electrons in 1.6 g methane ?

(a) 6.02×10^{24}
(b) 6.02×10^{23}
(c) 6.02×10^{22}
(d) 9.632×10^{23}

UPTU/UPSEE-2018

Ans. (b): Given mass of methane = 1.6g
Molecular weight of methane = 12 + 4 = 16 g mol^{-1}

Moles of methane $= \frac{\text{Given mass}}{\text{Molecular mass}}$

Moles of Methane = $\frac{1.6}{16} = 0.1$

In one mole there are 6.02×10^{23} atoms
In 0.1 mol there are $0.1 \times 6.02 \times 10^{23}$ atoms
= 6.02×10^{22} atoms
[No. of electron in CH_4 = 6+4=10]
Hence, Total number of electrons = Number of electrons present in CH_4 × atoms present in 0.1 mole
= 10× 6.02×10^{22} = 6.02×10^{23}

259. The heat of neutralisation of a strong base and a strong acid is 13.7 kcal. The heat released when 0.6 mole HCl solution is added to 0.25 mole of NaOH is

(a) 3.425 kcal
(b) 8.22 kcal
(c) 11.645 kcal
(d) 13.7 kcal

WB-JEE-2018

Ans. (a) :

$$\underset{1\,mol}{HCl} + \underset{1\,mol}{NaOH} \longrightarrow NaCl + H_2O$$

$$\Delta H = -13.7\ Kcal$$

According to question,

$$\underset{0.25\,mol}{HCl} + \underset{0.6\,mol}{NaOH} \longrightarrow NaCl + H_2O \qquad ....(i)$$

In equation (i), NaOH acts as a limiting reagent. for 1 mole of NaOH and 1 mole of HCl heat of neutralization = 13.7 kcal.

∴ For 0.25 mole of NaOH and 0.6 mole of HCl, heat of neutralization = 13.7 × 0.25 = 3.425 kcal.

260. How many moles of electrons will weigh one kilogram?

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(a) 6.023×10^{23} (b) $\frac{1}{9.108}\times10^{31}$

(c) $\frac{6.023}{9.108}\times10^{54}$ (d) $\frac{1}{9.108\times6.023}\times10^{8}$

WB-JEE-2018

Ans. (d) : 1 mole of electrons = 6.023×10^{23} electrons
Mass of 1 mole of electrons
$= 6.023\times10^{23}\times9.108\times10^{-31}$ kg

No. of moles of electron in 1 kg $= \frac{10^8}{9.108\times6.023}$ moles of electrons.

Thus, $\frac{1}{9.108\times6.023}\times10^{8}$ moles of electrons will weight one kilogram.

261. The number of molecules of 8 g of oxygen gas at NTP is

(a) 6.022×10^{23} (b) $8\times6.022\times10^{23}$

(c) $\frac{1}{4}\times6.022\times10^{23}$ (d) $\frac{1}{2}\times6.022\times10^{23}$

Assam CEE-2018

Ans. (c) : Mass of Oxygen molecule O_2 = 8g
Molar mass of O_2 = 16 + 16 = 32g

The number of Moles O_2 in 8g of O_2 = $\frac{8}{32}=\frac{1}{4}$
= 0.25 moles

1 mole contains = 6.022×10^{23} number of O_2
Then 0.25 mole will contain

$6.022\times10^{23}\times\frac{1}{4}$

The number of molecules of 8 g of oxygen gas at NTP is $6.022\times10^{23}\times\frac{1}{4}$.

262. The 25 mL of a 0.15 M solution of lead nitrate, $Pb(NO_3)_2$ reacts with all of the aluminium sulphate, $Al_2(SO_4)_3$, present in 20 mL of a solution. What is the molar concentration of the $Al_2(SO_4)_3$?

$$\mathbf{3Pb(NO_3)_2(aq)+Al_2(SO_4)_3(aq)\rightarrow}$$
$$\mathbf{3PbSO_4(s)+2Al(NO_3)_3(aq)}$$

(a) 6.25×10^{-2} M (b) 2.421×10^{-2} M

(c) 0.1875 M (d) None of these

BITSAT-2018

Ans. (a) : Given,
$Al_2(SO_4)_3 + Pb(NO_3)_2 \rightarrow 3PbSO_4 + 2Al(NO_3)_3$
As we know,
Molar mass of $Pb(NO_3)_2$ = Volume × Concentration
= 25 × 0.15
= 3.75 mL M

And Molar mass of $Al_2(SO_4)_3$ $=\frac{1}{3}\times3.75$

Then, $M\times20=\frac{1}{3}\times3.75$

M = 0.0625M
$M = 6.25\times10^{-2}$M

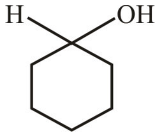
263. How many grams of cyclohexanol is required to produce 20 g cyclohexane, if % yield is 54%?

(a) 88 (b) 66

(c) 22 (d) 44

CG PET -2018

Ans. (d) : Formula of cyclohexanol is C_6H_{11} OH.



Molecular mass of C_6H_{11} OH = 100
Molecular mass of cyclohexane
$(C_6H_{12})=84$

∵ For 84 g of cyclohexane, we need = 100 g of material $C_6H_{11}(OH)$

∴ For 20 g of cyclohexane,

We need = $\frac{100\times20}{84}$
= 23.80 g of $C_6H_{11}(OH)$

∴ 54 g of $C_6H_{11}(OH)$ we get from = 100 g of $C_6H_{11}(OH)$

∴ 23.8 g of $C_6H_{11}(OH)$ get from = $\frac{100\times23.8}{54}$ = 44%

264. Excess of acidic solution of KI to mixed with 25 mL H_2O_2. Liberated I_2 requires 20 mL of 0.3 N $Na_2S_2O_3$ solution. The volume strength of H_2O_2 is

(a) 1.344 volume (b) 2.688 volume

(c) 1.5 volume (d) 2.5 volume

CG PET -2018

Ans. (a) : The reaction involved in this liberation is
$2KI+H_2O_2\rightarrow I_2+2KOH$
Normality of 25 ml H_2O_2 be x N
From above titration
N_1 = Normality of H_2O_2
V_1 = Volume of H_2O_2
N_2 = Normality of $Na_2S_2O_3$ or I_2
V_2 = Volume of $Na_2S_2O_3$ or I_2
$N_1V_1=N_2V_2$
a × 25 = 0.3 × 20
$a=\frac{0.3\times20}{25}$
a = 0.24
Normality of H_2O_2 solution = 0.24 N
Volume strength = Normality × Equivalent weight
Equivalent weight of H_2O_2 in terms of oxygen
= 5.6 L
Volume strength= 0.24 × 5.6
= 1.344 g L^{-1}

265. Number of electrons present in 3.6 mg of NH_4^+ are

@apna_pdf

(a) 1.20×10^{21} (b) 1.20×10^{20}
(c) 1.20×10^{22} (d) 2×10^{-3}

AMU-2017

Ans. (b) : Given, mass of NH_4^+ = 3.6 mg = 3.6×10^{-3} g

Molar mass of $NH_4^+ = (1 \times 14) + (4 \times 1) = 18$ g

[N = 14, H = 1]

$$\text{No. of moles} = \frac{\text{Given mass}}{\text{Molar mass}}$$

$$= \frac{3.6\times10^{-3}}{18} = 0.2\times10^{-3} \text{ moles}$$

No. of electrons in 3.6 mg of NH_4^+

= Moles × Avogadro Number

= $0.\ 2 \times 10^{-3} \times 6.023 \times 10^{23}$

= 1.2×10^{20} electron of NH_4^+

266. If 3.01×10^{20} molecules are removed from 98 mg of H_2SO_4, then number of moles of H_2SO_4 left are

(a) 0.1×10^{-3} mol (b) 9.95×10^{-2} mol
(c) 0.5×10^{-3} mol (d) 1.66×10^{-3} mol

Karnataka-CET-2017

Ans. (c) :

Molecular weight of H_2SO_4 = 98 mg = 98×10^{-3} g

$$\text{No. of moles} = \frac{\text{weight}}{\text{mole. wt.}}$$

$$= \frac{98 \times 10^{-3}}{98} = 10^{-3} \text{ moles} = 0.001 \text{ mol}$$

1 mole $H_2SO_4 = 6.022 \times 10^{23}$ molecules

0.001 moles = $6.022 \times 10^{23} \times 0.001$

= 6.022×10^{20} molecules

If 3.01×10^{20} molecules are removed then,

Remaining molecules = $6.022\times10^{20} - 3.01\times10^{20}$

= 3.01×10^{20}

$$\text{No. of moles} = \frac{3.01\times10^{20}}{6.022\times10^{23}}$$

$$= \frac{1}{2}\times10^{-3} = 0.5\times10^{-3} \text{ moles}$$

267. One mole of an unknown compound was treated with excess water and resulted in the evolution of two moles of a readily combustible gas. The resulting solution was treated with CO_2 and resulted in the formation of white turbidity. The unknown compound is

(a) Ca (b) CaH_2
(c) $Ca(OH)_2$ (d) $Ca(NO_3)_2$
(e) $CaSO_4$

Kerala-CEE-2017

Ans. (b) : The unknown compound is CaH_2 or calcium hydride

$CaH_2 + 2H_2O \rightarrow Ca(OH)_2 + 2H_2$

(2 mole)

readily combustible H_2 gas

$Ca(OH)_2 + CO_2 \rightarrow CaCO_3 + H_2O$

White turbidity.

268. The mass of $CaCO_3$ required to react with 25 mL of 0.75 M HCl is :

(a) 0.94 g (b) 9.4 g
(c) 0.094 g (d) 0.49 g

Manipal-2017

Ans. (a) :

1 moles $CaCO_3$ = 2 moles of HCl

$$\text{No. of moles of HCl} = \frac{MV}{1000} = \frac{0.75\times25}{1000} = 0.01875 \text{ moles}$$

$$\text{NO. of moles of } CaCO_3 = \frac{1}{2}\times\text{number of moles of HCl}$$

$$= \frac{1}{2}\times0.01875 = 9.375\times10^{-3}$$

Mass of $CaCO_3$ = No of moles × Molar Mass

[Molar mass of $CaCO_3$ = 40+12+16×3 = 100]

= $9.375 \times 10^{-3} \times 100 = 0.9375$g

269. What is the quantity of hydrogen gas liberated when 46 g sodium reacts with excess ethanol? (Given atomic mass of Na = 23)

(a) 2.4×10^{-3} kg (b) 2.0×10^{-3} kg
(c) 4.0×10^{-3} kg (d) 2.4×10^{-2} kg

MHT CET-2017

Ans. (b) : The reaction of ethanol with water is as follows-

$2C_2H_5OH(l) + 2Na(s) \rightarrow 2C_2H_5O^-Na^+ + H_2(g)\uparrow$

$$\text{Moles of Na (46g)} = \frac{\text{Mass}}{\text{Molecular weight}} = \frac{46}{23} = 2 \text{ mol}$$

Here, 2 moles of Na will give 1 mole of H.

The molecular weight of Hydrogen

$$= \frac{\text{Mass of hydrogen}}{\text{Moles of hydrogen}} = \frac{2}{1} = \text{g mol}^{-1}$$

Thus, quantity of hydrogen gas librated = 2 g

= 2×10^{-3} kg

270. The number of grams/weight of NH_4Cl required to be added to 3 liters of 0.01 M $NH_3$to prepare the buffer of pH=9.45 at temperature 298 K ($K_b$for NH_3 is 1.85×10^{-5})

(a) 0.354 gm (b) 4.55 gm
(c) 0.455 gm (d) 3.55 gm

UPTU/UPSEE-2017

Ans. (a) : Given pH = 9.45

K_b for NH_3 is 1.85×10^{-5}

$$pOH = pK_b + \log\frac{[NH_4Cl]}{[NH_3]}$$

$$\Rightarrow \ pOH = -\log K_b + \log\frac{[NH_4Cl]}{[NH_3]}$$

$(\because pK_b = -\log K_b)$

Also, pOH = 14 – pH = 14 – 9.45 = 4.55

$$\text{and } \log\frac{[NH_4Cl]}{[NH_3].K_b} = \log 3 \approx 0.470$$

$$\text{Thus, } \log 10^{14} - \left(\log10^9 + \log 3\right) \approx \log\frac{[NH_4Cl]}{[NH_3].K_b}$$

@apna_pdf

$$\frac{10^{14}}{10^9\times 3}\approx\frac{[NH_4Cl]}{[NH_3].K_b}$$

Or $\dfrac{10^4\times[NH_3].K_b}{10^9\times 3}$

$= [NH_4Cl]\approx\dfrac{10^{14}}{10^9\times 3}\times 0.01\times 1.85\times 10^{-5}$

$=$ 0.354 gm.

271. The yield of acetanilide in the reaction (100% conversion) of 2 moles of aniline with 1 mole of acetic anhydride is

(a) 270 g (b) 135 g

(c) 67.5 g (d) 177 g

WB-JEE-2017

Ans. (b) :

$$\underset{\text{Aniline}}{C_6H_5NH_2} + \underset{\substack{\text{Acetic}\\\text{anhydride}}}{(CH_3CO)_2O} \longrightarrow \underset{\text{Acetanilide}}{C_6H_5NHCOCH_3} + \underset{\text{Acetic acid}}{CH_3COOH}$$

Int.	2	1	0	0
Final	1	0	1	1

Thus acetic anhydride is the limiting reagent.

Molar mass of $C_6H_5NHCOCH_3$ or C_8H_9NO

$= 12 \times 8 + 9 \times 1 + 14 \times 1 + 16 \times 1$

$= 96 + 9 + 14 + 16 = 135$ g mol^{-1}

Amount of acetanilide formed = 1 mol

= 1 mol × 135 g mol^{-1} = 135g

272. 0.50 mol of $BaCl_2$ is mixed with 0.20 mol of Na_3PO_4 to get $Ba_3(PO_4)_2$. Number of moles $Ba_3(PO_4)_2$ of obtained are

(a) 0.6 mol (b) 0.2 mol

(c) 0.1 mol (d) 0.05 mol

BCECE-2017

Assam CEE-2014

Ans. (c) : Balanced equation for reaction between $BaCl_2$ and Na_3PO_4 is as follows:

$$3BaCl_2 + 2Na_3PO_4 \longrightarrow Ba_3(PO_4)_2$$

+ 6NaCl

3 moles of $BaCl_2$ react with 2 moles of Na_3PO_4 to give 1 mole of $Ba_3(PO_4)_2$

0.5 moles of $BaCl_2$ will react with (2/3) × 0.5 = 0.33 moles of Na_3PO_4

Available moles of Na_3PO_4 = 0.2

So, Na_3PO_4 is the limiting reagent

Now, 2 moles of Na_3PO_4 give 1 mole of $Ba_3(PO_4)_2$

So, 0.2 moles of $Na_3(PO_4)2$

Hence maximum number of moles of $Ba_3(PO_4)_2$ formed = 0.1

273. 4.9 g of H_2SO_4 is present in 100 mL solution. the molarity and normality of the solution will be

	Molarity	**Normality**
(a)	1M	0.5 N
(b)	1M	0.25 N
(c)	0.5M	1N
(d)	2M	3N

CG PET -2017

Ans. (c) : Given Mass of $H_2SO_4(w) = 4.9g$

Volume of solution (V)= 100mL

Molar mass (M)=98

Molarity (C) $= \dfrac{w\times 1000}{M\times V}, \therefore C = \dfrac{4.9}{98}\times\dfrac{1000}{100}$

Molarity = 0.5M

Normality (N)=Z× molarity (C)

where, Z= equivalent factor

For $H_2SO_4(Z=2) \Rightarrow 0.5M$

∴ Normality =2×0.5=1N

274. 1 g of a carbonate (M_2CO_3) on treatment with excess HCl produces 0.01186 mole of CO_2. The molar mass of M_2CO_3 in g mol^{-1} is

(a) 1186 (b) 84.3

(c) 118.6 (d) 11.86

[JEE Main-2017]

Ans. (b) : Given chemical equation.

$$M_2CO_3 + 2HCl \rightarrow 2MCl + H_2O + CO_2$$

1 gm 0.01186 mol

From the above chemical eq^n.

$$nM_2CO_3 = nCO_2$$

$$\frac{1}{\text{Molar mass of } M_2CO_3} = 0.01186$$

$$\text{Molar mass of } M_2CO_3 = \frac{1}{0.01186}$$

$$M = 84.3 \text{ g mol}^{-1}$$

275. At 25^{o}C consider the density of water is 1 g/L and that of propanol to be 0.925g/L what volume of propanol will have same number of molecules as present in 210 mL of water?

(a) 757 mL (b) 825 mL

(c) 646 mL (d) 437 mL

J & K CET-(2017)

Ans. (a) : Given, density of water = 1g/L

and Density of propanol = 0.925 g/L

$$\text{Density} = \frac{\text{Mass}}{\text{Volume}}$$

For water :

$1 = \dfrac{18}{V_{H_2O}}$ (molar mass of water = 18 g mol^{-1})

$V_{H_2O} = 18$ L

For propanol :

$0.925 = \dfrac{60}{V_{propanol}}$

[Molar mass of $CH_3CH_2CH_2OH$ = 60g mol^{-1}]

$V_{propanol} = 64.86$ L

Ratio : $\dfrac{V_{propanol}}{V_{H_2O}} = \dfrac{64.86}{18}$

$V_{propanol} = 3.603\times V_{H_2O}$

$V_{propanol} = 3.603\times 210$

$= 756.63$

$= 757$ mL

@apna_pdf

276. Dissolving 120 g of urea in 1000 g of water gave a solution of density 1.15 g/mL. The molarity of the solution is

(a) 1.78 M (b) 2 M
(c) 2.05 M (d) 2.22 M

JCECE - 2017

Ans. (c) : Given, Mass of urea = 120g
Molar mass of urea = 120 + 1000 = 1120 g
Density of solution = 1.15 g/mL

$$\text{Volume of solution} = \frac{\text{mass}}{\text{density}} = \frac{1120}{1.15} = 973.15\text{mL}$$

$$\text{Molarity} = \frac{W \times 1000}{M \times \text{Volume(in mL)}}$$

$$= \frac{120 \times 1000}{60 \times 973.15} = 2.05 \text{ M}$$

The molarity of the solution is 2.05M

277. How much CO_2 is produced on heating of 1 kg of carbon?

(a) $\frac{11}{3}$kg (b) $\frac{3}{11}$kg
(c) $\frac{4}{3}$kg (d) $\frac{3}{4}$kg

NDA (II)-2017

Ans. (a) : We know that, $C+O_2 \rightarrow CO_2$
12 g of C produces = 44 g of CO_2

$$\text{So,} \quad \frac{12}{1000} \text{ kg of C produces} = \frac{44}{1000} \text{ kg of } CO_2$$

$$\therefore 1 \text{ kg of C produces} = \frac{44}{1000} \times \frac{1000}{12} \text{kg of } CO_2$$

$$= \frac{11}{3} \text{ kg}$$

Hence, $\frac{11}{3}$ kg of CO_2 produced on heating 1 kg of carbon.

278. The compound $C_6H_{12}O_4$ contains

(a) 22 atoms per mole
(b) twice the mass percent of H as compared to the mass percent of C
(c) six times the mass percent of C as compared to the mass percent of H
(d) thrice the mass percent of H as compared to the mass percent of O

NDA (II)-2017

Ans. (c) : Given, $C_6H_{12}O_4$
Molar mass of C in $C_6H_{12}O_4$= 6×12=72
Molar mass of H in $C_6H_{12}O_4$= 1×12=12
Therefore, mass percent of C is six times as compared to the mass percent of H.

279. A 5.2 molal aqueous solution methyl alcohol, CH_3OH is supplied. What is the mole fraction of methyl alcohol in the solution?

(a) 0.05 (b) 0.10
(c) 0.18 (d) 0.086

JCECE - 2017

Ans. (d) : Given,
n_1 (CH_3OH) = 5.2 mol

$$n_2 (H_2O) = \frac{1000\text{g}}{18\text{g/mol}} = 55.56 \text{ mol}$$

$$\therefore \quad n_1 + n_2 = 5.20 + 55.56$$
$$= 60.76 \text{ mol}$$

$$\therefore \quad X_{CH_3OH} = \text{mole fraction of } CH_3OH$$

$$= \frac{n_1}{n_1 + n_2} = \frac{5.2}{60.76} = 0.086$$

280. The molality of 90% H_2SO_4 solution is [density = 1.8 g/mL]

(a) 1.8 (b) 48.4
(c) 91.8 (d) 94.6

COMEDK-2017

Ans. (c) : Given,
[density = 1.8 g/mL]
Sstrength of H_2SO_4=90%
and mass of solvent =100 – 90=10 g
Now, Molality= Moles of solute dissolved in

$$1000 \text{ g of the solvent} = \frac{90 \times 1000}{98 \times 10} = 91.8$$

281. 6g of a non-volatile, non-electrolyte X dissolved in 100 g of water freezes at –0.93ºC. The molar mass of X in g mol^{-1} is (K_f of H_2O = 1.86 K kg mol^{-1})

(a) 60 (b) 140
(c) 180 (d) 120

AP-EAMCET – 2016

Ans. (d) : Given that–
K_f = 1.86 K kg mol^{-1}
W = 6 gm
$\Delta T_f = -0.93^\circ C$
W' = 100 gm

$$\therefore \quad \Delta T_f = \frac{K_f \times W \times 1000}{M \times W'}$$

$$0.93 = \frac{1.86 \times 6 \times 1000}{M \times 100}$$

$$M = \frac{1.86 \times 6 \times 10}{0.93}$$

M = 120

282. The number of moles of H_2O in one litre is

(a) 50.5 (b) 55
(c) 55.05 (d) 55.55

SRMJEEE – 2015, 2010

Ans. (d) : A appropriate unit of measurement for water's density is gram per milliliter or 1 gram per cubic centimeter ($1g/cm^3$) i.e.
Density of water = 1 g/cc
and

$$\text{Density of water} = \frac{\text{Mass of water}}{\text{Volume of water}}$$

Or mass of water = 1 × 1000 = 1000 gm

@apna_pdf

$$\text{No. of moles} = \frac{\text{Mass of water}}{\text{Molecular weight}}$$

$$\text{No. of moles} = \frac{1000\text{ gm}}{18} = 55.5\text{ mol}$$

283. What weight of HCl is present in 155 mL of a 0.54 M solution?

(a) 3.06 g (b) 6.12 g
(c) 1.53 g (d) 0.30 g

AMU-2016

Ans. (a) : Given,
$V_s(\text{HCl}) = 155\text{ mL} = 0.155\text{ L}$
$n(\text{HCl}) = V_s(\text{HCl}) \times C(\text{HCl}) = 0.155\text{L} \times 0.540\text{M}$
$= 0.0837$ mol.
Molecular weight = 36.4 g/mol
$m(\text{HCl}) = n(\text{HCl}) \times M(\text{HCl})$
$= 0.0837\text{ mol} \times 36.5\text{ g/mol}$
$= 3.05505\text{g} \approx 3.060\text{ g}$

284. If 27 g of water is formed during complete combustion of pure propene (C_3H_6), the mass of propene burnt is

(a) 42 g (b) 21 g
(c) 14 g (d) 56 g
(e) 40 g

Kerala-CEE-2016

Ans. (b) : Given,
H_2O (formed) = 27g
Reaction,

$$\underset{\text{Propene}\,(3\times12+6=42)}{C_3H_6} + \frac{9}{2}O_2 \longrightarrow 3CO_2 + \underset{(3\times18=54)}{3H_2O}$$

The mass ratio between C_3H_6 and H_2O
$= 42:54$
$\therefore$ 54g of H_2O require = 42g C_3H_6
$\therefore$ 27g of H_2O require $= \frac{42\times27}{54}$
$= 21\text{g. } C_3H_6$

285. A silicon chip used in an integrated circuit of computer has a mass of 5.68 mg. The number of Si atoms present in this chip are :

(a) 144×10^{20} atoms (b) 18×10^{20} atoms
(c) 21×10^{20} atoms (d) None of these

Manipal-2016

Ans. (d) : Given,
Molar mass of Si = 28g = 28000 mg
So, 28000 mg of Si contain 6.022×10^{23} atoms
Then, 5.68 mg of silicon contain $\frac{6.022\times10^{23}}{28000}\times5.68$
$= 0.00122 \times 10^{23} = 1.22 \times 10^{20}$ atoms
The number of Si atoms present in this chip is
$= 1.22 \times 10^{20}$ atoms

286. Cost of sugar ($C_{12}H_{22}O_{11}$) is ₹ 50 per kg. Calculate its cost per mol.

(a) ₹ 17.1 per mol (b) ₹ 27.1 per mol
(c) ₹ 14.1 per mol (d) none of the above

Manipal-2016

Ans. (a) : Given, cost of sugar = ₹ 50 kg
Molar mass of sugar $= 12 \times 12 + 1 \times 22 + 11 \times 16$
= 342g
[C = 12, H = 1, O = 16]
$\because$ Cost of 1000 g of sugar is Rs. 50
$\therefore$ Cost of 342g of sugar $= \frac{50}{1000}\times342$
= ₹. 17.1

287. A man writes his biodata with carbon pencil on the plane paper having mass 150 mg. After writing his biodata, he weighs the written paper and find its mass is 152 mg. What is the number of carbon atoms present in the paper?

(a) 1.0036×10^{20} (b) 5.02×10^{20}
(c) 1.0036×10^{23} (d) 0.502×10^{20}

Manipal-2016

Ans. (a) : We know,
Mass of C-atoms = 152–150 = 2mg
Molar mass of C-atoms = 12g = 12000mg
12000 mg of carbon contains $= \frac{6.022\times10^{23}}{12000}\times2$
$= 0.0010036\times10^{23}$
$= 1.0036\times10^{20}$ atoms.
Therefore, the number of carbon atoms present in 1.0036×10^{20} atoms.

288. The concentration of a solution can be expressed in molarity, normality, formality and molality. Among them, which mode of expression is the most accurate for the all conditions?

(a) Molarity (b) Formality
(c) Normality (d) Molality

Manipal-2016

Ans. (d) : Molality (m) $= \frac{\text{Moles of solute}}{\text{Mass of solvent in kg}}$

Molality is defined in terms of weight, hence independent of temperature. Remaining three concentration units are defined in terms of volume of solution, they depends on temperature.

289. When a liquid that is immiscible with water was steam distilled at. 95.2°C at a total pressure of 99.652 kPa. The distillate contained 1.27 g of the liquid per gram of water. What will be the molar mass of the liquid if the vapour pressure of water is 85.140 kPa at 95.2°C^2

(a) 99.65 g mol^{-1} (b) 18 g mol^{-1}
(c) 134.1 g mol^{-1} (d) 105.74 g mol^{-1}

UPTU/UPSEE-2016

Ans. (c): Given,
$P_{\text{total}} = 99.652\text{ kP}_a$
$P_{\text{water}} = P_B = 85.140\text{ kP}_a$
$P_{\text{liquid}} = P_A = (99.652–85.140)\text{ kP}_a$
$= 14.512\text{ kP}_a$

and $\frac{m_A}{m_B} = \frac{1.27}{1} \Rightarrow \frac{m_A}{m_B} = \frac{p_A m_A}{p_B m_B}$

@apna_pdf

$$M_A = \left(\frac{m_A}{m_B}\right)\left(\frac{p_B m_B}{p_A}\right)$$

$$M_A = 1.27 \times \left(\frac{85.140\,kP_a \times 18\,g\,mol^{-1}}{14.512\,kP_a}\right)$$

$$M_A \simeq 134.1\,g\,mol^{-1}$$

290. Number of atoms of sulphur in 9.8 grams of H_2SO_4 are–

(a) 0.6023×10^{23} (b) 6.023×10^{23}

(c) 6×10^{23} (d) 6.023×10^{21}

BCECE-2016

Ans. (a) : No. of atom in 9.8 g of H_2SO_4

$H_2SO_4 = 2 + 32 + 16 \times 4$

$= 98$

$$\text{No. of moles} = \frac{\text{Given mass}}{\text{Molecular mass}}$$

$$= \frac{9.8}{98}$$

$= 0.1$ moles

So, No. of atoms = No. of moles × N_A

$= 0.1 \times 6.023 \times 10^{23}$

$= 0.6023 \times 10^{23}$

291. For 1 molar solution of NaCl in water at 25^0C and 1-atm pressure show that–

(a) molarity = mole fraction

(b) molality = mole fraction

(c) Normality = mole fraction

(d) molarity = normality

BCECE-2016

Ans. (d) : 1 Molar solution of NaCl will have molarity and Normality.

292. If 50 mL of 0.1 M HCl and 200 mL of 0.01 M HCl are mixed together. The molarity of mixture will be –

(a) 0.28 M (b) 2.8 M

(c) 0.028 M (d) 28..57 M

BCECE-2016

Ans. (c) : Given,

$M_1 = 0.1$, $M_2 = 0.001$

$V_1 = 50$, $V_2 = 200$

$$M_{(mixture)} = \frac{M_1V_1 + M_2V_2}{V_1 + V_2}$$

$$\frac{(0.1\times 50)+(0.01\times 200)}{50+200}$$

$$\frac{5+2}{250} = \frac{7}{250}$$

Molarity of mixture = 0.028M.

293. Among the following gases of specified masses, which one has least number of molecules? (Atomic masses of H, C, O and S are respectively 1, 12, 16 and 32 g mol^{-1})

(a) 32 g of sulphur dioxide gas

(b) 8 g of oxygen gas

(c) 16 g of methane gas

(d) 4 g of hydrogen gas

J & K CET-(2016)

Ans. (b) : We know that,

32g of SO_2 gas:

Molar mass of SO_2 = 64 g

64 g $SO_2 \equiv 6.023 \times 10^{23}$ molecules

$\therefore$ 32 g of $SO_2 = 3.01 \times 10^{23}$ molecules

8 g of oxygen gas :

32 g of $O_2 \equiv 6.023 \times 10^{23}$ molecules

$$\therefore 8 \text{ g of } O_2 \equiv \frac{6.023\times10^{23}}{32}\times 8 = 1.5\times10^{23} \text{ molecules}$$

16 g of $CH_4 \equiv 6.023 \times 10^{23}$ molecules

4g of H_2 gas:

2g $H_2 \equiv 6.023 \times 10^{23}$ molecules

$$4 \text{ g of } H_2 \equiv \frac{6.023\times10^{23}}{2}\times 4$$

$= 12.046 \times 10^{23}$ molecules

294. 20 volume of H_2O_2 means

(a) 20% H_2O_2 solution

(b) 20 mL of solution contain 1 g of H_2O_2

(c) 1 mL of solution liberate 20 mL of O_2 at STP

(d) 20 mL of solution contain 1 mol of H_2O_2

JCECE - 2016

Ans. (c) : By definition volume strength of H_2O, the amount of O_2 liberated by 1 mL of H_2O_2 at STP is the volume strength of H_2O_2.

295. If 1.4 g of N_2(g) react with 1 g of H_2(g) to form ammonia (NH_3), then amount of NH_3(g) formed and number of atoms present in NH_3 respectively are (in moles)

(a) 0.5 and 0.1 (b) 0.1 and 0.1

(c) 0.1 and 0.5 (d) 0.5 and 0.5

JCECE - 2016

Ans. (b) : The relation used for formation of ammonia is

Given,

$$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$$

Relation by mass = 28 : 6 : 34

14 : 3 : 17

$N_2(g) = 1.4g \Rightarrow H_2(g) = 1g$

Thus, N_2(g) behave as a limiting reagent and NH_3(g) will formed as per amount of N_2 used.

Therefore,

14g of N_2 give NH_3 = 17 g

$$\therefore \quad 1.4 \text{ g of } N_2 \text{ give } NH_3 = \frac{17\times1.4}{14}$$

Amount of NH_3 (g) = 1.7 g

$$\text{No. of moles of } NH_3,\ n = \frac{w}{M}$$

$$n = \frac{1.7}{17} = 0.1 \text{ mol.}$$

Also

No. of moles of $NH_3 \equiv$ No. of atoms of N in NH_3

$\therefore$ If no. of moles of NH_3 = 0.1

Then, no. of moles of N-atoms in NH_3 = 0.1 mol

Hence,

No. of moles of NH_3 = 0.1 mol

No. of moles of N-atoms = 0.1 mol

@apna_pdf

296. Solid $NaHCO_3$ will be neutralized by 40.0mL of 0.1M H_2SO_4 solution. What would be the weight of solid $NaHCO_3$ in gram?

(a) 0.672g (b) 6.07g
(c) 17g (d) 20g

JIPMER-2016

Ans. (a) :

$$\underset{\substack{\text{Mole ratio}\ \ 2\text{mole}\\ =168\text{g}}}{2NaHCO_3} + H_2SO_4 \longrightarrow \underset{\substack{1\text{mole}\\ =98\text{g}}}{Na_2SO_4} + 2H_2O + 2CO_2$$

m- moles of $H_2SO_4 = M \times V_{mL} = 40.0\times0.01$
$= 4$ m – mole

Moles of $H_2SO_4 = M \times VmL = 40.0\times0.1 = 4m$ mol

Also, it can written as m-moles of $NaHCO_3$ when neutralised = 4×2 = 8m-moles.

$$\text{But m-mole} = \frac{w}{m}\times1000$$

$$8 = \frac{w}{84}\times1000 \Rightarrow w = \frac{84\times8}{1000} \Rightarrow w = 0.672\,g.$$

297. Which one of the following has different number of molecules? (All are kept at normal temperature and pressure)

(a) 3 gram of Hydrogen (b) 48 gram of Oxygen
(c) 42 gram of Nitrogen (d) 2 gram of Carbon

NDA (II)-2016

Ans. (d) : We know that,

1 mole= 6.022×10^{23} atom
1g of hydrogen= 6.022×10^{23} atoms
3g of hydrogen= $3\times6.022\times10^{23}$ atoms

$\frac{3}{2}\times6.022\times10^{23}$ molecule (∴hydrogen is diatomic)

Now , 16g of oxygen = 6.022×10^{23} atoms

48g of oxygen= $\frac{3}{2}\times6.022\times10^{23}$ atoms

(∴Oxygen is diatomic)

Again, 12g of carbon= 6.022×10^{23} atoms

2g of carbon= $\frac{1}{6}\times6.022\times10^{23}$ molecule

(∴carbon is monoatomic molecule)

Hence, 2g of C contain different number of molecules.

298. The number of oxygen atoms in 4.4g of CO_2 is

(a) 1.2×10^{23} (b) 6×10^{22}
(c) 6×10^{23} (d) 12×10^{23}

Karnataka-CET-2016

Ans. (a) : Given that,

$$\text{Moles of } CO_2 = \frac{4.4}{44} = 0.1\text{moles}$$

∴ Number of molecules of $CO_2 = 0.1 \times 6.022 \times 10^{23}$
$= 6.022 \times 10^{22}$ molecules

1 molecule of CO_2 contains 2 oxygen atoms.

∴Number of oxygen atoms $= 2 \times 6.022 \times 10^{22}$
$= 12.044 \times 10^{22}$ atoms
$= 1.2 \times 10^{23}$ atoms

299. One mole of $N_2O_{4(g)}$ at 300 K is kept in a closed vessel at 1 atm pressure. It is heated to 600 K when 20% by mass of $N_2O_{4(g)}$ decomposes to $NO_{2(g)}$. The resultant pressure is

(a) 1.2 atm (b) 2.4 atm
(c) 2.0 atm (d) 1.0 atm

AMU-2015

Ans. (b) : $N_2O_4 \rightarrow 2NO_2$

Moles of un reacted $N_2O_4 = 1(1 - 0.2) = 0.8$

Moles of $NO_2 = 2 \times 0.2 = 0.4$

Total moles $(n_2) = 0.8 + 0.4 = 1.2$

$$P_1/(T_1n_1) = P_2/T_2\times n_2$$

$$\frac{1}{300\times1} = \frac{P_2}{600\times1.2}.$$

$P_2 = 2.4$ atm

300. When 4A of current is passed through a 1.0 L, 0.10 M Fe^{3+} (aq) solution for 1 hour, it is partly reduced to Fe(s) and partly of Fe^{2+}(aq), Identify the incorrect statement.

(a) 0.10 mole of electrons are required to convert all Fe^{3+} to Fe^{2+}
(b) 0.025 mol of Fe(s) will be deposited
(c) 0.05 mol of iron remains as Fe^{2+}
(d) 0.050 mol of iron remains as Fe^{2+}

BCECE-2015

Ans. (d) : Given,

4 a, 1 hours, 1.0L, 0.l0mF_e^{+3}

$$\text{Number of } F = \frac{It}{96500} = \frac{4\times3600}{96500} = 0.15\,F$$

Initially mole Fe^{+3} =b 1 × 0.10 = 0.1 mole

$e^- + F3^{+3} \longrightarrow F^{+3}$

1F = 1 Mole $F3^{+3}$ deposited

0.15 F = 0.15 mole $F3^{+3}$ deposited > Initially mole

0.1 mole Fe^{+3} = 0.1 F electricity = 0.1 mole Fe^{+2}

Fe^{+2} 0.1 mole

$0.05\ F \Rightarrow Fe^{+2} + 2e^- \longrightarrow Fe$

2F = 1 mole Fe^{+2}

$$0.05 = \frac{1}{2}\times0.05 \text{ mole } Fe^{+2}\ 0.025 \text{ mole } Fe^{+2}$$

Fe mole = 0.025 mole

$Fe^{+2} \rightarrow 0.1 - 0.025 = 0.05$ mole

Hence the in correct option (d)

301. The number of Na atoms in 46g of Na (atomic weight of Na = 23) is

(a) 6.023×10^{23} (b) 2
(c) 1 (d) 12.046×10^{23}

J & K CET-(2015)

Ans. (d) : Given,

Molar mass of Na = 23 g, Given mass = 46 g

$$\text{No. of atoms} = \frac{\text{Given mass}\times N_A}{\text{Molar mass}}$$

$$= \frac{46\times6.022\times10^{23}}{23}$$

$$= 2\times6.022\times10^{23}$$

$= 12.044 \times 10^{23}$ atoms

∴ 46 g of Na contains 12.044×10^{23} atoms

302. In order to prepare one liter 1N solution of $KMnO_4$, how many grams of $KMnO_4$ are required, if the solution to be used in acid medium for oxidation?

@apna_pdf

(a) 128 g (b) 41.75 g
(c) 31.60 g (d) 62.34 g

JIPMER-2015

Ans. (c) : Given,
Normality = 1 N, volume = 1L

$$\text{Normality} = \frac{\text{No. of gram equivalence}}{\text{Volume of solution in (L)}}$$

No. of gram equivalence = N × V in (L)
= 1 × 1 = 1

$$\text{No. of gram equivalence} = \frac{\text{wt}}{\text{eq wt}}$$

$$\text{Where, eq. wt} = \frac{\text{molecular wt}}{\text{n} - \text{factor}} . \text{m.w} = 158\text{g}$$

$$\overset{+7}{\text{KMnO}_4} \xrightarrow{\quad 5 \quad} \overset{+2}{\text{Mn}} \quad \Rightarrow \text{ n factor} = 5$$

$$\text{equal} = \frac{158}{5} = 31.6$$

Let of $KMnO_4$ = eq. wt × No. of gram equivalence
= 31.6 × 1 == 31.6 g

303. What amount of dioxygen (in gram) contains 1.8×10^{22} molecules?
(a) 0.0960 (b) 0.960
(c) 9.60 (d) 96.0

Karnataka-CET-2015

Ans. (b): Dioxygen = O_2
Molar mass of O_2 = 2(16)
= 32g mol^{-1}
1 mole = 6.022×10^{23} molecule
32 g of O_2 = 6.022×10^{23} molecules of O_2
∴ 1.8×10^{22} molecules of O_2

$$= \frac{32 \times 1.8 \times 10^{22}}{6.022 \times 10^{23}} = 0.955 = 0.960$$

304. How many ions per molecular are produced in the solution, when Mohr salt is dissolved in excess of water?
(a) 4 (b) 5
(c) 6 (d) 10

Karnataka-CET-2015

Ans. (b) : Mohrs salt: $(NH_4)_2 Fe(SO_4)_2 . 6H_2O$

$$(NH_4)_2 Fe(SO_4)_2 \cdot 6H_2O \xrightarrow[\text{of water}]{\text{in excess}} 2NH_4^+ + 2SO_4^{2-} + Fe^{2+}$$

on dissolving in water two NH_4^+ ions, two SO_4^{2-} ions and one Fe^{2+} ion will be produced.
Total number of ions = 5

305. How many moles of platinum will be deposited on the cathode when 0.60 F of electricity is passed through a 1.0 M solution of Pt^{4+} ?
(a) 0.60 mol (b) 0.15 mol
(c) 0.30 mol (d) 0.45 mol
(e) 1.0 mol

Kerala-CEE-2015

Ans. (b) :
$$pt^{4+} + 4e^- \rightarrow pt$$
When 4F electricity is passed, it gives = 1mole pt
When 0.60 F electricity passed through solution then, the number of moles of pt = x
number of moles (x) = 0.6F/ 4F = 0.15 moles

306. A mixture of gases contains H_2 and O_2 gases in the ratio of 1 : 4 (w/w). What is the molar ratio of the two gases in the mixture?
(a) 16 : 1 (b) 2 : 1
(c) 1 : 4 (d) 4 : 1

NEET-2015, cancelled

Ans. (d) $$\text{Number of moles (n)} = \frac{\text{given mass (m)}}{\text{Molar mass (M)}}$$

As the ratio by weight of Hydrogen and Oxygen is 1: 4

$$\text{Molar ratio will be } \frac{n_{H_2}}{n_{o_2}} = \frac{32}{8} = 4:1$$

The molar ratio of hydrogen and Oxygen is 4 :1

307. Vapour pressure in mm Hg of 0.1 mole of urea in 180 g of water at 25°C is (The vapor pressure of water at 25°C is 24 mm Hg)
(a) 2.376 (b) 20.76
(c) 23.76 (d) 24.76

AP EAMCET (Engg.) -2014

Ans. (c) : Given,
$P^0 = 24, P_S = ?$

$$\frac{w}{m} = 0.1$$

From Raoults law –

$$\frac{P^\circ - P_S}{P^\circ} = \frac{w}{m} \times \frac{M}{W}$$

$$\frac{24 - P_S}{24} = 0.1 \times \frac{18}{180}$$

$24 - p_s = 0.24$
∴ $p_s = 23.76$ mm Hg

308. $KMnO_4$ reacts with KI, in basic medium to form I_2 and MnO_2. When 250 mL of 0.1 M KI solution is mixed with 250 mL of 0.02 M $KMnO_4$ in basic medium, what is the number of moles of I_2 formed?
(a) 0.015 (b) 0.005
(c) 0.005 (d) 0.01

AP EAMCET (Engg.) -2014

Ans. (b) : Given that,
Number of equivalents of $KMnO_4$ =
Number of equivalents of $I_2 = 0.02 \times 3 \times 250 \times 10^{-3}$
= 0.015

$$\text{Number of moles of } I_2 \text{ is } \frac{0.015}{2} = 0.005$$

309. Density of 3 M solution of NaCI is 1.25 g/mL. The mass of the solvent in the solution is
(a) 105.4 g (b) 10.745g
(c) 10.754 g (d) 1074.5g

COMEDK 2014

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Ans. (d) : Density of solution = 1.25 g/mL
M = 3 mol/lit
Molar mass of NaCl = 58.5 g mol^{-1}

$$\text{No. of moles} = \frac{\text{Weight}}{\text{Molecular weight}}$$

∴ Mass of solution = d×V
= 1.25 g mL^{-1}×1000 mL= 1250 g
Mass of solute (NaCl) = n× molar mass
= 3×58.5=175.5 g
Mass of solvent = Mass of solution – mass of solute
= 1250–175.5= 1074.5 g

310. How many moles of magnesium phosphate $Mg_3(PO_4)_2$ will contain 0.25 mole of oxygen atoms?

(a) 0.02 (b) 3.125×10^{-2}
(c) 1.25×10^{-2} (d) 2.5×10^{-2}

SRMJEEE – 2014

Ans. (b) :
8 mole oxygen contained by → 1 mole of $Mg_3(PO_4)_2$

1 mole oxygen contained by → $\frac{1}{8}$ mole of $Mg_3(PO_4)_2$

∴ 0.25 mole oxygen contained by → $\left(\frac{1}{8}\times 0.25\right)$ mole of $Mg_3(PO_4)_2$

= 3.125×10^{-2} moles

311. 25 mL of 3.0 M HCl are mixed with 75 mL of 4.0 M HCl. If the volumes are additive, the molarity of the final mixture will be

(a) 4.0 M (b) 3.75 M
(c) 4.25 M (d) 3.50 M

AMU-2014

Ans. (b) : Given, M_1 = 25, V_1 = 3
M_2 = 75. V_2 = 4
On mixing two solutions of same substance Molarity of the final mixture, $M = \frac{M_1V_1 + M_2V_2}{V_1 + V_2}$

$$= \frac{25\times3+75\times4}{25+75} = \frac{375}{100} = 3.75 \text{ M}$$

312. The total number of protons in 10g of calcium carbonate is

(a) 1.5057×10^{24} (b) 2.0478×10^{24}
(c) 3.0115×10^{24} (d) 4.0956×10^{24}

Assam CEE-2014

Ans. (c) : 1 mole of $CaCO_3$ = 20 × 1 + 6 × 1 + 8 × 3
= 50
One mole of $CaCO_3$ contains 50 moles of protons.
10 g of CaCO3 contains:

$$\frac{50\times10}{100}$$

Moles of protons

$$\frac{500}{100} = 5$$

Number of protons = 5 × 6.02 × 10^{23}
= 3.01 × 10^{24} Protons.

313. In which one of the following, does the given amount of chlorine exert the least pressure in a vessel of capacity 1 dm^3 and 273K?

(a) 0.0355 g (b) 0.071 g
(c) 6.023×10^{21} molecules (d) 0.02 mol

BCECE-2014

Ans. (a) : Given that,
Ideal gas equation in

$$PV = nRT$$

When V and T are same

$$P \propto n$$

Thus when number of moles, i.e., n is least, it will exert the least pressure.

(a) $n = \frac{\text{Wt}}{\text{Mol. wt}} = \frac{0.0355}{35.5} = 1\times10^{-3}\text{ mol}$

(b) $n = \frac{0.071}{35.5} = 2\times10^{-3}\text{ mol}$

(c) $n = \frac{\text{Number of molecules}}{N_A}$

$$n = \frac{6.023\times10^{21}}{6.023\times10^{23}} = 0.01 \text{ mol}$$

(d) n = 0.02 mol
Thus, 0.0355 g chlorine will exert the least pressure.

314. 19 g of a mixture containing $NaHCO_3$ and Na_2CO_3 on complete heating liberated 1.12 L of CO_2 at STP. The weight of the remaining solid was 15.9 g. What is the weight (in g) of Na_2CO_3 in the mixture before heating?

(a) 8.4 (b) 15.9
(c) 4.0 (d) 10.6

BCECE-2014

Ans. (d) : The component $NaHCO_3$ can only produce CO_2 on heating of the given mixture as per following balanced equation.

$$2NaHCO_3 \rightarrow Na_2CO_3 + H_2O + CO_2$$

This equation reveals that 22.4 L CO_2 is produced from 2 moles or $NaHCO_3$
2(23 + 1 + 12 + 3 × 16) = 168 g $NaHCO_3$
1.12 L of CO_2 can be obtained from
168/22.4 × 1.12 = 8.4 g of $NaHCO_3$
Weight of Na_2CO_3 in the mixture of 19 g before heating was = 19 – 8.4 = 10.6 g

315. The volume strength of 1 molar solution of H_2O_2 is

(a) 11.2 (b) 22.4
(c) 5.6 (d) 56

JCECE - 2014

Ans. (a) : 1 molar H_2O_2 solution means 1 mole (or 34g H_2O_2) is present in 10^3 mL solution.
∴ 68 g H_2O_2 gives = 22400 mL of O_2

∴ 34 g H_2O_2 will gives = $\frac{22400\text{ mL}\times34}{68}$ = 11200 mL

Volume strength = $\frac{11200}{10^3} = 11.2$

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316. 5.5 mg of nitrogen gas dissolves in 180 g of water at 273 K and 1 atm pressure due to nitrogen gas. The mole fraction of nitrogen in 180 g of water at 5 atm nitrogen pressure is approximately

(a) 1×10^{-6} (b) 1×10^{-5}

(c) 1×10^{-3} (d) 1×10^{-4}

Karnataka-CET-2014

Ans. (d) : Moles of $N_2 = \dfrac{5.5\times10^{-3}\text{g}}{28\text{g}}$

$P_{gas} = K_H.\ X_{gas}$

Moles fraction of :

$$\frac{P_1}{P_2}=\frac{X_1}{X_2}\Rightarrow\frac{1}{5}=\frac{\dfrac{5.5\times\dfrac{10^{-3}}{28}}{5.5\times\dfrac{10^{-3}}{28}+\dfrac{180}{18}}}{x_2}$$

$$X_2=5\left(\frac{0.0001964}{0.0001785+10}\right)$$

$$X_2=9.819\times10^{-5}$$

$$X_2=0.9819\times10^{-4}\approx1\times10^{-4}$$

317. 25 cm^3 of oxalic acid completely neutralized 0.064g of sodium hydroxide. Molarity of the oxalic acid solution is

(a) 0.064 (b) 0.045

(c) 0.015 (d) 0.032

Karnataka-CET-2014

Ans. (d) : Given,

V(oxalic acid) = $25cm^3$

W (NaOH) = 0.064 g

Moles of oxalic acid = Mole of NaOH

$$V(\text{oxalic acid})\times N(\text{oxalic acid})=\frac{W\ (\text{NaOH})}{M(\text{NaOH})}$$

$$N\ (\text{oxalic acid})=\frac{0.064\times1000}{25\times40}=0.064$$

Normality = Molarity × Basicity

$$\text{Molarity}=\frac{0.064}{2}=0.032$$

318. A sample of sea water contains 5×10^{-3} g of dissolved oxygen in 1 kg of the sample. The concentration of O_2 in that sea water sample in ppm is

(a) 5×10^{-4} (b) 5×10^{-3}

(c) 5×10^{-2} (d) 5×10^{-1}

(e) 5

Kerala-CEE-2014

Ans. (e) :

10^3g (1kg) sample contains oxygen= 5×10^{-3}g

$$\therefore\quad 10^6\text{g sample will contain oxygen}=\frac{5\times10^{-3}\text{g}}{10^3\text{g}}\times10^6\text{g}$$

= 5 ppm

Concentration of O_2 in that sea water sample in PPM is 5 ppm.

319. At 273 K, the density of a certain gaseous oxide at 2 atm is same as that of dioxygen at 5 atm. The molecular mass of the oxide (in g mol^{-1})

(a) 80 (b) 64

(c) 32 (d) 160

(e) 70

Kerala-CEE-2014

Ans. (a) : Given,

$P_1 = 2$, M_1 = ?

$P_2 = 5$, $M_2 = 32$

We know that-

$$pV=nRT=\frac{W}{M}RT$$

$$pM=\frac{W}{V}RT$$

$$pM=dRT\Rightarrow\text{or, }d=\frac{pM}{RT}$$

Since, R and T are constant and d_1=d_2

$\therefore\quad p_1 M_1 = p_2 M_2 \Rightarrow 2 \times M_1 = 5 \times 32$

$$M_1=\frac{5\times32}{2}=80\,\text{g mol}^{-1}$$

320. 20 mL solution of 0.1 M ferrous sulphate was completely oxidised using a suitable oxidising agent. What is the number of electrons exchanged?

(a) 1.204×10^{22} (b) 193

(c) 1930 (d) 1.204×10^{21}

MHT CET-2014

Ans. (d) : When oxidation of Fe_2SO_4, Fe^{2+}, ion is oxidises into $Fe^{3+} + e^-$

i.e. $1e^-$ is transferred from 1 molecule of $FeSO_4$, i.e. from $1Fe^{2++}$ ion.

molarity of $FeSO_4$ solution = 0.1 M

$$\text{Volume of solution} = 20\text{ mL}=\frac{20}{1000}\text{L}$$

$$\therefore\ \text{Number of moles}=0.1\times\frac{20}{1000}=0.002\ .$$

$\because$ In 1 mole $FeSO_4$, number of molecules

$= 6.022\times10^{23}$

$\therefore$ In 0.002 mol $FeSO_4$, number of molecules

$= 6.022 \times 10^{23} \times 0.002$

$= 1.204\times10^{21}$

$\therefore$Number of electrons transferred = 1.204×10^{21}

321. 1.0 g of magnesium is burnt with 0.56 g O_2 in a closed vessel, Which reactant is left in excess and how much? (At. wt. Mg = 24, O = 16)

(a) Mg, 0.16 g (b) O_2, 0.16 g

(c) Mg, 0.44 g (d) O_2, 0.28 g

NEET-2014

Ans. (a):

$2Mg + O_2 \rightarrow 2MgO$

2 moles of Mg require 1 mole of O_2 to produce 2 moles of MgO.

$$\text{Mole of Mg}=\frac{\text{given mass}}{\text{molar mass}}$$

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$$= \frac{1}{24} = 0.041667$$

$$\text{moles of } O_2 = \frac{\text{gives mass}}{\text{molar mass}}$$

$$= \frac{0.56}{32} = 0.0175$$

⇒ 0.0175 moles O_2 require 0.0175 × 2 = 0.035 moles of Mg.

Mass of Magnesium (Mg) that reacts:-

Mass = moles × molar mass

= 0.035 × 24

= 0.84 g

That means only 0.84 g magnesium is used.

Therefore magnesium is in excess by 0.16 g

322. How many grams of $MgCO_3$ contain 24.00 g of oxygen? (The molar mass of $MgCO_3$ is 84.30 g mol^{-1})

(a) 42.15 g
(b) 84.30 g
(c) 126.00 g
(d) 154.00 g

NDA (II)-2014

Ans. (a) : Given data,

Molar mass of $MgCO_3$ = 84.30 g mol^{-1}

Gram of oxygen present in 1 mole $MgCO_3$

= 3 × atomic weight of oxygen

= 3 × 16

= 48 g

48g of oxygen present in 84.30 $MgCO_3$

$$1\text{ g } O_2 = \frac{84.30}{48} MgCO_3$$

$$24\text{ g } O_2 = \frac{84.30}{48} \times 24$$

= 42.15 g

323. The system that contains the maximum number of atoms is

(a) 4.25 g of NH_3
(b) 8 g of O_2
(c) 2 g of H_2
(d) 4 g of He

WB-JEE-2014

Ans. (c) : 17g of NH_3 = 4 × N_A atoms

$$\therefore 4.25\text{ g of } NH_3 = \left(\frac{4.25}{17}\right) \times 4 \times N_A = N_A \text{ atoms}$$

32g of O_2 = 2 × N_A atoms

$$8\text{g of } O_2 = \frac{2\times 8}{32} \times N_A = \frac{N_A}{2} \text{atoms}$$

2g of H_2 = 2 × N_A atoms

= 2 N_A atoms

4g of He = N_A atoms

Thus, the system that contains 2g of H_2 has maximum numbers of atoms.

324. The volume occupied by 16 g of oxygen gas at S.T.P. is

(a) 22.4 L
(b) 44.8 L
(c) 11.2 L
(d) 5.6 L

AMU-2013

Ans. (c) : Gram Molecular mass of oxygen = 32 g

Now 32 g oxygen at STP occupies volume = 22.4 lit

∴ 16 g oxygen at STP would occupy volume

$$= \frac{22.4}{32} \times 16 = 11.2 \text{ liters}$$

325. 100 mL of 0.1 M H_2SO_4 is mixed with 100 mL of 0.1 N NaOH. The normality of the solution obtained is

(a) 0.4 N
(b) 0.05 N
(c) 0.04 N
(d) 0.2 N

AMU-2013

Ans. (b) : We know,

N_1V_1 = 0.2 × 100 = 20

(0.1 MH_2SO_4 = 0.2 NH_2SO_4) acid

N_2V_2 = 0.1 × 100 = 10 base

N_1V_1 acid > N_2V_2 base therefore, resultant mixture is acidic.

$$\text{Resultant normality} = \frac{N_1V_1 - N_2V_2}{V_1 + V_2} = \frac{20-10}{200}$$

$$= \frac{10}{200} = 0.05 \text{ N}$$

326. What volume of oxygen at 18°C and 750 torr, can be obtained from 110 g of $KClO_3$?

(a) 32.6 L
(b) 42.7 L
(c) 3.26 L
(d) 4.27 L

AMU-2013

Ans. (a) : Since,

$$2KClO_3 \rightarrow 2KCl + 3O_2$$

245 g $KClO_3$ gives = 3 mole O_2

$$110 \text{ g } KClO_3 \text{ will give} = \frac{3\times 110}{245} = 1.346 \text{ mole}$$

PV = nRT

Given P = 750 torr, V = ?

R = 62.364 dm^3 Torr k^{-1} mol^{-1}

and T = 273 + 18 = 291 K

$$V = \frac{1.346 \times 62.34 \times 291}{750}$$

$$= 32.569 \approx 32.6 \text{L}$$

327. A drop water is about 0.05 mL. The density of water at room temperature is about 1.0 mL^{-1}. The number of water molecules present in a drop of water are

(a) 1.67 × 10^{21} H_2O molecules
(b) 1.67 × 10^{26} H_2O molecules
(c) 1.806 × 10^{23} H_2O molecules
(d) 1.806 × 10^{21} H_2O molecules

JCECE - 2013

Ans. (a) : Given,

$$d = \frac{m}{v} \text{ or mass of 0.05 mL water}$$

= 0.05 mL × 1.0 gmL^{-1} = 0.05g H_2O

$$\text{Therefore, Moles of } H_2O = \frac{0.05}{18} \text{mol } H_2O$$

$$= \frac{6.023\times 10^{23} \times 0.05}{18}$$

= 1.67 × 10^{21} H_2O molecules

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328. The mass of 112 cm^3 of NH_3 gas at STP is

(a) 0.085 g (b) 0.850 g

(c) 8.500 g (d) 80.500 g

Karnataka-CET-2013

Ans. (a): The molar volume of a gas is volume of one mole of a gas at STP. At STP, one mole of any gas occupies a volume of 22.4 L=22400 cm^3.

Therefore, 1 mol of NH_3= 17g = 22400 cm^3 at STP

$\therefore$ 112 cm^3 of NH_3 at STP will have mass

$$=\frac{17}{22400}\times 112 = 0.085\,g$$

329. The number of water molecules present in a drop of water weighing 0.018 g is

(a) 6.022×10^{26} (b) 6.022×10^{23}

(c) 6.022×10^{19} (d) 6.022×10^{20}

Karnataka-CET-2013

Ans. (d) : We know,

Number of moles $=\frac{0.018}{18} = 0.001$ moles

Number of molecules = moles · N_A

$= 0.001\times 6.022 \times 10^{23}$

$= 1\times10^{-3}\times6.022\times10^{23}$

$= 6.022 \times 10^{20}$

330. An organic compound crystallises in an ortho rhombic system with two molecules per unit cell. The unit cell dimensions are 12.05, 15.05 and 2.69 $\overset{o}{A}$. If the density of the crystal is 1.419 g cm^{-3}, then molar mass of compound will be

(a) 207 g mol^{-1} (b) 209 g mol^{-1}

(c) 308 g mol^{-1} (d) 317 g mol^{-1}

UPTU/UPSEE-2013

Ans. (b): Orthorhombic system has different edge length, width and height

Given,

$\therefore$ a = 12.05 $\overset{o}{A}$ = 12.05×10^{-8} cm

b = 15.05 $\overset{o}{A}$ = 15.05×10^{-8} cm

c = 2.69 $\overset{o}{A}$ = 2.69×10^{-8} cm

$\therefore$ System has 2 molecules per unit cell.

Z = 2

and $N_A = 6.023 \times 10^{23}$

$$\text{Density. P} = \frac{Z\times M}{a^3\times N_A}$$

Now, molecular mass =

$$M=\frac{1.419\times12.05\times10^{-8}\times15.05\times10^{-8}\times2.69\times10^{-8}\times6.023\times10^{23}}{2}$$

$$M=2084.6\times10^{-1} = 209\,\text{gmole}^{-1}$$

331. If a LPG cylinder contains mixture of butane and isobutene, then the amount of oxygen that would be required for combustion of 1 kg of it will be

(a) 2.50×10^3 g (b) 4.50×10^3 g

(c) 1.80×10^3 g (d) 3.58×10^3 g

UPTU/UPSEE-2013

Ans. (d) :

$$C_4H_{10}+\frac{13}{2}O_2 \rightarrow 4CO_4 + 5H_2O$$

58g C_4H_{10} required $O_2 = \frac{13}{2}\times 32g$

1000g C_4H_{10} required $O_2 = \frac{13\times32\times1000}{58}$

$= 3.58 \times 10^3$ g

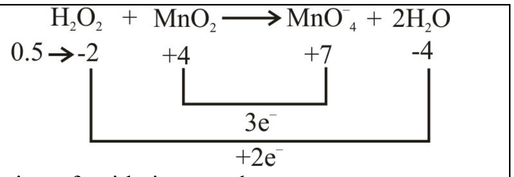
332. H_2O_2 oxidises MnO_2 is MnO_4^- in basic medium, H_2O and MnO_2 react in the molar ratio of–

(a) 1 : 1 (b) 2 : 1

(c) 2 : 3 (d) 3 : 2

BCECE-2013

Ans. (d):



On Balancing of oxidation number, we get-

$$3H_2O_2 + 2MnO_2 \rightarrow 2MnO_4^- + 6H_2O$$

Thus H_2O_2: MnO_2 = 3: 2

333. In HNC, which element has least value of formal charge?

(a) H (b) N

(c) C (d) All have same value

BCECE-2013

Ans. (c) : We know,

$$\text{Formal charge, F} = V-\frac{S}{2}-u$$

Where, V = valency electrons

S = shared electrons

u = unshared electron.

	H	N	C
V	1	5	4
S	2	8	6
U	0	0	2
F	0	1	–1

334. Haemoglobin contains 0.33% of iron by weight. The molecular weight of haemoglobin is approximately 67200. The number of iron atoms (At. Wt. of Fe = 56) persent in one molecule of haemoglobin is

(a) 4 (b) 1

(c) 5 (d) 2

BITSAT 2013

Ans. (a) : Given,

$\because$ 100 g Hb contain = 0.33 g Fe

$$\therefore 67200\,g\,Hb = \frac{67200\times0.33}{100}g\,Fe$$

$$\text{Gram atom of Fe} = \frac{672\times0.33}{56} = 4$$

335. How many grams of concentrated nitric acid solution should be used to prepare 250 mL of 2.0M HNO_3? The concentrated acid is 70% HNO_3.

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(a) 90.0 g conc. HNO_3 (b) 70.0 g conc. HNO_3
(c) 54.0 g conc. HNO_3 (d) 45.0 g conc. HNO_3

BITSAT-2013

Ans. (d) : $\text{Molarity (M)} = \dfrac{\text{wt} \times 1000}{\text{mol.wt} \times \text{vol (mL)}}$

$$2 = \frac{\text{wt.}}{63} \times \frac{1000}{250}$$

$$\text{wt.} = \frac{63}{2}\text{g}$$

$$\text{wt. of 70\% acid} = \frac{100}{70} \times 31.5 = 45\,\text{g}$$

336. How many moles of O_2 can be obtained by electrolysis of 90 g H_2O?
(a) 5.0 mol (b) 0.50mol
(c) 2.5 mol (d) 0.25 mol

CG PET- 2013

Ans. (c) : Electrolytic decomposition of 18 g of water gives 0.5 mole of O_2.
90 g of water will give (0.5/18) × 90
= 2.5 moles of O_2.

337. Which of the following would contain the same number of atoms as 20 grams of calcium?
[At masses : Ca = 40, Mg = 24, C = 12]
(a) 24 grams of magnesium
(b) 12 grams of carbon
(c) 24 grams of carbon
(d) 12 grams of magnesium

J & K CET-(2013)

Ans. (d) : Number of atoms in 40 g of Ca = 6.022 × 10^{23} (Avogadro's number)
∴ Number of atoms in 20 g of Ca =

$$\frac{6.022 \times 10^{23} \times 20}{40} = 3.011 \times 10^{23}$$

Number of atoms in 24 g of Mg = 6.022×10^{23}
∴ Number of atoms in 12 g of Mg =

$$\frac{6.022 \times 10^{23} \times 12}{24} = 3.011 \times 10^{23}$$

Number of atoms in 12 g of Carbon = 6.022×10^{23}
Number of atoms in 24 g of Carbon = $2 \times 6.022 \times 10^{23}$
= 12.044 × 10^{23}

338. Which has minimum number of atoms ?
(a) 24 gms of $C_{(12)}$ (b) 56 gms of $Fe_{(56)}$
(c) 27 gms of $Al_{(27)}$ (d) 108 gms of $Ag_{(108)}$

MPPET-2013

Ans. (a) :

Species	**Mole**	**No. of atom**
24gms of C	$\frac{12}{24} = \frac{1}{2}$	$\frac{1}{2}N_A$
56 gms of Fe	$\frac{56}{56} = 1$	1 N_A
27 gms of Al	$\frac{27}{27} = 1$	1 N_A
108 gms of Ag	$\frac{108}{108} = 1$	1 N_A

Hence, the option (a) is correct.

339. In an experiment it showed that 10 mL of 0.05 M solution of chloride required 10 mL of 0.1 M solution of $AgNO_3$. Which of the following will be the formula of the chloride? (X stands for the symbol of the element other than chlorine.)
(a) X_2Cl_2 (b) XCl_2
(c) XCl_4 (d) X_2CI

COMEDK 2013

Ans. (b) : Millimoles of solution of chloride
= 0.05×10=0.5
Millimoles of $AgNO_3$ solution = 10×0.1 =1
So, the millimoles of $AgNO_3$ are double than the chloride solution.

$$\therefore XCl_2 + 2AgNO_3 \longrightarrow 2AgCl + X(NO_3)_2$$

340. Calculate the normality of 10 volume H_2O_2?
(a) 1.7 N (b) 12 N
(c) 30.3 N (d) 0.0303 N

(AIIMS-2013)

Ans. (a): $\text{Normality} = \dfrac{\text{Gram equivlent}}{\text{volume}}$

$$\text{Gram equivalent} = \frac{\text{Molar mass}}{\text{Normality factor}}$$

Molar mass of H_2O_2 is = 1 × 2 + 2 × 16 = 34 g
N. factor of H_2O_2 is 2.

$$\text{Gram equivalent} = \frac{34}{2} = 17$$

$$\text{Normality} = \frac{17}{10} = 1.7$$

341. Number of atoms in 560 cm^3 of oxygen at S.T.P. is
(a) $\frac{1}{20} \times 6.022 \times 10^{23}$ (b) $\frac{1}{40} \times 6.022 \times 10^{23}$
(c) $\frac{1}{16} \times 6.022 \times 10^{23}$ (d) $\frac{1}{32} \times 6.022 \times 10^{23}$

COMEDK-2012

Ans. (a) : 22400 cm^3 of oxygen (O_2) at S.T.P.
=2 ×6.022×10^{23} atoms
560 cm^3 of oxygen at S.T.P.

$$= \frac{2 \times 6.022 \times 10^{23}}{22400} \times 560 = \frac{1}{20} \times 6.022 \times 10^{23}\ \text{atoms}$$

342. How many molecules of CO_2 are formed when one milligram of 100% pure $CaCO_3$ is treated with excess hydrochloric acid?
(a) 6.023 × 10^{23} (b) 6.023 × 10^{21}
(c) 6.023 × 10^{20} (d) 6.023 × 10^{19}
(e) 6.023 × 10^{18}

Kerala-CEE-2013

Ans. (e) :

$$\underset{100g}{CaCO_3} + 2HCl \rightarrow CaCl_2 + H_2O + \underset{1mol}{CO_2}$$

∵ 100g $CaCO_3$ gives, molecules of CO_2 = 6.022×10^{23}
∴ 1×10^{-3}g $CaCO_3$ given molecules of CO_2 =

$$\frac{6.022 \times 10^{23} \times 1 \times 10^{-3}}{100} = 6.022 \times 10^{18}$$

@apna_pdf

343. The volume of CO_2 (in cm^3) liberated at S.T.P. when 1.06 g of anhydrous sodium carbonate is treated with excess of dilute HCl is [atomic mass of Na = 23J]

(a) 112 (b) 224

(c) 56 (d) 2240

COMEDK-2012

Ans. **(b)** :

$$\underset{\substack{106g \\ 1.06g}}{Na_2CO_3} + 2HCl \rightarrow 2NaCl + \underset{\substack{22400cm^3 \\ \frac{22400}{106}\times 1.06cm^3 \\ =224cm^3}}{CO_2} + H_2O$$

344. The number of moles of electrons required to deposit 36 g of Al from an aqueous solution of $Al(NO_3)_3$ is (At. wt. of Al = 27)

(a) 4 (b) 2

(c) 3 (d) 1

AP EAMCET (Engg.) 2012

Ans. (a) : $Al(NO_3)_3 \longrightarrow Al^{+3} + 3NO_3^-$

$$\underset{3\text{ mol}}{Al^{3+} + 3e^-} \longrightarrow \underset{1\text{ mole} = 27\text{ gm}}{Al}$$

$\therefore$ 27 gm of Al is deposited by 3 moles of electrons.

$\therefore$ 36 gm of Al will be deposited by electrons $= \frac{3}{27}\times 36 = 4$ mole

345. The vapour density of a mixture containing NO_2 and N_2O_4 is 27.6 Mole fraction of NO_2 in the mixture is

(a) 0.8 (b) 0.6

(c) 0.4 (d) 0.2

AIIMS-2012

Ans. (a): Let the moles of NO_2 be x.

Moles of N_2O_4 will be 1 – x

Molar mass = 2 × Vapour density

So, Molar mass = 2 × 27.6 = 55.2 g

Molar mass of NO_2 = 46 g and N_2O_4 = 92 g

$$\frac{x\times 46 + (1-x)\times 92}{1} = 55.2$$

$46x + 92 - 92x = 55.2$

$$x = \frac{36.8}{46} = 0.8$$

Here, mole fraction of NO_2 in the mixture is 0.8

346. For preparing 0.1 N solution of a compound from its impure sample of which the percentage purity is known, the weight of the substance required will be

(a) less than the theoretical weight

(b) more than the theoretical weight

(c) same as the theoretical weight

(d) none of these

AIIMS-2012

Ans. (b): The sample contains impurity. The impurity won't contribute to the normality of the solution. So, we need to take more amount of sample than the theoretical weight so that the theoretical weight of compound equals weight of compound in the sample.

347. Which has the maximum number of molecules among the following ?

(a) 44 g CO_2 (b) 48 g O_3

(c) 8 g H_2 (d) 64 g SO_2

VITEEE- 2012, NEET Mains-2011

Ans. (c) : $\text{No. of moles}(n) = \frac{\text{weight in gram}}{\text{molecualr weight}}$

$$(i)\ 44\text{ gram } CO_2 = \frac{44}{44} \quad \begin{cases} \text{Molecular weight of } CO_2 \\ = 12 + 2\times 16 \\ = 12 + 32 \\ = 44 \end{cases}$$

= 1 mol

= N_A i.e. 6.022×10^{23} atoms

$$(ii)\ 48\text{ gram } O_3 = \frac{48}{48} = 1\text{ mol}$$

$$(iii)\ 8\text{ gram } H_2 = \frac{8}{2} = 4\text{ mol}$$

$$(iv)\ 64\text{ gram } SO_2 = \frac{64}{(32+2\times 16)} = \frac{64}{64} = 1\text{ mol}$$

So, maximum no. of moles present in H_2.

348. Which one of the following will have largest number of atoms?

(a) 1 g Au (b) 1 g Na

(c) 1 g Li (d) 1 g Cl_2

BCECE-2012

Ans. (c) : (i) 197 g of Au Contains = 6.022×10^{23}

1 gm of Au Contains = $\frac{6.022\times 10^{23}}{197\times 1}$

= 3.06×10^{21} atoms

(ii) 23 g of Na Contains atoms = 6.022×10^{23}

1 gm of Na Contains atoms = $\frac{6.022\times 10^{23}}{23\times 1}$

= 26.2×10^{21} atoms

(iii) 7 g of Li Contains atoms = 6.022×10^{23}

1 g of Li Contains atoms = $\frac{6.022\times 10^{23}}{7\times 1}$

= 86.0×10^{21} atoms

(iv) 1 g of Cl Contains atoms = $\frac{6.022\times 10^{23}}{71\times 1}$

= 8.48×10^{21} atoms

Hence, 1 g of Li will have the largest number of atoms.

349. Morality of liquid HCl if density of solution is 1.17 g/cc

(a) 36.5 (b) 18.25

(c) 32.05 (d) 42.10

BCECE-2012

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Ans. (c) : Molarity = (density /molar mass) × 1000 moles per liter.

Molar mass of HCl = [1 + 35.5] = 36.5 g/mol

Molarity = (1.17/36.5) × 1000 = 32.05 M

Molarity of liquid HCl with density equal to 1.17 g/cc is 32.05.

350. The volume of neon gas in cm^3 at STP having the same number of atoms as that present in 800 mg of Ca is (At. mass : Ca = 40 g mol^{-1} Ne = 20 g mol^{-1})

(a) 56 (b) 896
(c) 224 (d) 112
(e) 448

Kerala-CEE-2013

Ans. (e) : Given,

Mass of Ca = 800mg = $\frac{800}{1000} = 0.8g$

Moles of Ca in 0.8g = $\frac{0.8}{40} = 2\times10^{-2}$

∵ At S.T.P. Volume of 1 mole = 22400 cm^3

∴ At S.T.P, Volume of 2×10^{-2} moles

$= 22400 \times 2 \times 10^{-2} = 448\ cm^3$

351. Avogadro number (6.023×10^{23}) of carbon atoms are present in

(a) 12 grams of $^{12}CO_2$
(b) 22.4 liter $^{12}CO_2$ in room temperature
(c) 44 grams of $^{12}CO_2$
(d) 12 moles of $^{12}CO_2$

J & K CET-(2012)

Ans. (c) : 1 mole of CO_2

= Gram molecular mass of CO_2 (44g)

= 6.023×10^{23} molecules of CO_2

= 6.023×10^{23} atoms of Carbon

352. The volume of 0.1 M $Ca(CH)_2$ required to neutralize 10 mL of 0.1 N HCl

(a) 10 mL (b) 20 mL
(c) 5 mL (d) 15 mL

J & K CET-(2012)

Ans. (c) : The volume of 0.1 M $Ca(OH)_2$ required to neutralize 10 mL of 0.1 N HCl =

$$\underset{Ca(OH)_2}{2M_1V_1} = \underset{(HCl)}{M_2V_2}$$

(because 0.1 NHCl = 0.1 MHCl)

$2 \times 0.1 \times v_1 = 0.1 \times 10$

$v_1 = \frac{0.1\times10}{2\times0.1}$

$v_1 = 5$ mL

353. 6.02×10^{20} molecules of urea are present in 100 ml. of its solution. The concentration of solution is

(a) 0.001 M (b) 0.1 M
(c) 0.02 M (d) 0.01 M

NEET-2013

Ans. (d) : Number of molecules of Urea = 6.02×10^{20}

Number of moles = $\frac{6.02\times10^{20}}{N_A}$

$= \frac{6.02\times10^{20}}{6.02\times10^{23}} = 1\times10^{-3}$ mol

volume of the solution

= 100 mL = $\frac{100}{1000}L = 0.1L$

Concentration of Urea solution (in mol L^{-1}) =

$\frac{1\times10^{-3}}{0.1} mol\,L^{-1} = 10^{-2}\ molL^{-1} = 0.01M$

Hence the concentration of solution is 0.01M

354. 10 g of hydrogen and 64 g of oxygen were filled in a steel vessel and exploded. Amount to water produced in this reaction will be

(a) 3 mol (b) 4 mol
(c) 1 mol (d) 2 mol

JCECE - 2012

Ans. (b) : Moles of $H_2 = \frac{10}{2} = 5\,mol$

Moles of $O_2 = \frac{64}{32} = 2\,mol$

$$\underset{(5mol)}{2H_2} + \underset{(2mol)}{O_2} \longrightarrow \underset{(4mol)}{2H_2O}$$

Here O_2 is limiting reagent. So, amount of product, H_2O obtained depends on the amount of O_2. According to equation,

1 mole O_2 on reaction with H_2 gives = 2 mole of H_2O

2 mole O_2 on reaction with H_2 will give $= \frac{2\times2}{1} = 4$ mole of H_2O

Note 1 mole of H_2 is in excess.

355. The total number of electrons present in 18 mL of water (density = 1g mL^{-1}) is

(a) 6.02×10^{25} (b) 6.02×10^{24}
(c) $6.02 \times 18 \times 10^{23}$ (d) 6.02×10^{23}

Karnataka-CET-2012

Ans. (b):

18 ml H_2O = 18g H_2O = 1 mole of H_2O

1 mole H_2O = 6.022×10^{23} molecules

(Number of electrons present in one molecule of water = 2 + 8 = 10)

then, 1 mole H_2O = $10 \times 6.02 \times 10^{23}$

= 6.02×10^{24} electrons.

356. 0.02 mole of $[Co(NH_3)_5Br]Cl_2$ and 0.02 mole of $[Co(NH_3)_5Cl]SO_4$ are present in 200 cc of a solution X. The number of moles of the precipitates Y and Z that are formed when the solution X is treated with excess silver nitrate and excess barium chloride are respectively

(a) 0.02, 0.02 (b) 0.01, 0.02
(c) 0.02, 0.04 (d) 0.04, 0.02
(e) 0.02, 0.01

Kerala-CEE-2012

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Ans. (d):

$$[Co(NH_3)_5Br]Cl_2 \longrightarrow [Co(NH_3)_5Br]^{2+} + 2Cl^-$$

Here, 1 mole of $[Co(NH_3)_5Br]Cl_2$ is giving 2 moles of Cl^- ion. Then 0.02 mole will dissociate to give $2\times0.02 = 0.04$ moles of Cl^- ions.

⇒ On reaction with silver nitrate, 0.04 moles of silver chloride precipitate will be obtained. $[Co(NH_3)_5Cl]SO_4 \longrightarrow [Co(NH_3)_5Cl]^{2+} + SO_4^{2-}$

Here, 1 mole of $[Co(NH_3)_5Cl]SO_4$ is giving 1 mole of SO_4^{2-} ion. Then 0.02 moles of $[Co(NH_3)_5Cl]SO_4$ will dissociate to give 0.02 moles of SO_4^{2-}ion.

⇒ On reaction with silver nitrate, 0.02 moles of silver sulphate precipitate will be obtained.

357. The mole fraction of methanol is in 4.5 molal aqueous solution is

(a) 0.250 (b) 0.125
(c) 0.100 (d) 0.05
(e) 0.055

Kerala-CEE-2012

Ans. (d):

$$\text{molality} = \frac{\text{moler of solute}}{\text{mass of solvent}(kg)}$$

$$4.5 = \frac{n_A}{18g}\times1000$$

$$n_A = \frac{4.5\times18}{1000} = 0.081 \text{ moles}$$

$$\text{mole fraction } = \frac{\text{moles of solute}}{\text{total moles of solution}}$$

$$= \frac{n_A}{n_A + n_B}$$

$$= \frac{0.081}{0.081+1} \quad (n_B = \text{moles of solvent} = \text{moles of water})$$

$$= 0.075$$

358. How many grams of sulphuric acid is to be dissolved to prepare 200 mL aqueous solution having concentration of $[H_3O^+]$ ions 1 M at 25^0 C temperatures? [H= 1, O= 16, S= 32g mol^{-1}]

(a) 4.9g (b) 19.6g
(c) 9.8g (d) 0.98g

UP CPMT-2012

Ans. (c) ∴ 2 M $[H_3O^+]$ ions are obtained from 1M H_2SO_4
∴ 1 M $[H_3O^+]$ ions are obtained from 0.5 M H_2SO_4
Molarity

$$M = \frac{m(H_2SO_4)\times1000}{M(\text{molar mass } H_2SO_4)}\times\text{Volume of solution(mL)}$$

$$0.5 = \frac{m\times1000}{98\times200}$$

$$m = \frac{0.5\times98\times200}{1000} = 9.8g$$

359. How much ethyl alcohol C_2H_5OH, must be added to 1.00 L of water so that the solution will not are freeze at – 4° F?

(a) 211 g (b) 495 g
(c) 85 g (d) 46 g

UPTU/UPSEE-2012

Ans. (b) :

$$4^oF = \frac{5}{9}(-4-32)^oC = -20^oC$$

$$\Delta T_f = 20^oC = K_f m = (1.86^o c/m)(m)$$

$$m = \frac{20^oC}{1.86^oc/m} = 10.70m = (10.7\,mol)(46.0g/mole)$$

$$= 495g$$

360. The number of sodium atoms in 2 moles of sodium ferroyanide is

(a) 12×10^{23} (b) 26×10^{23}
(c) 34×10^{23} (d) 48×10^{23}

UPTU/UPSEE-2012

Ans. (d) : formula of sodium ferrocyanide = $Na_4[Fe(CN)_6]$. It has four sodium atoms. Number of Na atoms = no of moles × no. of atoms per Molecule × Avogadro number
$= 2 \times 4 \times 6.023 \times 10^{23}$
$= 48 \times 10^{23}$

361. Sodium bicarbonate on heating decomposes to form sodium carbonate, CO_2 and water. If 0.2 moles of sodium bicarbonate is completely decomposed, how many moles of sodium carbonate is formed?

(a) 0.1 (b) 0.2
(c) 0.05 (d) 0.025

UPTU/UPSEE-2012

Ans. (a) : Sodium hydrogen carbonate (also known as sodium bicarbonate or bicarbonate of soda) has the chemical formula $NaHCO_3$.

$$\underset{2mol}{2NaHCO_3} \xrightarrow{\Delta} \underset{1mol}{Na_2CO_3} + H_2O + CO_2$$

∵ 2 mol $NaHCO_3$ on decomposition gives = 1 mol Na_2CO_3

∴ 0.2 mol $NaHCO_3$ on decomposition will give

$$= \frac{1}{2}\times0.2 = 0.1 \text{ mol } Na_2CO_3$$

362. The weight of oxalic acid that will be required to prepare a 1000 mL (N/20) solution is

(a) 126/100 g (b) 63/40 g
(c) 63/20 g (d) 126/20 g

WB-JEE-2012

Ans. (c) : Hydrated oxalic acid = $C_2H_2O_4.2H_2O$
Molecular mass of oxalic acid = 126
12.6g oxalic acid per liter of the solution should be dissolved to prepare M/10 oxalic acid solution.
M.wt of $H_2C_2O_4.2H_2O$ is 126 (n factor = 2),

$$E.wt = \frac{126}{2} = 63$$

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$$N = \frac{\text{no.of gm-equivalent}}{\text{Volume of Solution in L}}$$

$$\therefore \quad \frac{1}{20} = \frac{W/63}{1}$$

$$\because \quad \frac{63}{20}\text{gm}.$$

363. If one mole of a substance is present in 1kg of solvent then its concentration is called

(a) molar conc. (b) molal conc.
(c) normality (d) strength wt/wt.

BCECE-2011

Ans. (b) : If one mole of a substance is present in 1 kg of solvent then it concentration is called molal concentration.

A 1-molar solution contains one mole of solute per 1kg solvent, molality is a hybrid concentration unit, retaining the convenience of mole measure for the solute, but expressing it in relation to a temperature-independent mass rather than a volume.

364. The mass of potassium dichromate crystals required to oxidise 750 cm^3 of 0.6 M Mohr's salt solution is (molar mass = 392)

(a) 0.49 g (b) 0.45 g
(c) 22.05 g (d) 2.2 g

[AIEEE 2011]

Ans. (c) : Given,

Concentration of Mohr's salt = 0.6M

Volume = $750cm^3$ = 0.75L

$$\text{Molarity} = \frac{\text{No.of Moles Solute}}{\text{Volume of Solution in L}}$$

$$0.6 = \frac{n}{0.75\,L}$$

n = 0.6×75L = 0.45 mol

$$K_2Cr_2O_7 + 6FeSO_4 + 7H_2SO_4 \rightarrow K_2SO_4 + Cr_2(SO_4)_3 + 3Fe(SO_4)_3 + 7H_2O$$

For 6 mol Mohr's salt 1 mole of Potassium dichromate is required.

For 0.45 mol of Mohr's salt, Potassium dichromate required is 1 × 0.45/6 = 0.05 mol

Mass of Potassium dichromate required is 0.05 × 294
= 22.05 g

365. When 6.3 g of sodium bicarbonate are added to 30.0 g of acetic acid solution, the residual solution is found to weigh 33.0 g. The mass of carbon dioxide released in the reaction is

(a) 3.0 g (b) 0.91 g
(c) 1.91 g (d) 3.3 g

J & K CET-(2011)

Ans. (d) : Given,

Amount of sodium bicarbonate = 6.3g

Amount of acetic acid = 30.0g

Amount of residual solution = 33.0g

$$CH_3COOH + NaHCO_3 \rightarrow CH_3COONa + H_2O + CO_2$$

Total amount of reactants = 6.3 + 30.0 = 36.3 g

∴ Mass of Carbon dioxide released
= 36.3 – 33.0
= 3.3 g

366. 0.1 mol HCl is equal to

(a) 3.65 g (b) 36.5 g
(c) 18 g (d) 1.8 g

JIPMER-2011

Ans. (a) : Given,

The number of moles of HCl = 0.1

The number of particles in one mole = 6.023×10^{23}

The molar mass of a substance is defined as the mass of 1 mole of that substance, expressed in gram per mole, and is equal to the mass of 6.022×10^{23} atoms, molecules, or formula units of that substance.

So the mass of one mole of HCl = 1 + 35.5 = 36.5 g

- So, the mass of 0.1 mole = $\frac{36.5}{10} = 3.65g$

367. A mixture of ethane and ethene occupies 41L at 1 atm and 500 K. The mixture reacts completely with $\frac{10}{3}$ mole of O_2 to produce CO_2 and H_2O. The mole fraction of ethane and ethene in the mixture are respectively (R = 0.082 L atm K^{-1} mol^{-1})

(a) 0.50, 0.50 (b) 0.75, 0.25
(c) 0.67, 0.33 (d) 0.25, 0.75
(e) 0.33, 0.67

Kerala-CEE-2011

Ans. (c) : For a gaseous mixture of C_2H_6 and C_2H_4

$$pV = nRT \text{ or } n = \frac{PV}{RT} = \frac{1\times 41}{0.082\times 500}$$

or n = 1

∴ Total mole of $C_2H_6 + C_2H_4$ = 1mole

Let the mole of

$C_2H_6 = x$

Then mole of $C_2H_4 = 1 – x$

$C_2H_6 + 7/2O_2 \rightarrow 2CO_3 + 3H_2O$

$C_2H_4 + 3O_2 \rightarrow 2CO_3 + 2H_2O$

∴ Mole of O_2

Needed for complete reaction of mixture

$$= \frac{7}{2}x + 3(1-x)$$

$$\therefore \quad \frac{7}{2}x + 3(1-x) = \frac{10}{3}$$

$$\text{or } x = \frac{2}{3}$$

Thus, mole fraction of

$$C_2H_6 = \frac{2}{3} = 0.67$$

and mole fraction of

$$C_2H_6 = \frac{2}{3} = 0.67$$

and mole fraction of

$$C_2H_4 = 1 - \frac{2}{3} = 0.33$$

368. How many moles of magnesium phosphate, $Mg_3(PO_4)_2$ will contain 0.25 mole of oxygen atoms.

(a) 0.02 (b) 3.125×10^{-2}
(c) 1.25×10^{-2} (d) 2.5×10^{-2}

UP CPMT-2011

@apna_pdf

Ans. (b): 8 mol O-atoms are contained by 1 mole $Mg_3(PO_4)_2$.

$\therefore$ 0.25 mole of O-atoms are present in

$$Mg_3(PO_4) = \frac{1}{8} \times 0.25 \text{ mol}$$

$$= 3.125 \times 10^{-2} \text{ mol}$$

369. The amount of energy released when 20 mL 0.5 M NaOH is mixed with 100 ML 0.1 M HCl is x kJ. The heat of neutralization (in kj mol^{-1}) is

(a) –100 x kJ/mol (b) –50 x kJ/mol

(c) +100x kJ/mol (d) +50 x kJ/mol

WB-JEE-2011

Ans. (a) :

$$\text{moles of NaOH} = \frac{20\text{mL}}{1000\text{mL/L}} \times 0.5\text{mol/L}$$

$$= 0.01 \text{ mol.}$$

$$\text{moles of HCl} = \frac{100\text{mL}}{1000\text{mL/L}} \times 0.1\text{mole} = 0.01\text{mol}$$

when 0.01 moles of NaOH neutralizes 0.01 moles of HCl, the heat released is x kJ.

when 1 mole of NaOH neutralizes 1 mole of HCl, heat released will be $\dfrac{x\,\text{kJ}}{0.01\text{mol}} = 100x\,\text{kJ/mol}$

Since heat is released, negative sign will be introduced. Hence, the answer is

= –100x kJ/mol.

370. 2 g of non-volatile water soluble compound is dissolved in 100 g of water. The elevation in boiling point is found to be 0.26. The molecular mass of the compound X is

(a) 20 (b) 60

(c) 80 (d) 40

COMEDK-2011

Ans. (d) : Given that,

$\Delta T_b = 0.26$

$K_b = 0.512$

$\therefore \Delta T_b = K_b m$

$$0.26 = \frac{1000 \times K_b \times \omega_2}{M_2 \times \omega_1}$$

$$M_2 = \frac{1000 \times 0.52 \times 2}{0.26 \times 100} = 40 \text{ gm.}$$

371. A container of 1.0 lit. capacity filled with 1.0 mole of ideal gas is connected to an evacuated vessel of 9.0 lit. calculate change in entropy. (R = 1.987 Cal.)

(a) 0.188 Cal. K^{-1} mol^{-1}

(b) 0.4576 Cal. K^{-1} mol^{-1}

(c) 4.576 Cal. K^{-1} mol^{-1}

(d) 4.366 Cal. K^{-1} mol^{-1}

GUJCET-2011

Ans. (d): Given that, V_1 = 1 liter, V_2 = 9 liter, n = 1

$$\therefore \text{Change in entropy} = nR\ln\frac{V_2}{V_1}$$

Putting the value of these, we get

$$\therefore \text{Change in entropy} = 2.303 \times 1 \times 1.987 \times \log\frac{9}{1}$$

$$= 2.303 \times 1.987 \times 0.9542$$

Change in entropy = 4.366 cal K^{-1} mol^{-1}

372. How many grams of sulphuric acid is to be dissolved to prepare 200 ml. aqueous solution having concentration of $[H_3O^+]$ ions 1 M at 25ºC temperature.

[H = 1, O = 16, S = 32 gram $mole^{-1}$]

(a) 4.9 gram (b) 19.6 gram

(c) 9.8 gram (d) 0.98 gram

GUJ CET-2011

Ans. (c): Given that, V = 200 ml

Concentration of $[H_3O^+]$ ions = 1 M

$$\therefore \quad M = \frac{W_2 \times 1000}{M_2 \times V(\text{ml})}$$

$$W_2 \text{ (Weight of } H_2SO_4) = \frac{M \times M_2 \times V}{1000}$$

$$= \frac{1 \times 98 \times 200}{1000} = 19.6$$

$\therefore$ $H_2SO_4 + 2H_2O \rightleftharpoons 2H_3O^+ + SO_4^{2-}$

1 mole of $H_2SO_4 \rightarrow$ 2 mole of H_3O^+

W_2 = 19.2/2 = 9.8 gm

373. A solution is prepared by dissolving 24.5 g of sodium hydroxide in distilled water to give 1 L solution. The molarity of NaOH in the solution is (Given that molar mass of NaOH = 40.0 g mol^{-1})

(a) 0.2450 M (b) 0.6125 M

(c) 0.9800 M (d) 1.6326 M

AIIMS-2010

Ans. (b): Given, W_{NaOH} = 24.5 g

Molar mass of NaOH = 23 + 16 + 1 = 40

$$\text{No. of moles of NaOH} = \frac{24.5}{40}\text{moles}$$

$$= 0.6125$$

$$\therefore \text{Molarity of solution} = \frac{0.6125\text{moles}}{1\text{L}}$$

$$= 0.6125 \text{ M}$$

374. The number of molecules of CO_2 liberated by the complete combustion of 0.1 g atom of graphite in air is

(a) 3.01×10^{22} (b) 6.02×10^{23}

(c) 6.02×10^{22} (d) 3.01×10^{23}

AP-EAMCET- (Engg.) - 2010

Ans. (c) : $\underset{1\text{ mole}}{C(s)} + O_2(g) \longrightarrow \underset{1\text{ mole}}{CO_2(g)}$

$\because$ 1 mole of graphite on complete combustion gives $CO_2 = 6.023 \times 10^{23}$ molecules.

$\therefore$ 0.1 mole of graphite will give CO_2

$$= \frac{6.023 \times 10^{23} \times 0.1}{1} = 6.023 \times 10^{22}$$

375. The number of water molecules is maximum in

(a) 1.8 gram of water

(b) 18 gram of water

@apna_pdf

(c) 18 moles of water
(d) 18 molecules of water

NEET-2013

Ans. (c) : No of moles of water in 1.8 g = 0.1 moles in 18 g = 1 moles.

$\because$ 1 mole water = 6.02×10^{23} molecules

$\therefore$ 18 mole water = $18 \times 6.02 \times 10^{23}$ molecules

Here, 18 mole water has maximum number of molecules.

376. Which of the following has smallest number of molecules ?

(a) 11.2 L of O_2 at NTP
(b) 8.0 g of O_2
(c) 0.1 mole of O_2
(d) 2.24×10^4 mL of O_2

AMU – 2010

Ans. (c) : (i) No. of molecules in 11.2 lit of O_2

$$= \frac{11.2}{22.4} \times 6.023 \times 10^{23}$$

$$= 0.5 \times 6.023 \times 10^{23}$$

(ii) No. of. molecules in 8.0 g of O_2

$$= \frac{8.0}{32} \times 6.023 \times 10^{23}$$

$$= 0.25 \times 6.023 \times 10^{23}$$

(iii) No. of. molecules in 0.1 mole of O_2

$$= 0.1 \times 6.023 \times 10^{23}$$

(iv) No. of molecules in 2.24×10^4 ml of O_2

$$= \frac{2.24 \times 10^4}{22400} \times 6.023 \times 10^{23}$$

$$= 6.023 \times 10^{23}$$

So, 0.1 mole of O_2 contains smallest no. of molecules.

377. The total number of atoms of all elements present in 1 mole of ammonium dichromate is

(a) 19
(b) 6.023×10^{23}
(c) 114.437×10^{23}
(d) 84.322×10^{23}

AMU – 2010

Ans. (c) : Ammonium dichromate is $(NH_4)_2Cr_2O_7$.

1 mole consists of 2 atoms of N,
8 atoms of H,
2 atoms of Cr,
and 7 atoms of O

So, total = $(2+8+2+7) \times 6.023 \times 10^{23}$
= 114.473×10^{23}

378. In redox reaction 1 g-eq of reducing agent requires P gm-eq. of oxidizing agent. The value of P is

(a) 1
(b) 2
(c) 3
(d) Depends on reaction

BITSAT 2010

Ans. (a) : In redox reaction,

g equivalent of reducing agent = g equivalent of oxidizing agent

Hence, 1g equ. of reducing agent = Pg equ. of oxidizing agent.

379. If 20 mL of 0.4 N NaOH solution completely neutralises 40 mL of a dibasic acid, the molarity of the acid solution is

(a) 0.1 M
(b) 0.2 M
(c) 0.3 M
(d) 0.4 M

CG PET- 2010

Ans. (a) : Volume b of NaOH = 20 ml.

Strength of NaOH = 0.4 N

Volume of dibasic acid = 40 ml

Strength of dibasic acid = $20 \times \frac{0.4}{40} = 0.2$ N

Molarity of the dibasic acid = $\frac{\text{Normality}}{2}$

Molarity = $\frac{0.2}{2} = 0.1\text{m}$

380. Molality of a solution is equal to

(a) $\frac{\text{number of Moles of solute}}{\text{number of litres of solution}}$

(b) $\frac{\text{number of equivalents of solute}}{\text{number of litres of solution}}$

(c) $\frac{\text{number of Moles of solute}}{\text{number of kilogram of solvent}}$

(d) $\frac{\text{number of Moles of a component}}{\text{total number of moles of all components}}$

CG PET- 2010

Ans. (c) : Molarity = $\frac{\text{number of Moles of solute}}{\text{number of litres of solution}}$

Molarity = $\frac{\text{number of equivalents of solute}}{\text{number of litres of solution}}$

Molarity = $\frac{\text{number of Moles of solute}}{\text{number of kilogram of solvent}}$

Molarity = $\frac{\text{number of Moles of a component}}{\text{total number of moles of all components}}$

381. If 300 mL of a gas weighs 0.368 g at STP. What is its molecular weight?

(a) 30.16 g
(b) 2.55 g
(c) 27.5 g
(d) 37.5 g

J & K CET-(2010)

Ans. (c) : Given,

Weight of 300mL gas = 0.368g

As we know that one mole of any gas occupies a volume of 22.4L = 22400mL at STP.

Weight of 22400 mL gas

$$= \frac{0.368 \times 2240}{300} \text{g/mol}$$

$$= 27.47 \text{ g/mol} \simeq 27.5 \text{g/mol}$$

$\because$ Molecular weight of the gas is 27.5 g

[$\therefore$ 22400 mL of a gas contains amount equal to molecular weight of the gas.]

@apna_pdf

382. The molecules present in 5.6 L of sulphur dioxide at STP is

(a) 1.5×10^{23} (b) 1.5×10^{-23}

(c) 4×10^{23} (d) 0.15×10^{23}

J & K CET-(2010)

Ans. (a) : The molar volume of a gas is the volume of one mole of a gas at STP. At STP, one mole (6.02×10^{23} particles) of any gas occupies a volume of 22.4 L.

22.4 L of gas at STP = 1 mole

$$5.6 \text{ L of gas at STP} = \frac{5.6}{22.4} \text{ moles}$$
$$= 0.25 \text{ moles}$$

$\therefore$ Number of molecules in 5.6 L SO_2

$$= 0.25 \times 6.023 \times 10^{23}$$
$$= 1.50 \times 10^{23}$$

383. The number of moles of H_2 in 0.224 L of hydrogen gas at STP (273 K, 1 atm), is

(a) 0.1 (b) 0.01

(c) 0.001 (d) 1

JCECE - 2010

Ans. (b) : As we know that one mole of any gas occupies a volume of 22.4L at STP.

22.4 L of H_2 = 1 mol H_2

$$0.224 \text{ L of } H_2 = \frac{1}{22.4} \times 0.224 \text{ mol}$$
$$= 0.01 \text{ mol of } H_2$$

384. 9.65 C of electric current is passed through fused anhydrous magnesium chloride. The magnesium metal thus, obtained is completely converted into a Grignard reagent. The number of moles of the Grignard reagent obtained is

(a) 5×10^{-4} (b) 1×10^{-4}

(c) 5×10^{-5} (d) 1×10^{-5}

KARNATAKA-CET, 2010

Ans. (c) : Given, volue of electric current = 9.65C

$$MgCl_2 \longrightarrow Mg^{2+} + 2Cl^-$$
$$Mg^{2+} + 2e^- \longrightarrow \underset{1\,mol}{Mg} \text{ (at cathode)}$$

$\because$ 2F (2 × 96500 C) deposits Mg = 1 mol

$$9.65 \text{ C charge will deposit Mg} = \frac{1 \times 9.65}{2 \times 96500}$$
$$= 5 \times 10^{-5} \text{mol}$$

In order to prepare Grignard reagent, one mole of Mg is used per mole of reagent obtained. Thus, by 5×10^{-5} mol Mg, 5×10^{-5} mole of Grignard reagent are obtained.

385. How much time (in hours) would it take to distribute one Avogadro number of wheat gains, if 10^{20} grains are distributed each second?

(a) 0.1673 (b) 1.673

(c) 16.73 (d) 167.3

(e) 1673

Kerala-CEE-2010

Ans. (b): Avogadro's number, number of units in one, mole of any substance (defined as its molecular weight is grams), equal to 6.022×10^{23}. The units may be electrons, atoms, ions, or molecules.

If 10^{20} grains are distributed in 1s, 6.023×10^{23} grains will be distributed

$$\frac{6.023 \times 10^{23} \times 1}{10^{20}} = 6023 \text{ sec} = 1.673 \text{hr.}$$

386. A 600 W mercury lamp emits monochromatic radiation of wavelength 331.3 nm. How many photons are emitted from the lamp per second? (h = 6.626×10^{-34} Js; velocity of light = 3×10^8 ms^{-1})

(a) 1×10^{19} (b) 1×10^{20}

(c) 1×10^{21} (d) 1×10^{23}

(e) 1×10^{22}

Kerala-CEE-2010

Ans. (c) : Given than, $\lambda = 331.3 \text{ nm} = 331.3 \times 10^{-9}$ m

$h = 6.626 \times 10^{-34}$ Js, $c = 3 \times 10^8$ ms^{-1}

Photons are emitted from the lamp per second

$$E = \frac{nhc}{\lambda}$$
$$\therefore \quad n = \frac{E\lambda}{hc}$$
$$\Rightarrow \quad n = \frac{600 \times 331.3 \times 10^{-9}}{6.626 \times 10^{-34} \times 3 \times 10^8}$$
$$n = 1 \times 10^{21}$$

387. How many gram-equivalents of NaOH are required to neutralise 25 cm^3 of a decinormal HCl solution?

(a) 0.00125 (b) 0.0025

(c) 0.0050 (d) 0.025

MHT CET-2010

Ans. (b) : For acid-base reactions,

gram equivalent of acid (HCl) = gram equivalent of base (NaOH)

$$\therefore \text{ gram equivalent of acid} = (25 \times 10^{-3}) dm^3 \times \frac{1}{10}$$
$$= 25 \times 10^{-4}$$
$$= 0.0025$$

388. 25.3 g of sodium carbonate, Na_2CO_3 is dissolved in enough water to make 250 ml. of solution. If sodium carbonate dissociates completely, molar concentration of sodium ion, Na^+ and carbonate ions, CO_3^{2-} are respectively (Molar mass of Na_2SO_3 = 106 g mol^{-1})

(a) 0.955 M and 1.910 M

(b) 1.910 M and 0.955 M

(c) 1.90 M and 1.910 M

(d) 0.477 M and 0.477 M

NEET-2010

Ans. (b) : Given that, weight of sodium carbonate = 25.3 gm

$$\text{Moles of } Na_2CO_3 = \frac{\text{Moles of solute}}{\text{litre of solution}}$$
$$= \frac{25.3}{106} = 0.239 \text{ moles}$$

@apna_pdf

Molarity of solution $= \dfrac{0.239}{0.25} = 0.956$ mol/litre

$Na_2CO_3 \rightarrow 2Na^+ + CO_3^{2-}$

∴ Concentration of $CO_3^{2-} = 0.956$ M

Concentration of $Na^+ = 2\times0.956$

$= 1.912$ M.

389. The number of atoms in 0.1 mol of triatomic gas is ($N_A = 6.02 \times 10^{23}$ mol^{-1})

(a) 6.026×10^{22}
(b) 1.806×10^{23}
(c) 3.600×10^{23}
(d) 1.800×10^{22}

NEET-2010

Ans. (b) : 1 mole of triatomic gas has $3 \times 6.02\times10^{23}$ atoms

Therefore, no. of atoms 0.1 mol $= 0.1 \times 3\times6.02 \times 10^{23}$

$= 1.806 \times 10^{23}$

390. Which is heaviest?

(a) 25g mercury
(b) 2 mole carbon dioxide
(c) 2 mole water
(d) 4 g-atom of oxygen

UPTU/UPSEE-2010

Ans. (d) : The atom which has maximum mass is known as heaviest.

(i) Mass of Hg = 25g
(ii) Mass of 2 moles of $CO_2 = 2 \times 44 = 88$g
(iii) Mass of 2 moles of $H_2O = 2 \times 18 = 36$g
(iv) Mass of 4g atoms of $O_2 = 4 \times 32 = 128$g

391. How many moles of helium gas occupy 22.4 L at 0^o C and at 1 atm pressure?

(a) 0.11
(b) 1.11
(c) 0.90
(d) 1.0

BCECE-2010

Ans. (d) : Given that, P = 1 atm, T = 0^oC = 273K

$$PV = nRT$$

$$n = \frac{PV}{RT}$$

$$n = \frac{1\,atom(22.4L)}{(0.082\ L\,atm/mol\,k)273k}$$

$$n = 1 \text{ mole}$$

1mole of the gas occupies 22.4 L at 0°C at 1 atm pressure.

392. If two moles of glucose are oxidized in the body through respiration, then number of moles of ATP produced are

(a) 19
(b) 38
(c) 57
(d) 76

AMU–2009

Ans. (d) : Cellular respiration can be an anaerobic or aerobic respiration, depending on whether or not oxygen is present. Anaerobic respiration makes a total 2ATP. Aerobic respiration is much more efficient and can produce upto 38 ATP with a single molecule of glucose.

It two moles of glucose is oxidized to give 38 × 2 = 76 moles of ATP.

393. 1 mole of CO_2 contains

(a) 6×10^{23} atoms of C
(b) 6×10^{23} atoms of O
(c) 18×10^{23} molecules of CO_2
(d) 3 g-atoms of CO_2

BCECE-2009

Ans. (a) : The molecular mass of carbon dioxide is 44 amu. The molar mass of any compound is the mass in grams of one mole of that compound. One mole of carbon dioxide molecules has a mass of 44.01 gm.

One mole of any substance contains Avogadro number of atoms. In this carbon one mole is present.

So, 1 mole of CO_2 contains $= 6.023 \times 10^{23}$ atoms of C

394. If $NO_2(N_2O_4)$ is dissolved in NaOH, we get solution of

(a) $NaNO_2$
(b) $NaNO_3$
(c) mixture of $NaNO_2$ and $NaNO_3$
(d) $NaNO_4$

CG PET-2009

Ans. (c) : Nitrogen dioxide (NO_2) exists as a dimer N_2O. When it is dissolved in sodium hydroxide or any other alkali, a mixture of nitrate and nitrite is obtained.

$$2NO_2 + 2NaOH \rightarrow \underset{\substack{\text{Sodium}\\\text{Nitrite}}}{NaNO_2} + \underset{\substack{\text{Sodium}\\\text{Nitrate}}}{NaNO_3} + H_2O$$

395. If 'F' is Faraday and 'N' is Avogadro number, then charge of electron can be expressed as

(a) $F \times N$
(b) $\dfrac{F}{N}$
(c) $\dfrac{N}{F}$
(d) F^2N

CG PET -2009

Ans. (b) : We know that,

$$F = N \cdot e$$

Where, F = Faraday Constant
N = Avogadro number
e = Charge of electron.

Or $\quad e = \dfrac{F}{N}$

396. By passing 9.65 A current for 16 min 40s, the volume of O_2 liberated at STP will be

(a) 280 mL
(b) 560 mL
(c) 1120 mL
(d) 2240 mL

CG PET -2009

Ans. (b): Given than, i = 9.65A, t = 16 min 40 sec = 1000 sec.

We known that, Charge (Q) = i × t

= 9.65 × 1000 coulomb

= 9650 C = 0.1 F

$$O^{2-} \rightarrow \frac{1}{2}O_2 + 2e^-$$

$2F = 0.5$ mol $O_2 = 0.5 \times 22400$ mol

$$0.1F \text{ of } O_2 = \frac{0.5\times22400}{2F}\times0.1F = 560\,\text{mole}$$

@apna_pdf

397. The number of molecules in 18 mg of water in terms of Avogadro number N is

(a) 10^{-3} N (b) 10^{-2} N

(c) 10^{-1} N (d) 10 N

J & K CET-(2009)

Ans. (a) : Weight of water = 18 mg = 18 × 10^{-3} g

$$\therefore \text{ Number of moles } = \frac{\text{weight}}{\text{molar mass}}$$

$$= \frac{18\times10^{-3}}{18} = 1\times10^{-3}$$

Number of molecules = no. of moles × Avogadro no.

$$= 1\times10^{-3}\text{N} = 10^{-3}\text{N}$$

398. How much volume of oxygen at STP in litres is required to burn 4 gm of methane gas completely?

(a) 11.2 (b) 5.6

(c) 2.8 (d) 8

J & K CET-(2009)

Ans. (a) : $CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$

1 mole of CH_4 needs 2 moles of molecular O_2.

4 g of CH_4 = 0.25 mole of CH_4 mole ratio between CH_4 and O_2 = 1: 2 then 0.25

Mole of CH_4 reacts with $\cancel{2/1} \times 0.25 = 0.50$ mole of O_2

Volume of O_2 required to completely combust CH_4 at STP condition is

= 0.50 mole × 22.4 L/ mole

= 11.20 L

399. Excess of carbon dioxide is passed through 50 mL of 0.5 M calcium hydroxide solution. After evaporated to dryness. The solid calcium carbonate was completely neutralised with 0.1 N hydrochloric acid. The volume of hydrochloric acid required is (Atomic mass of calcium = 40)

(a) 300 cm^3 (b) 200 cm^3

(c) 500 cm^3 (d) 400 cm^3

Karnataka-CET, 2009

Ans. (c) : No. of millimoles of Ca $(OH)_2$ = 50 × 0.5 = 25

No. of millimoles of $CaCO_3$ = 25

No. of milliequivalents of $CaCO_3$ = 50

$$\therefore \text{ Volume of 0.1 N HCl} = \frac{50}{0.1} = 500\text{ cm}^3$$

400. 0.25 g of an organic compound on Kjeldahl's analysis gave enough ammonia to just neutralize 10 cm^3 of 0.5 M H_2SO_4. The percentage of nitrogen in the compound is

(a) 28 (b) 56

(c) 14 (d) 112

(e) 42

Kerala-CEE-2009

Ans. (b) : Given that,

Mass of given compound = 0.25g

Molarity = 0.5M

Volume = 10M (Let 1cm^3 = 1 mL)

$$\%\text{ of Nitrogen} = \frac{1.4\times\text{molarity}\times V\times B}{\text{mass of given compound}}$$

B = Basicity of acid = $(2H^+)$ (B = 2)

$$\%\text{ of Nitrogen } = \frac{1.4\times0.5\times2\times10}{0.25}$$

$$= 56\%$$

401. In the following reaction,

$$\mathbf{M^{x+} + MnO_4^- \longrightarrow MO_3^- + Mn^{2+} + \frac{1}{2}O_2,}$$

If one mole of MnO_4^- oxidizes 2.5 moles of M^{x+}, then the value of x is

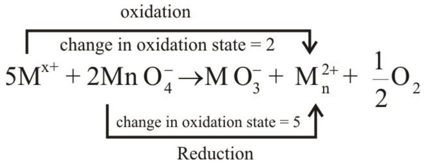
(a) 5 (b) 3

(c) 2 (d) 1

(e) 4

Kerala-CEE-2009

Ans. (b):



$$5M^{x+} + 2Mn\,O_4^- \rightarrow M\,O_3^- + M_n^{2+} + \frac{1}{2}O_2$$

$$MnO_4^- \rightarrow Mn^{2+} \qquad M^{x+} \rightarrow MO_3^-$$

n = 5 n = (5 – x)

$\therefore$ gm equation of MnO_4^- = gm equation of M

1 × 5 = 2.5 × (5 – x)

x = 3

402. In acid medium Zn reduces nitrate ion to NH_4^+ ion according to the reaction $Zn + NO_3^- \rightarrow Zn^{2+} + NH_4^+ + H_2O$ (unbalanced) How many moles of HCl are required to reduce half a moles of HCL are required to reduce half a mole of $NaNO_3$ completely? Assume the availability of sufficient Zn

(a) 5 (b) 4

(c) 3 (d) 2

(e) 1

Kerala-CEE-2009

Ans. (a): First the given unbalanced equation is balanced by using following steps

Step I. The equation is splitted into two half equations as

$$Zn \rightarrow Zn^{2+}$$

$$NO_3^- \rightarrow NH_4^+$$

Step II. Now water molecules are added to the side deficient in oxygen and H^+ and added to the side deficient in hydrogen as

$$Zn \rightarrow Zn^{2+};NO_3^- + 10H^+ \rightarrow NH_4^+ + 3H_2O$$

Step III. The number of electorns are balanced and the two half equations are added

$$[Zn \rightarrow Zn^{2+} + 2e^-]\times4;$$

@apna_pdf

$$NO_3^- + 10H^+ + 8e^- \rightarrow NH_4^+ + 3H_2O$$

$$4Zn \rightarrow 4Zn^{2+} + 8e^-$$

∴ $4Zn + NO_3^- + 10H^+ \rightarrow 4Zn^{2+} + NH_4^+ + 3H_2O$

(Net equation) or

$4Zn + NO_3^- + 10HCl \rightarrow 4Zn^{2+} + NH_4^+ + 5Cl_2 + 3H_2O$

∵ 1 mole of NO_3^- (or $NaNO_3$) is reduced by = 10 moles of HCl

∴ $\frac{1}{2}$ mole of NO_3^- will be reduced by = 10 × $\frac{1}{2}$ mole of HCl = 5 moles of HCl

403. The number of electrons required to reduce 4.5×10^{-5} g of Al is

(a) 1.03×10^{18} (b) 3.01×10^{18}

(c) 4.95×10^{26} (d) 7.31×10^{20}

MHT CET-2009

Ans. (b) : $\underset{27}{Al^{3+}} + 3e^- \rightarrow \underset{27g}{Al}$

27g of Al is reduced by = 3 × 6.023 × 10^{23} e^-s

1 gm of Al is reduced by = $\frac{3 \times 6.023 \times 10^{23}}{27}$

4.5 × 10^{-5}g of Al will be reduced by

$= \frac{3 \times 6.023 \times 10^{23} \times 4.5 \times 10^{-5}}{27}$

= 3.01 × 10^{18} electrons.

404. Which of the following contains greatest number of oxygen atoms?

(a) 1 g of O

(b) 1 g of O_2

(c) 1 g of O_3

(d) All have the same number of atoms

UPTU/UPSEE-2009

Ans. (d) :

Step-1 : Finding the number of moles

Number of moles = $\frac{\text{Given mass}}{\text{Molecular mass}}$

1 gram of O = $\frac{1}{16}$

1 gram of O_2 = $\frac{1}{32}$

1 gram of O_3 = $\frac{1}{48}$

Setp-2 : Finding the number of atoms

Number of atoms = Number of moles × N_A × Atomicity

In O = $\frac{1}{16} \times N_A \times 1$

In O_2 = $\frac{1}{32} \times N_A \times 2 = \frac{1}{16} N_A$

In = $\frac{1}{48} \times N_A \times 3 = \frac{1}{16} \times N_A$

Therefore, all three have the same number of O atoms.

405. What is the number of moles of oxygen gas evolved by electrolysis of 180 g of water ?

(a) 2.5 (b) 5.0

(c) 7.5 (d) 10.0

SCRA - 2009

Ans. (b) :

Reaction is given by, $\underset{2\times18=36g}{2H_2O(l)} \rightarrow 2H_{2(g)} + O_{2(g)}$

Using unitary method -

36g of water produces 1 mole of O_2 gas

180g water of will produce $\frac{180}{36} = 5$ moles of O_2 gas

Hence, 5 moles of oxygen gas can be produced during the electrolytic decomposition of 180 g of water.

406. Calculate the millimoles of SeO_3^{2-} in solution on the basis of following data: 70 mL of $\frac{M}{60}$ solution of $KBrO_3$ was added to SeO_3^{2-} solution. The bromine evolved was removed by boiling and excess of $KBrO_3$ was back titrated with 12.5 mL of $\frac{M}{25}$ solution of $NaAsO_2$.

The reactions are given below.

I. $SeO_3^{2-} + BrO_3^- + H^+ \rightarrow SeO_4^{2-} + Br_2^+ + H_2O$

II. $BrO_3^- + AsO_2^- + H_2O \rightarrow Br^- AsO_4^{3-} + H^+$

(a) 1.6 × 10^{-3} (b) 1.25

(c) 2.5 × 10^{-3} (d) None of these

AIIMS-2009

Ans. (c): Given that,

$$SeO_3^{2-} + BrO_3^- + H^+ \rightarrow SeO_4^{2-} + Br_2^+ + H_2O$$

$$BrO_3^- + AsO_2^- + H_2O \rightarrow Br^- AsO_4^{3-} + H^+$$

In reaction (i)

Moles of BrO_3^- Consumed = $\frac{70}{1000} \times \frac{1}{60} - \frac{10^{-3}}{6} = 10^{-3}$

gm. eq. of SeO_3^{2-} = gm. eq. of BrO_3^-

$n_{SeO_3^{2-}} \times 2 = 10^{-3} \times 5$

$n_{SeO_3^{2-}} = 2.5 \times 10^{-3}$

In reaction (ii)

Gm. Eq. of BrO_3^- = gm. Eq. of AsO_2^-

$n_{BrO_3^-} \times 6 = n_{AsO_2^-} \times 2 = \frac{12.5}{1000} \times \frac{1}{25} \times 2 = 10^{-3}$

$n_{BrO_3^-} = \frac{10^{-3}}{6}$

407. If 11.1 mg of $CaCl_2$ and 12 mg of $MgSO_4$ are present in 2 L of water, what is its hardness (in gram $CaCO_3$/ppm)?

(a) 5 (b) 10

(c) 15 (d) 20

AP-EAMCET (Medical), 2008

Ans. (b) : $MgSO_4 \equiv CaCO_3$

$24 + 32 + 64 \quad 40 + 12 + 48$

$= 120 \times 10^3 \text{mg} \quad = 100 \times 10^3 \text{mg}$

@apna_pdf

And $\quad CaCl_2 \equiv CaCO_3$

$$40+35.5\times2 \quad 40+12+48$$

$$=111\times10^3\text{mg} \quad =100\times10^3\text{mg}$$

111×10^3mg of $CaCl_2$ = 100 × 10^3mg of $CaCO_3$

$$11.1\text{mg of } CaCl_2 = \frac{100\times10^3\times11.1}{111\times10^3}\text{mg of } CaCO_3$$

$$= 10\text{mg of } CaCO_3$$

Similarly,

120 × 10^3mg of $MgSO_4$ = 100 × 10^3mg of $CaCO_3$

$$12\text{mg of } MgSO_4 = \frac{100\times10^3}{120\times10^3}\times12\text{mg of } CaCO_3$$

$$= 10\text{mg of } CaCO_3$$

∴ Total weight of $CaCO_3$ in 2L of water = 10 + 10 = 20mg.

∴ In 1L of water, total weight of $CaCO_3 = \frac{20}{2}$ mg=10mg.

∴ In 10^6 mg of water, total weight of $CaCO_3$ = 10mg.

So, in 10^6 part water, hardness of water in terms of $CaCO_3$ = 10mg.

408. 40 g of a sample of carbon on combustion left 10% of it unreacted. The volume of oxygen required at STP for this combustion reaction is

(a) 22.4 L (b) 67.2 L

(c) 11.2 L (d) 44.8 L

AP-EAMCET (Medical), 2008

Ans. (b) : The combustion of carbon can be expressed by following equation-

$$C(s)+O_2(g)\longrightarrow CO_2(g)$$

$$12g \quad 22.4L$$

$$\therefore \text{amount of carbon unreacted} = \frac{40\times10}{100} = 4g$$

So, the amount of carbon reacted = (40 – 4) g = 36g

∴ At STP, for the combustion of 12g of C, oxygen required is = 22.4L

∴ For the combustion of 36g of C, oxygen required will be $= \frac{22.4}{12}\times36L = 67.2L$

409. Assertion: One molal aqueous solution of glucose contains 180 g of glucose in 1 kg water.
Reason: The solution containing one mole of solute in 1000 g of solvent is called one molal solution.

(a) If both Assertion and Reason are correct and the Reason is the correct explanation of Assertion.

(b) If both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.

(c) If Assertion is correct but Reason is incorrect.

(d) If both the Assertion and Reason are incorrect.

AIIMS-2008

Ans. (a): Molality = No. of moles of solute /wt. of solvent in kg

If no. of moles of solute = 1

weight of solvent = 1 kg

then,

molality = 1

Glucose ($C_6H_{12}O_6$)

molecular weight = 180

$$\text{Here, No. of mole} = \frac{\text{Molecular mass}}{\text{wt.of solvent}}$$

$$= \frac{180}{180} = 1$$

$$\text{Molality} = \frac{1}{1}$$

Hence, assertion and reason, both are Correct and reason is the correct explanation of assertion.

410. The number of hydrogen atoms present in 25.6 g of sucrose ($C_{12}H_{22}O_{11}$) which has a molar mass of 342.3 g is

(a) 22 × 10^{23} (b) 9.91 × 10^{23}

(c) 11 × 10^{23} (d) 44 × 10^{23}

VITEEE- 2008

Ans. (b) : No. of moles of a sucrose

$$= \frac{\text{Given mass (gm)}}{\text{Molar mass (gm)}}$$

$$= \frac{25.6}{342.3} = 0.0748 \text{ moles.}$$

1 mole of sucrose ($C_{12}H_{22}O_{11}$) contains 6.022 × 10^{23} molecules of it.

Hence, 0.0748 moles contains

$$= 6.022\times10^{23}\times0.0748$$

$$= 0.4504\times10^{23} \text{ molecules.}$$

1 molecule of sucrose by formula is having 22 atoms of hydrogen.

$\therefore\ 0.4504\times10^{23}\times22 = 9.91\times10^{23}$ atoms of hydrogen.

411. One mole of magnesium nitride on the reaction with an excess of water gives

(a) One mole of NH_3 (b) two moles of NH_3

(c) One mole of HNO_3 (d) two moles of HNO_3

UPTU/UPSEE-2008

Ans. (b): Formula for magnesium MgN_2

Reaction of magnesium nitride with excess of water

$$Mg_3N_2 + 6H_2O \rightarrow 3Mg(OH)_2 + 2NH_3$$

Hence one mole of magnesium nitride on reaction with excess water gives two moles of ammonia.

Note- Nitride on reaction with water gives ammonia

412. 2 N HCI solution will have same molar concentration as a

(a) 4.0 N H_2SO_4 (b) 0.5 N H_2SO_4

(c) 1 N H_2SO_4 (d) 2 N H_2SO_4

WB-JEE-2008

Ans. (a) : From the relation -

$$\frac{\text{Normality}}{\text{Molarity}} = \frac{\text{Molecular mass}}{\text{Equivelent mass}} = n$$

For 2NHCl

$$\text{Molarity} = \frac{\text{Normality}\times\text{Equivalent weight}}{\text{Molecular weight}}$$

@apna_pdf

$$\text{Molarty} = \frac{2\times 36.5}{36.5} = 2$$

For $4NH_2SO_4$

$$\text{Molarity} = \frac{4\times 49}{98} = 2$$

Hence, $4NH_2SO_4$ and 2NHCl solution will have same molar concentration.

413. 1 mole of methyl amine on reaction with nitrous acid gives at NTP

(a) 1.0 Litre of nitrogen
(b) 22.4 Litre of nitrogen
(c) 11.2 Litre of nitrogen
(d) 5.6 Litre of nitrogen

WB-JEE-2008

Ans. (b) : $CH_3 — NH_2 + HNO_2 \rightarrow CH_3OH + N_2 + H_2O$
1 mole of methyl amine gives 1 mole N_2 i.e. 22.4 L of nitrogen at NTP.

414. Sodium nitrate on reduction with Zn in presence of NaOH solution produces NH_3. Mass of sodium nitrate absorbing 1 mole of electron will be

(a) 7.750 (b) 10.625
(c) 8.000 (d) 9.875

WB-JEE-2008

Ans. (b) : Required equation is given below,

$$Zn + 2OH^- \rightarrow Zn O_2^{2-} + 2H^+ + 2e^-$$

$$NO_3^- + 8H^+ 8e^- \rightarrow OH^- + 2H_2O + NH_3$$

∵ 8 moles of electron absorbed by 85g of $NaNO_3$

∴ 1 mole of electron absorbed by $\frac{85}{8}$ g of $NaNO_3$
=10.625g

415. Of two oxides of iron, the first contained 22% and the second contained 30% of oxygen by weight. The ratio of weights of iron in the two oxides that combine with the same weight of oxygen is

(a) 3 : 2 (b) 2 : 1
(c) 1 : 2 (d) 1 : 1

J & K CET-(2008)

Ans. (a) : For first oxide, moles of oxygen = $\frac{22}{16}$ = 1.375

$$\text{Mole of Fe} = \frac{78}{56} = 1.392$$

$$\text{Molar ratio, } \frac{1.375}{1.375} = 1, \frac{1.392}{1.375} = 1$$

∴ The formula of first oxide is

FeO for second oxide, Moles of oxygen = $\frac{30}{16}$ = 1.875

$$\text{Moles of Fe} = \frac{70}{56} = 1.25 .$$

$$\text{Molar ratio} = \frac{1.875}{1.25} = 1.5, \frac{1.25}{1.25} = 1$$

∴ The formula of second oxide is Fe_2O_3.

Suppose in both the oxides, iron reacts with xg oxygen.
∴ Equivalent weight of Fe in

$$\text{FeO or} = \frac{\text{weight of Fe}_{\text{II}}}{\text{weight of oxygen}} \times 8$$

$$\frac{56}{2} = \frac{\text{weight of Fe}_{\text{II}}}{x} \times 8 \qquad \text{.... (i)}$$

∴ Equivalent weight of Fe in

$$Fe_2O_2 = \frac{\text{weight of Fe}_{\text{III}}}{\text{weight of oxygen}} \times 8$$

$$\frac{56}{3} = \frac{\text{weight of Fe}_{\text{III}}}{x} \times 8 \qquad \text{.... (ii)}$$

From eq (i) & (ii)

$$\frac{\text{weight of Fe}_{\text{II}}}{\text{weight of Fe}_{\text{III}}} = \frac{3}{2}$$

416. 80 g of oxygen contains as many atoms as in

(a) 80 g of hydrogen (b) 1g of hydrogen
(c) 10g of hydrogen (d) 5 g of hydrogen

Karnataka-CET, 2008

Ans. (d) : No. of mole of oxygen = $\frac{80}{16}$ = 5mol

1 mol contains Avogadro no. of atom i.e., 60.2×10^{23} atoms.

∴ 5 mol contains $6.02\times10^{23}\times5$ atoms = 30.1×10^{23} atoms

No. of mole of hydrogen = $\frac{5}{1}$ = 5 mol

5 mol of hydrogen contains 30.1×10^{23} atoms.

417. 10 cm^3 of 0.1N monobasic acid requires 15 cm^3 of sodium hydroxide solution which normality is

(a) 1.5 N (b) 0.15 N
(c) 0.066 N (d) 0.66 N

Karnataka-CET, 2008

Ans. (c) : Given,

Volume of monobasic acid = 10 cm^3
Normality of monobasic acid = 0.1 N
Volume of NaOH solution = 15 cm
Normality of NaOH solution = ?
From normality equation,
$N_1V_1 = N_2V_2$
(for monobasic acid) (for NaOH)
$10 \times 0.1 = 15 \times N_2$

$$N_2 = \frac{10\times 0.1}{15} = 0.066N$$

418. For the reaction Fe_2O_3 + 3CO × 2Fe + $3CO_2$ the volume of carbon monoxide required to reduce on mole of ferric oxide is

(a) 22.4 dm^3 (b) 44.8 dm^3
(c) 67.2 dm^3 (d) 11.2 dm^3

Karnataka-CET, 2008

Ans. (c) : $\underset{1\,mol}{Fe_2O_3} + \underset{3\,mol}{3CO} \longrightarrow 2Fe + 3CO_2$

Volume of 1mole carbon monoxide
= 22.4 L (at STP)
1 mole of ferric oxide is reduced by = 3 moles of CO
= 3 × 22.4 L = 67.2 dm^3 [∵ 1 dm^3 = 1L]

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419. Three moles of PCl_5, three moles of PCl_3 and two moles of Cl_2 are taken in a closed vessel. If at equilibrium the vessel has 1.5 moles of PCl_5, the number of moles of PCl_3 present in it is?

(a) 5 (b) 3
(c) 6 (d) 4.5

Karnataka-CET, 2008

Ans. (d) : $$\underset{\substack{3\,\text{mol}\\(3-x)\,\text{mol}}}{PCl_5} \rightleftharpoons \underset{\substack{3\,\text{mol}\\(3+x)\,\text{mol}}}{PCl_3} + \underset{\substack{2\,\text{mol intially}\\(2+x)\,\text{mol at equilibrium}}}{Cl_2}$$

So, $3 - x = 1.5$

$x = 1.5$

Number of moles of $PCl_3 = 3 + x$

$= 3 + 1.5 = 4.5$

420. One mole of which of the following has the highest entropy?

(a) Liquid nitrogen (b) Hydrogen gas
(c) Mercury (d) Diamond

Karnataka-CET, 2008

Ans. (b) : Entropy is the measure of degree of disorder (or randomness) of a system. The greater the disorder in a system, the higher is the entropy. Hence, entropy is highest for hydrogen gas.

421. The number of moles of lead nitrate needed to coagulate 2 moles of colloidal $[AgI]I^-$ is

(a) 2 (b) 1
(c) 1/2 (d) 2/3
(a) 5/2

Kerala-CEE-2008

Ans. (b):

$$2[AgI]\,I^- + Pb^{2+} \rightarrow PbI_2 + 2AgI$$

Since for this reaction we required 1 mole of Pb^{2+} is 1 mole of $Pb(NO_3)_2$.

422. Two liquids X and Y form an ideal solution. The mixture has a vapour pressure of 400 mm at 300 K when mixed in the molar ratio of 1: 1 and a vapour pressure of 350 mm when mixed in the molar ratio of 1: 2 at the same temperature. The vapour pressures of the two pure liquids X and Y respectively are

(a) 250 mm, 550 mm (b) 350 mm, 450 mm
(c) 350 mm, 700mm (d) 500 mm, 500 mm
(e) 550 mm, 250 mm

Kerala-CEE-2008

Ans. (e): Molar ration of 1 : 1 means $X_x = X_y = 0.5$

$P_{total} = X_x p_x^o + X_y p_y^o \Rightarrow 400 = 0.5\,p_x^o + 0.5\,p_y^o$

$p_x^o + p_y^o = 800$ ….(i)

Molar ratio of 1 : 2, $X_x = 1/3$, $X_y = 2/3$

Similarly, $350 = 1/3\,p_x^o + 2/3\,p_y^o$

$p_x^o + 2\,p_y^o = 1050$ ….(ii)

From equation (i) and (ii),

$p_y^o = 250$ mm and $p_x^o = 550$mm

423. 1.6 moles of PCl_5 (g) is placed in 4 dm^3 closed vessel. When the temperature is raised to 500 K, it decomposes and at equilibrium 1.2 moles of PCl_5 (g) remains. What is the K_c value for the decomposition of $PCl_5(g)$ to PCl_3 (g) and Cl_2 (g) at 500 K?

(a) 0.013 (b) 0.050
(c) 0.033 (d) 0.067
(a) 0.045

Kerala-CEE-2008

Ans. (c) 1.6 mol of PCl_5 is placed in $4dm^3$ closed vessel.

$$\begin{array}{llll} & PCl_5(g) \rightleftharpoons & PCl_3(g) + & Cl_2(g) \\ \text{Intial} & 1.6\,\text{mol} & 0 & 0 \\ \text{At eqm.} & 1.2\,\text{mol} & 0.4\,\text{mol} & 0.4\,\text{mol} \end{array}$$

Therefore, $PCl_5 = \frac{1/2}{4} = 0.3, PCl_3 = \frac{0.4}{4} = 0.1$

$$Cl_2 = \frac{0.4}{4} = 0.1$$

$$K_c = \frac{PCl_3 \times Cl_2}{PCl_5} = \frac{0.1 \times 0.1}{0.3} = 0.033$$

424. How many moles of lead (II) chloride will be formed from a reaction between 6.5 g of PbO and 3.2 g HCI? (atomic weight of Pb = 207)

(a) 0.011 (b) 0.029
(c) 0.044 (d) 0.333

NEET-2008

Ans. (b) :

$$\underset{223g/mol}{PbO} + \underset{2(35.59+1)g/mole}{2HCl} \longrightarrow \underset{277\,g/mol}{PbCl_2} + \underset{18g/mol}{H_2O}$$

223g/mol of PbO need → 70g of HCl

$$6.5 \rightarrow x \quad \Rightarrow x = \frac{6.5 \times 70}{223}$$

$\Rightarrow$ x = 2.04 g of HCl is needed.

223g of PbO→277g of $PbCl_2$

$$6.5 \rightarrow y \quad \Rightarrow y = \frac{6.5 \times 277}{223} \Rightarrow y = 8.07g$$

1 mol → 277g

x mol → 8.07

$$\Rightarrow \quad x = \frac{8.07}{277} = 0.029\,\text{moles}$$

425. 1 mole of H_2 and 2 moles of I_2 are taken initially in a two liter vessel. The number of moles of H_2 at equilibrium is 0.2. Then, the number of moles of I_2 and HI at equilibrium are–

(a) 1.2, 1.6 (b) 1.8, 1.0
(c) 0.4, 2.4 (d) 0.8, 2.0

BCECE-2008, UP CPMT-2006

Ans. (a) :

$$\begin{array}{llll} & H_2 \; + & I_2 \rightleftharpoons & 2HI \\ \text{Intial} & 1\text{mol} & 2\text{mol} & \\ \text{At, equlibrium} & 0.2 & 2-0.8 & 2\times 0.8 \\ & & 1.2\,\text{mol} & 1.6\,\text{mol} \end{array}$$

The numbers of moles of I_2 and HI at equilibrium are 1.2 moles and 1.6 moles respectively.

426. The number of electrons in a mole of hydrogen molecule is :

(a) 6.023×10^{23} (b) 12.046×10^{23}
(c) 3.0115×10^{23} (d) indefinite

BITSAT 2008

@apna_pdf

Ans. (b) : 1 mole of H_2 contains 6.023×10^{23} moleculer no of electron in $H_2 = 6.023\times10^{23}\times 2 = 12.046\times10^{23}$

427. Amount of oxalic acid present in a solution can be determined by its titration with $KMnO_4$ solution in the presence of H_2SO_4. The titration gives unsatisfactory result when carried cut in the presence of HCl because HCl

(a) Gets oxidized by oxalic acid to chlorine
(b) Furnishes H^+ ions in addition to those from oxalic acid
(c) Reduces permanganate to Mn^{2+}
(d) Oxidises oxalic to carbon dioxide and water

[AIEEE 2008]

Ans. (c) : Titration of oxalic acid by $KMnO_4$ in the presence of HCl gives unsatisfactory result because HCl is a better reducing agent than oxalic acid and HCl reduces preferably MnO_4^- to Mn^{2+}.

428. 200 g of hydrogen reacts with nitrogen according to equation $3H_{2(g)}+N_{2(g)}\rightarrow 2NH_{3(g)}$, to produce

(a) 11.322 g of ammonia
(b) 113.22 g of ammonia
(c) 1132.2 g of ammonia
(d) 11322 g of ammonia

AMU–2007

Ans. (c) : Given, in equation

$$3H_{2(g)} + N_{2(g)} \rightarrow 2NH_{3(g)}$$

3(2) 2(17)

6 g H_2 34 g NH_3

6 g of H_2 reacts with nitrogen to produce34g of NH_3

$$1g\ H_2 \rightarrow \frac{34}{6}\ \text{g of } H_3$$

$$200\ g\ H_2 \rightarrow \frac{34}{6}\times 200\ \text{g of } NH_3$$

= 1133.33 g of ammonia ≃ 1132.2 g of ammonia

429. In the reaction,
$2Al(s)+6HCl(aq)\rightarrow 2Al^{3+}(aq)+6Cl^-(aq)+3H_2(g)$

(a) 6L HCl (aq) is consumed for every 3L H_2 (g) produced
(b) 33.6 L H_2(g) is produced regardless of temperature and pressure for every mole Al that reacts
(c) 67.2 L H_2 (g) at STP is produced for every mole Al that reacts
(d) 11.2 L H_2 (g) at STP is produced for every mole HCl (aq) consumed

[AIEEE 2007]

Ans. (d) : In the case of option D, from the balanced chemical equation, it Can be seen that 6 moles of HCl reacts with 3 moles of hydrogen.

Hence, 1 mole of HCl will react with $\frac{3}{6}$ = 0.5 mole of hydrogen.

At STP 1 mole of hydrogen Corresponds to 22.4 L

Hence, 0.5 moles of hydrogen will corresponds to $\frac{22.4}{2}$ = 11.2 L

Thus, 11.2 L of hydrogen gas at STP is produced for every mole of HCl Consumed.

430. What volume of hydrogen gas, at 273 K and 1 atm pressure will be consumed in obtaining 21.6 g of elemental boron (atomic mass = 10.8) form the reduction of boron trichloride by hydrogen?

(a) 89.6 L (b) 67.2 L
(c) 44.8 L (d) 22.4 L

[AIEEE 2007]

Ans. (b) : If $BCl_3 + 1.5H_2 \rightarrow B + 3HCl$

From the equation it is clear that 1 mole of boron formation requires 1.5 moles of hydrogen gas.

$$\text{No. of moles} = \frac{\text{Mass}}{\text{Molar mass}}$$

$$= \frac{21.6\,g}{10.8\,g\,mol^{-1}} = 2.00\ mol$$

To obtain 2.00 mol of boron, 3.00 mol of hydrogen gas is required.

One mole of hydrogen gas at 273 k and 1 atm occupies a volume of 22.4 L.

Therefore volume of hydrogen gas = 3.00 mol × 22.4L mol^{-1}

= 67.2 L

431. Maximum number of molecules of CH_3I that can react with a molecule of CH_3NH_2 are

(a) 3 (b) 4
(c) 2 (d) 1

Karnataka-CET-2007

Ans. (a) : $\underset{\text{Methly amine}}{CH_3NH_2} \xrightarrow[-HI]{CH_3I} \underset{\text{Dimethyl amine}}{(CH_3)_2NH} \xrightarrow[-HI]{CH_3I} \underset{\text{Trimethyl amine}}{(CH_3)_3N} \xrightarrow{CH_3I} \underset{\text{Tetramethyl ammonium iodide}}{(CH_3)_4N^+I^-}$

Hence, three molecules of CH_3I is used.

432. The number of gram molecules of chlorine in 6.02×10^{25} hydrogen chloride molecules is

(a) 10 (b) 100
(c) 50 (d) 5

Karnataka-CET-2007

Ans. (c) : Let the Number of gram molecules

$$\frac{6.02\times10^{25}}{6.02\times10^{23}} = 100$$

∴ Gram molecular mass of chlorine in 6.023 × 10^{25} molecules of HCl = $\frac{100}{2} = 50$

433. Molarity of a given orthophosphoric acid solution is 3M. It' s normality is

(a) 9N (b) 0.3N
(c) 3N (d) 1N

Karnataka-CET-2007

Ans. (a) : Orthophosphoric acid (H_3PO_4) is a tribasic acid.

∵ Normality = Molarity × basicity

∴ Normality = 3M × 3

= 9N

@apna_pdf

434. One mole of oxygen at 273 K and one mole of sulphur dioxide at 546 K are taken in two separate containers, then,

(a) kinetic energy of O_2> kinetic energy of SO_2
(b) kinetic energy of O_2 < kinetic energy of SO_2
(c) kinetic energy of both are equal
(d) None of the above

Karnataka-CET-2007

Ans. (b) : $KE = \frac{3}{2}RT$

$KE \propto T$

$$\frac{KE_{o_2}}{KE_{so_2}} = \frac{T_{o_2}}{T_{so_2}} = \frac{273}{546} = \frac{1}{2}$$

$KE_{SO_2} = 2KE_{O_2}$

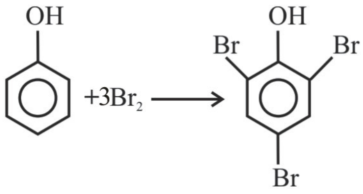
$\therefore\ KE_{SO_2} > 2KE_{O_2}$

435. What amount of bromine will be required to convert 2 g of phenol into 2, 4, 6-bribromo phenol

(a) 20.44 g
(b) 6.00 g
(c) 4.00 g
(d) 10.22 g

UPTU/UPSEE-2007

Ans. (d) :



molecular weight of Phenol = 12 × 6 + 1 × 6 + 16 = 94

molecular wt. of Br_2 = 3 × 160 = 480

$\because$ 94 of phenol requires = 480 of Br_2

$\therefore$ 2 g of phenol requires $= \frac{480}{94} \times 2 = 10.22g$

436. 138 g of ethyl alcohol is mixed with 72 g of water. The ratio of mole fraction of alcohol to water is

(a) 3 : 4
(b) 1 : 2
(c) 1 : 4
(d) 1 : 1

AP EAMCET (Engg.) -2007

Ans. (a) : Mass of ethyl alcohol $(C_2H_5OH) = 46$ g

Number of moles of ethyl alcohol

$$= \frac{138}{46} = 3$$

Number of moles of water $= \frac{72}{18} = 4$

$$X_{C_2H_5OH} = \frac{3}{3+4} = \frac{3}{7}$$

$$X_{H_2O} = \frac{4}{3+4} = \frac{4}{7}$$

$$\frac{X_{C_2H_5OH}}{X_{H_2O}} = \frac{3/7}{4/7} = \frac{3}{4} = 3 : 4$$

437. Assertion: Equal moles of different substances contain same number of constituent particles.

Reason: Equal weights of different substances contain the same number of constituent particles.

The correct answer is

(a) Both (A) and (R) are true and (R) is the correct explanation of (A).
(b) Both (A) and (R) are true but (R) is not the correct explanation of (A).
(c) (A) is true, but (R) is false.
(d) (A) is false but (R) is true.

AP EAMCET (Engg.) -2007

Ans. (c) : Here, assertion is right, but reason is false Because –

Equal moles of different substances contain same number of constituent particles but equal weights of different substances do not contain the same number of constituent particles.

438. 250 mL of a 0.50 M NaCl solution contains [Given that molar mass of NaCl = 58.5 g mol^{-1}]

(a) 7.32 g of NaCl
(b) 14.64 g of NaCl
(c) 21.96 g of NaCl
(d) 5.85 g of NaCl

AMU–2006

Ans. (a) : Molarity, $M = \frac{\text{No.of moles of solute}(n)}{\text{Volume of solution in lit.}(v)}$

$$\text{or, } M = \frac{\frac{\text{weight.of solute}(w)}{\text{Molecular weight of solute}(M_s)}}{(V)}$$

$$\text{or, } M = \frac{w}{M_s \times V} \quad \text{or, } w = M \times M_s \times V$$

$= 0.50 \times 58.5 \times 0.25$ g = 7.3125 g

439. The volume of Cl_2 at STP obtained on reacting 4.35 g MnO_2 with conc. HCl (At. Wt. of Mn = 55)

(a) 4.48 litre
(b) 2.24 litre
(c) 1.12 litre
(d) 0.56 litre

BITSAT 2006

Ans. (c) : $\underset{87g}{MnO_2} + 4HCl \rightarrow MnCl_2 + 2H_2O + \underset{\substack{22.4\,litre \\ s\,at\,STP}}{Cl_2}$

1 gm MnO_2 gives $= \frac{22.4}{87}$ litres of Cl_2

4.35 g MnO_2 gives $= \frac{22.4 \times 4.35}{87}$

= 1.12 lit. of Cl_2.

440. CO_2 gas obtained by the combustion of 12 mL butane gas is

(a) 3 mL
(b) 12 mL
(c) 24 mL
(d) 48 mL

CG PET -2006

Ans. (d) :

$$C_4H_{10} + \frac{13}{2}O_2 \rightarrow 4CO_2 + 5H_2O$$

1 mole — 4 mole

12 mL — 12 × 4 = 48 mL

@apna_pdf

441. How many moles of magnesium phosphate, $Mg_3(PO_4)_2$ will contain 0.25 mole of oxygen atoms?

(a) 0.02 (b) 3.125×10^{-2}
(c) 1.25×10^{-2} (d) 2.5×10^{-2}

[AIEEE 2006]

Ans. (b) : $Mg_3(PO_4)_2$; mole

8 moles of O atom are contained by 1 mole $Mg_3(PO_4)_2$

Hence, 0.25 moles of O atom = $\frac{1}{8}\times0.25$

$= 3.125\times10^{-2}$

442. 1.25 g NH_3 contains how many atoms?

(a) 10^{23} (b) 1.77×10^{23}
(c) 6×10^{13} (d) 4×10^{23}

JCECE - 2006

Ans. (b) : Given that,
Mass of NH_3(W) = 1.25 g
Molar mass of NH_3(M) = 17 g/mol

$$\therefore \text{Number of moles } (n) = \frac{W}{M} = \frac{1.25}{17} = \frac{5}{68}\text{mol}$$

Each molecule contain 4 atom

$\therefore$ Number of atom (N) = 4 × n × N_A

$$= 4\times\frac{5}{68}\times6.022\times10^{23} = 1.77\times10^{23}\text{atoms}$$

443. One mole of acidified $K_2Cr_2O_7$ on reaction with excess KI will liberate.....mole (s) of I_2:

(a) 6 (b) 1
(c) 7 (d) 2
(e) 3

Kerala-CEE-2006

Ans. (e) : When one mole of acidified potassium dichromate ($K_2Cr_2O_7$) react with excess of KI solution the balanced chemical reaction is as

$$Cr_2O_7^{2-} + 14H^+ + 6I^- \to 2Cr^{3+} + 3I_2 + 7H_2O$$

3 moles of I_2 is evolved when excess of KI react with one mole of acidified potassium dichromate ($K_2Cr_2O_7$).

444. On a humid day in summer, the mole fraction of gaseous H_2O (water vapour) in the air at 25°C can be high as 0.0287. Assuming a total pressure of 0.977 atm. What is the partial pressure of dry air?

(a) 94.9 atm (b) 0.949 atm
(c) 949 atm (d) 0.648 atm
(e) 1.248 atm

Kerala-CEE-2006

Ans. (b) :

$$P_{H_2O} = X_{H_2O}P_{total} = 0.0287\times0.977 = 0.028\,\text{atm}$$

$$P_{total} = P_{dryair} + P_{H_2O}$$

$$P_{dryair} = P_{total} - P_{H_2O} = 0.977 - 0.028 = 0.949\,\text{atm}$$

445. Number of atoms of He in 100 amu of He (atomic wt. of He is 4) are

(a) 25 (b) 100
(c) 50 (d) 100

UP CPMT-2006

Ans. (a) : Number of atom of a substance = Number of gram molecular weight × 6.05 × 10^{23} × atomicity

$$= \frac{\text{wt. of substance}}{\text{Number of g.molecules}}\times6.02\times10^{23}\times\text{atomicity}$$

$$= 1\,\text{amu} = 1.6\times10^{-24}\text{g}$$

$$= 100\,\text{amu} = 1.6\times100\times10^{-24}\text{ g}$$

$$= \frac{100\times1.6\times10^{-24}}{4}\times6.023\times10^{23}\times1$$

$$= 25\times1.6\times10^{-24}\times6.023\times10^{23} = 25$$

446. One mole of CO_2 contains:

(a) 3g atoms of CO_2
(b) 18.1×10^{23} molecules of CO_2
(c) 6.02×10^{23} atoms of O
(d) 6.02×10^{23} atoms of C

UPTU/UPSEE-2006

Ans. (d) : One mole of CO_2 contains 6.02×10^{23} atoms of C and 6.023×10^{23} molecules of oxygen.

447. In the equation $H_2S + 2HNO_3 \longrightarrow 2H_2O + 2NO_2 + S$. The equivalent weight of hydrogen sulphide is :

(a) 18 (b) 68
(c) 34 (d) 17

BCECE-2006

Ans. (d): (Increase in oxidation state = 2)

$$\overset{-2}{H_2S} + 2HNO_3 \to 2H_2O + 2NO_2 + \overset{0}{S}$$

Hence, the equivalent weight of

$$H_2S = \frac{\text{molecular weight}}{\text{change in oxidation number}}$$

$$H_2S = \frac{34}{2} = 17$$

448. What is the weight of oxygen that is required for the complete combustion of 2.8 kg of ethylene?

(a) 9.6 kg (b) 96.0 kg
(c) 6.4 kg (d) 2.8 kg

BCECE-2006

Ans. (a) : $\underset{(12\times2+4=28)}{C_2H_4} + \underset{(3\times16\times2=96)}{3O_2} \to 2CO_2 + 2H_2O$

$\therefore$ The weight of oxygen required for complete Combustion of 28 kg ethylene = 96 kg

$\therefore$ Weight of oxygen required for combustion of 2.8 kg ethylene

$$= \frac{96\times2.8}{28}\text{kg} = 9.6\text{kg}$$

449. 100 g $CaCO_3$ is treated with 1 L of 1N HCl. What would be the weight of CO_2 liberated after the completion of the reaction?

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(a) 55g (b) 11g
(c) 22g (d) 33g
(e) 44g

Kerala-CEE-2005

Ans. (c):

$$CaCO_3 + 2HCl \longrightarrow CO_2 + CaCl_2 + H_2O$$

No. of mole ⇒ 1 2 1 1 1

Molecular mass of $CaCO_3$ = 100g = 1 mole of $CaCO_3$

1 N HCl = 1 M HCl (n factor for HCl = 1)

No. of moles = molarity × volume (L)

= 1

Hence, 1 mole of HCl would react with 0.5 moles of $CaCO_3$ to give 0.5 mole of CO_2.

$$\text{Now, 0.5 moles of } CO_2 = \frac{\text{weight}}{\text{molar mass}}$$

$$0.5 = \frac{\text{weight}}{44\text{g}}$$

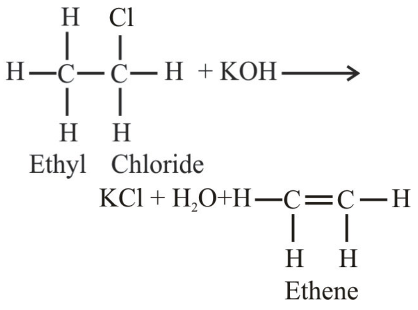
weight = 22g

450. When 32.25 g of ethyl chloride is subjected to dehydrohalogenation reaction the yield of the alkene formed is 50%. The mass of the product formed is : (atomic mass of chlorine is 35.5)

(a) 14g (b) 28g
(c) 64.5g (d) 56g
(e) 7g

Kerala-CEE-2005

Ans. (e) :



$$H-\underset{H}{\overset{H}{C}}-\underset{H}{\overset{Cl}{C}}-H + KOH \longrightarrow KCl + H_2O + H-\underset{H}{C}=\underset{H}{C}-H$$

Ethyl Chloride

Ethene

Molar mass of ethyl chloride

= 2 × 12 + 5 × 1 + 1 × 35.5

= 24 + 5 +350.5 = 64.5g mol^{-1}

Molar mass of ethene = 2 × 12 + 4 × 1

= 28 g mol^{-1}

Actual yield = 50% of 28g = 14g

64.5g of ethyl chloride on dehydrohalogenation gives 14g ethene

∴ 32.25 g of ethyl chloride on dehydoholoenation will give ethene = 7g.

451. How much of sulphur is present in an organic compound, if 0.53 g of the compound gave 1.158 g of $BaSO_4$ on analysis?

(a) 10% (b) 15%
(c) 20% (d) 25%
(e) 30%

Kerala-CEE-2005

Ans. (e) : Organic compond mass=0.53 g

$Baso_4$ produce =1.158 g

$$\% \text{ of sulphur in } BaSO_4 = \frac{32}{233} \times 100 = 13.7\%$$

$$\text{weight of sulphur in 1.158g of } BaSO_4 = \frac{13.7}{100} \times 1.158$$

$$= 0.158\text{g}$$

0.53g of compound gives 0.158g of sulphur

$$\% \text{ sulphur in given compound } = \frac{0.158}{0.53} \times 100 = 30\%$$

452. In alkaline medium, ClO_2 oxidises H_2O_2 to O_2 and itself gets reduced to Cl^-. How many moles of H_2O_2 are oxidized by 1 mole of ClO_2?

(a) 1.0 (b) 1.5
(c) 2.5 (d) 3.5
(e) 5.0

Kerala-CEE-2005

Ans. (c) : The balanced chemical equation is

$$2ClO_2 + 5H_2O_2 + 2OH^- \rightarrow 2Cl^- + 5O_2 + 6H_2O$$

$$\frac{1}{2} \text{ mol } ClO_2 = \frac{1}{5} \text{ mol } H_2O_2$$

$$1 \text{ mol } ClO_2 = \frac{5}{2} \text{ mol } H_2O_2$$

$$= 2.5 \text{ mol } H_2O_2$$

453. Number of moles of $K_2Cr_2O_7$ reduced by one mole of Sn^{2+}?

(a) $\frac{1}{3}$ (b) 3
(c) $\frac{1}{6}$ (d) 6

UP CPMT-2005

Ans. (a) One mole of Sn^{2+} can reduce 1/3 moles $K_2Cr_2O_7$.

454. How many moles of $Al_2(SO_4)_3$ would be in 50 g of the substance?

(a) 0.083mol (b) 0.952mol
(c) 0.481mol (d) 0.140 mol

UPTU/UPSEE-2005

Ans. (d) : $\text{Moles} = \frac{\text{Mass}}{\text{Molecular weight}}$

mass of $Al_2(SO_4)_3$ = 50g.

Molecular mass of $Al_2(SO_4)$ = 342g

$$\therefore \quad \text{Moles of } Al_2(SO_4) = \frac{50}{342} = 0.14 \text{ mol.}$$

455. The number of moles of proton which can be easily given by butyne-1 (1mole) is

(a) 1 (b) 2
(c) 3 (d) 6

CG PET -2005

Ans. (a) : The structure of butyne -1 is given below

$$H-C\equiv C-CH_2-CH_3$$

If triple bond bearing carbon attached with hydrogen, such hydrogen is acidic in nature.

Number of this type of hydrogen present in butyne –1 is one.

@apna_pdf

456. 50 mL of benzene is mixed with 50mL of chloroform. What is the volume of solution?

(a) Less than 100mL (b) More than 100mL
(c) Equal to 100mL (d) None of the above

CG PET -2005

Ans. (a) : 50 mL benzene is mixed with 50 mL of chloroform to form less than 100 mL volume of solution.

457. A mixture has 18g water and 414 ethanol. The mole fraction of water in mixture is (assume ideal behaviour of the mixture)

(a) 0.1 (b) 0.4
(c) 0.7 (d) 0.9

CG PET -2005

Ans. (a) :

$$\text{Mole fraction} = \frac{\text{moles of water}}{\text{moles of water} + \text{moles of ethanol}}$$

mol. wt. of H_2O = 18 mol

atomic weight of $C_2H_5OH = 46 \rightarrow 2 \times 12 + 5 \times 1 \times 16 + 1 = 26$ molecular weight.

$$\text{Mole fraction of water} = \frac{\frac{18}{18}}{\frac{18}{18}+\frac{414}{46}}$$

$$= \frac{1}{10} = 0.1$$

458. 1 moles of crystalline NaCl will have how many unit cells?

(a) 1.506×10^{23} (b) 3.012×10^{23}
(c) 4.518×10^{23} (d) 6.023×10^{23}

CG PET -2005

Ans. (a) : The molar mass of NaCl is ⇒ 23 + 35.5 = 58.5 g

58.5 g of NaCl corresponds to 1 mole of NaCl and Contains 6.023×10^{23} molecules.

One unit cell of NaCl (fcc structure) has 4 NaCl molecules.

1 mole of NaCl will contain

$$\frac{6.023 \times 10^{23}}{4} = 1.506 \times 10^{23} \text{ unit cells.}$$

459. The volume of 0.1 M H_2SO_4 that is needed to completely neutralise 30mL of 0.2 M NaOH solution, is

(a) 15 mL (b) 30 mL
(c) 40 mL (d) 60 mL

CG PET -2005

Ans. (b) : Let V be the volume of H_2SO_4 required.

Given:-

$M_{H_2SO_4} = 0.1$ M

$M_{NaOH} = 0.2$ M

$V_{NaOH} = 30$ ML

Now, as we know that

$N_1V_1 = N_2V_2$

The relation between the molarity and the normality is

$N = n \times m$

Where as n is the valence factor

$n_1m_1v_1 = n_2m_2v_2$

For H_2SO_4; n = 2

For NaOH ; n = 1

Therefore

$2 \times 0.1 \times v = 1 \times 0.2 \times 30$

$\Rightarrow v = \frac{6}{0.2}$

v = 30 mL

460. In 1 mole of NaCl the protons are

(a) 6 moles (b) 11 moles
(c) 17 moles (d) 28 moles

CG PET -2005

Ans. (d) : Constituent of NaCl are Na and Cl.

Number of proton is Na = 11

[Atomic number of Na = 11]

Number of proton in Cl = 17

[Atom number of Cl = 17]

So, 1 mole Na contains 11 moles of protons and 1 mole of Cl contains 17 moles of protons. Hence, 1 mole NaCl contains 28 moles of protons.

461. The morality of a solution made by mixing 50 mL of conc. H_2SO_4 (36N) with 50mL of water, is

(a) 36 M (b) 18 M
(c) 9 M (d) 6 M

CG PET -2005

Ans. (c) : Concentrated H_2SO_4 36 N is 18 M with 50 ml of water

Sulphuric acid

$m_1v_1 = m_2v_2$

Where

M_1 = intial molarity

V_1 = intial volume

M_2 = final molarity

V_2 = final volume

$m_1v_1 = m_2v_2$

$18 \times 50 = m_2 \times (50 + 50)$

$900 = 100\, m_2$

$m_2 = 9$

The molarity of the solution is 9M.

462. 171g of sugar cane ($C_{12}H_{22}O_{11}$) is dissolved in 1 L of water. The molarity of the solution is

(a) 2.0 M (b) 1.0M
(c) 0.5 M (d) 0.25 M

CG PET -2005

Ans. (c) : Number of mole of sugar cane ($C_{12}H_{22}O_{11}$)

$$\Rightarrow \frac{\text{Given weight}}{\text{Molecular weight}} = \frac{171}{342} = 0.5$$

@apna_pdf

$$\text{Molarity} = \frac{\text{No. of mole of solute}}{\text{volume of solution (L)}}$$

$$\text{Molarity} = \frac{171/342}{1}$$

$$= 0.5$$

463. The vapour pressure of a pure liquid 'A' is 0.80 atm. When a non-volatile solute 'B' is dissolved in 'A' its vapour pressure becomes 0.60 atm. The mole fraction of 'B' in the solution is

(a) 0.125 (b) 0.25
(c) 0.50 (d) 0.75

CG PET -2005

Ans. (b) : The vapour pressure of a solvent A = P_0 = 0.80 atm.

And after adding non- volatile substance B, vapour pressure P = 0.6 atm

According to Raoult's law for relative lowering of vapour pressure

$$\frac{P_0 - P}{P_0} = X_B$$

$$\Rightarrow \frac{0.80 - 0.60}{0.80} = \frac{0.20}{0.800} = X_B = \frac{1}{4}$$

i.e. $X_B = 0.25$

mole fraction of B in the solution is 0.25

464. If we consider that 1/6, in place of 1/12, mass of carbon atom is taken to be the relative atomic mass unit, the mass of one mole of a substance will

(a) Be a function of the molecular mass of the substance
(b) Remain unchanged
(c) Increase two fold
(d) Decrease twice

[AIEEE 2005]

Ans. (b) : If $\frac{1}{6}$ is used in place of $\frac{1}{12}$ mass of carbon then the mass of 1 mole of substance will remain unchange.

Since 1 mole = N_A × mass of 1 atom.

When we use $\frac{1}{6}$th in place of $\frac{1}{12}$th

Then,

1 AMU = 2 AMU

Now, the new Avogardo number (N_A) becomes $\frac{N_A}{2}$ since the atomic mass corresponding to it becomes 6 g.

So, 1 mole $= \frac{N_A}{2} \times 2\,\text{a.m.u.}$

Hence, the mass remains unchange.

465. The number of sodium atoms in 2 moles of sodium ferrocyanide is :

(a) 12×10^{23} (b) 26×10^{23}
(c) 34×10^{23} (d) 48×10^{23}

BITSAT 2005

Ans. (d) : $Na_4[Fe(CN)_6]$

No. of Na-atoms in molecules of $Na_4[Fe(CN)_6]$ is =4

No. of Na–atom in 1 mole of $Na_4[Fe(CN)_6]$=4 times of Na

$=4\times6.023\times10^{23}$

No. of Na-atom in 2 moles of $Na_4[Fe(CN)_6]$

$=2\times4\times6.023\times10^{23}$

$=48.134\times10^{23}$

466. Assertion (A) : 8 g of methane occupies 11.207 L of volume at 273K and 1 atm. pressure.

Reason (R) : One mole of any gas at STP occupies 22.414 litres of volume :

The correct answer is

(a) both A and R are true and R is the correct explanation of A
(b) both A and R are true but R is not the correct explantation of A
(c) A is true but R is false
(d) A is false but R is true

AP-EAMCET (Engg.)-2004

Ans. (a) : One mole of CH_4 gas is equal to 16 g of CH_4. So, at STP

∵ 1 mole or 16 g of CH_4 occupies volumes = 22.414 L

$$\therefore \text{ 8 g of } CH_4 \text{ occupies volume} = \frac{22.414\times8}{16} = 11.207\,\text{L}$$

Reason – At STP one mole of gas occupies 22.414 L of volume. Thus, both A and R are true and R is the correct explanation of A.

467. 10 g of $CaCO_3$ is completely decomposed to X and CaO. X is passed into an aqueous solution containing one mole of sodium carbonate. What is the number of moles of sodium bicarbonate formed ?

(a) 0.2 (b) 0.1
(c) 0.01 (d) 10

AP-EAMCET (Engg.)-2004

Ans. (a) :

$$\underset{\text{molecular weight}=100\text{g}}{CaCO_3} \longrightarrow CaO + \underset{\substack{(x)\\ \text{molecular}\\ \text{weight}=44\text{g}}}{CO_2}$$

Now (x) is passed into an aqueous solution containing one mole of Na_2CO_3 as given below–

$$CO_2 + \underset{\substack{\text{Sodium}\\ \text{carbonate}}}{Na_2CO_3} + H_2O \rightarrow \underset{\text{Sodiumbicarbonate}}{2NaHCO_3}$$

∵ No. of moles of Na_2CO_3 when 100 gm $CaCO_3$ is decomposed = 2

∴ No. of moles of $NaCO_3$ when 10g $CaCO_3$ is decomposed $= \frac{2\times10}{100} = 0.2$ mole

468. The normality of mixture obtained by mixing 100 mL of 0.2 M H_2SO_4 + 100 mL of 0.2 M NaOH is :

(a) 0.2 (b) 0.01
(c) 0.1 (d) 0.3

BCECE-2004

Ans. (c) : From the relation between molarity and normality is N = n × M

$N_1 = 2 \times 0.2 = 0.4$ N, $N_2 = 1 \times 0.2 = 0.2$N

@apna_pdf

When V_1 mL acid having normality N_1 is mixed with V_2 mL of base having normality N_2, the normality of the resultant solution is

$$\frac{V_1N_1 - V_2N_2}{V_1 + V_2} = N_R \qquad V_1N_1 > V_2N_2$$

$$N_R = \frac{0.4\times100 - 0.2\times100}{100+100} = \frac{40-20}{200}$$

$$N_R = \frac{1}{10} = 0.1\text{ N}$$

Normality = 0.1 N

469. Mole fraction of a solute in benzene is 0.2 then find molality of solute :

(a) 3.2 (b) 2
(c) 4 (d) 3.6

BCECE-2004

Ans. (a) : Let the solution be x molal then moles of benzene present in 1000 g of benzene

$$= \frac{1000}{78} = 12.82\text{ mol}$$

$$\therefore \text{ Mole fraction of solute} = \frac{x}{x+12.82}$$

$$0.2 = \frac{x}{x+12.82}$$

x = 0.2x + 2.564
0.8x = 2.564

$$x = \frac{2.564}{0.8} = 3.2$$

470. The number of moles of a solute in its solution is 20 and total numbers of moles are 80. The mole fraction of solute is

(a) 2.5 (b) 0.25
(c) 1 (d) 0.75

CG PET -2004

Ans. (b) : Given,
Number of moles = 20
Total number of moles = 80

$$\text{Mole fraction} = \frac{\text{Number of solute moles}}{\text{total number of moles}}$$

$$= \frac{20}{80} = 0.25$$

471. Vapour pressure of dilute aqueous solution of glucose is 750 mm of mercury at 373 K. The mole fraction of solute is

(a) 1/76 (b) 1/7.6
(c) 1/38 (d) 1/10

J & K CET-(2004)

Ans. (a) : 373 K is the boiling point of H_2O So, p° = 760

mm Hg, p_s = 750 mm Hg

$$\text{We know that-}\quad \frac{p^\circ - p_s}{p^\circ} = \text{mole fraction}\,(x_B)$$

$$\frac{760-750}{760} = x_B$$

$$x_B = \frac{1}{76}$$

472. One of the mole of a gas at NTP occupies 22.4 litres. This fact was derived from

(a) Law of gaseous volumes
(b) Avogadro's hypothesis
(c) Berzelius hypothesis
(d) Dalton's atomic theory

J & K CET-(2004)

Ans. (b) : One gram mole of a gas at NTP required 22.4 as volume. This fact was derived from Avogadro's hypothesis.

Taking STP to be 101.325 kPa and 273.15 K. From ideal gas equation PV = nRT

$$V = \frac{1\times RT}{p}$$

we can find the volume of one mole of a gas.

$$\text{Volume} = \frac{RT}{P} = \frac{8.314\times273.15}{101.325} = 22.4\text{L}$$

473. Number of atoms of oxygen present in 10.6 g of Na_2CO_3 will be

(a) 6.02×10^{22} (b) 12.04×10^{22}
(c) 1.806×10^{23} (d) 31.80×10^{28}

J & K CET-(2004)

Ans. (c) : 1 mole of Na_2CO_3 = 106 g

$$\text{Moles in 10.6 g of } Na_2CO_3 = \frac{10.6}{106} = 0.1\text{ mole}$$

106 g Contain atoms of oxygen = 3 × 6.022 ×10^{23}
10.6 g Contain atoms = 0.1 × 3 × 6.022 ×10^{23}
= 1.8 × 10^{23} atoms

474. 2 g of aluminium is treated separately with excess of dil. H_2SO_4 and excess of NaOH, the ratio of volume of hydrogen evolved in:

(a) 1:1 (b) 2:3
(c) 1:2 (d) 2:1
(e) 3:1

Kerala-CEE-2004

Ans. (a): $2Al + 3H_2SO_4 \longrightarrow Al_2(SO_4)_3 + 3H_2$

$2Al + 2NaOH + 6H_2O \longrightarrow 2Na[Al(OH)_4] + 3H_2$

In both reaction, 2 mole Al gives 3 mole. H_2 1 mole of H_2 = 22.4L

So, equal moles of H_2 corresponds to equals volume of H_2 in both reaction.

$$\text{Ratio} = \frac{3(H_2)}{3(H_2)} = \frac{1}{1}$$

475. The numerical value of $\frac{N}{n}$ (where, N is the number of molecules in a given sample of gas and n is the number of moles of the gas) is:

(a) 8.314 (b) 6.02×10^{23}
(c) 0.0821 (d) 1.66×10^{-19}
(e) 1.62×10^{-24}

Kerala-CEE-2004

Ans. (b) The numerical value of N/n, where:
N = The number of molecules in a given sample
n = number moles
suppose, we are having × mol of gas.

@apna_pdf

n = x mol
According to mole concept, 1 mole = $N_A = 6.023 \times 10^{23}$ molecules or atoms
Number of molecules in x moles of gas,
$N = x \times 6.023 \times 10^{23}$
The value of N/n is :

$$\frac{x \times 6.023 \times 10^{23}}{x} = 6.023 \times 10^{23}$$

476. The mass of 11.2 L of ammonia gas at STP is:

(a) 8.5 g (b) 85 g
(c) 17 g (d) 1.7 g
(e) 4.25 g

Kerala-CEE-2004

Ans. (a)
1 mole of NH_3 at STP occupies volume of 22.4 lit.
1 mole of NH_3 weights = molar mass = 17 g
So, 17 g of NH_3 = 22.4 lit
Let 17g of NH_3 = 22.4 lit
Let × g of NH_3 = 11.2 lit

Therefore, $x = \frac{(11.2 \times 17)}{(22.4)} = 8.5g$

477. Which of the following contains maximum number of molecules?

(a) 100 cc of CO_2 at STP
(b) 150 cc of N_2 at STP
(c) 50 cc of SO_2 at STP
(d) 150 cc of O_2 at STP
(e) 200 cc of NH_3 at STP

Kerala-CEE-2004

Ans. (e) 1 litre = 1000 cm^3 = 1000cc
We know that, volume of 1 mol of gas at S.T.P. = 22.4 L = 22400 cm^3 = 24000cc
200cc of NH_3 at S.T.P contains

$$\frac{(6.022 \times 10^{23} \times 200)}{22400} = 0.0537 \times 10^{23} \text{molecules}$$

150cc of N_2 at S.T.P. and 150cc of O_2 at S.T.P

$$\frac{(6.022 \times 10^{23} \times 150)}{22400} = 0.0403 \times 10^{23} \text{molecules}$$

50cc of SO_2 at S.T.P

$$= \frac{(6.022 \times 10^{23} \times 50)}{22400} = 0.013 \times 10^{23} \text{molecules}$$

From the above expression, it is clear that 200 cc of NH_3 at S.T.P. contains maximum number of molecule.

478. A litre of solution is saturated with Ag*Cl*. To this solution if 1.0 × 10^{-4} mole of solid Na*Cl* is added, what will be the $[Ag^+]$, assuming no volume change?

(a) More (b) Less
(c) Equal (d) Zero

UPTU/UPSEE-2004

Ans. (b) : A litre of solution is saturated with AgCl
1.0 × 10^{-4} mole of solid NaCl is added,
$[Ag^+]$ will be loss.

$$AgCl \rightleftharpoons Ag^+ + Cl^-$$

$$NaCl \rightarrow Na^+ + Cl^{-+}$$

Thus, the dissociation of NaCl provides chloride ions that are common to AgCl. Due to common ion effect, the dissociation of AgCl is suppressed and $[Ag^+]$ decreases.

479. The mass of $BaCO_3$ produced when excess CO_2 is bubbled through a solution of 0.205 mole $Ba(OH)_2$.

(a) 81 g (b) 40.5 g
(c) 20.25 g (d) 162 g

UPTU/UPSEE-2004

Ans. (b) : Given that,
Mole of $Ba(OH)_2$ =0.205 mole
Now,

$$Ba(OH)_2 + CO_2 \rightarrow BaCO_3 + H_2O$$

1 mole 1 mole
0.205 mol 0.205 mol
mole of $BaCO_3$ produced (n)=0.205 mol
molor man of $BaCO_3$ (m) =197 g/ mol
mass of $BaCO_3$ produced = 0.205 × 197g
= 40.385 g

480. Which of the following contains least number of molecules?

(a) 16 g of CO_2 (b) 8 g of O_2
(c) 4 g of N_2 (d) 2 g of H_2

AMU–2003

Ans. (c) : No. of molecules in 16 g of

$CO_2 = \frac{6.023 \times 10^{23}}{44} \times 16$

No. of molecules in 8 g of $O_2 = \frac{6.023 \times 10^{23}}{32} \times 8$

No. of molecules in 4 g of $N_2 = \frac{6.023 \times 10^{23}}{28} \times 4$

No. of molecules in 2 g of $H_2 = \frac{6.023 \times 10^{23}}{2} \times 2$

∴ 4 g of N_2 contains least number of molecules.

481. $KMnO_4$ reacts with oxalic acid according to the equation

$$\mathbf{2MnO_4^- + 5C_2O_4^{2-} + 16H^+ \rightarrow 2Mn^{2+} + 10CO_2 + 8H_2O}$$

Here 20 mL of 0.1 $MKMnO_4$ is equivalent to

(a) 20 mL of 0.5 (b) 50 mL of 0.1
(c) 50 mL of 0.01 (d) 20 mL of 0.1

J & K CET-(2003)

Ans. (b) :

$$2MnO_4^- + 5C_2O_4^{2-} + 16H^+ \rightarrow 2Mn^{2+} + 10CO_2 + 8H_2O$$

At NTP, 2 × 22.4 L react with 5 × 22.4 L oxalic acid

$$\frac{5 \times 22.4 \times 20}{2 \times 22.4} \text{ ml} = 50 \text{ ml}$$

20 mL of 0.1 m $KMnO_4$ is equivalent to 50 mL of 0.1 oxalic acid.

482. 720 g water contain the number o moles:

(a) 2 (b) 190
(c) 40 (d) 55

JCECE - 2003

@apna_pdf

Ans. (c): Given that –

Mass of H_2O is = 720 g

Molar mass of water = 18 g/mol

We know that, no. of mole = $\frac{\text{weight}}{\text{molecular weight}}$

Moles of water = $\frac{720}{18}$

= 40 moles.

483. The total number of protons in 10g of calcium carbonate is (N_0=6.023×10^{23})

(a) 3.01×10^{24} (b) 4.06×10^{24}

(c) 2.01×10^{24} (d) 3.01×10^{24}

UP CPMT-2003

Ans. (a) : Number of protons = Atomic number

∴ Protons in 1 mole $CaCO_3$

= Atomic No. of Ca + atomic. No. of C + 3 × atomic No. of O

= 20 + 6 + 3 × 8

= 50

Atomic mass of $CaCO_3$

= 40 + 12 + 3 × 16

=100

∵ 100 g of $CaCO_3$ has protons= 50

∴ 10 g of $CaCO_3$ has protons

$$= \frac{50}{100}\times10\times6.02\times10^{23}$$

$$= \frac{50}{100}\times10\times6.02\times10^{23}$$

$$= 3.01\times10^{24}$$

484. 3.65 g of HCl is dissolved in 16.2 g of water. The mole fraction of HCl in the resulting solution is:

(a) 0.4 (b) 0.3

(c) 0.2 (d) 0.1

AP-EAMCET (Medical), 2003

Ans. (d) : Given data:

$W_{HCl} = 3.65g$

$W_{H_2O} = 16.2g$

$X_{HCl} = ?$

Number of moles of HCl $\left(n_{HCl}\right) = \frac{3.65}{36.5} = 0.1$

Number of moles of H_2O $\left(n_{H_2O}\right) = \frac{16.2}{18} = 0.9$

Now, $X_{HCl} = \frac{n_{HCl}}{n_{HCl} + n_{H_2O}}$

$X_{HCl} = \frac{0.1}{0.1+0.9}$

or $X_{HCl} = 0.1$

485. One mole of fluorine reacted with two moles of hot concentrated KOH. The products formed are KF, H_2O and O_2. The molar ratio of KF, H_2O and O_2 respectively, is?

(a) 1 :1 : 2 (b) 2 :1 : 0.5

(c) 1 :2 : 1 (d) 2 :1 :2

AP EAMCET- 2002

Ans. (b) : $F_2 + 2KOH \rightarrow 2KF + H_2O + 1/2O_2$

The molar ratios of KF, H_2O and O_2 is 2: 1: 0.5 respectively.

486. The concentration of a 100 mL solution containing X g of Na_2CO_3 (molecular wt. = 106) is Y M. The values of X and Y are respectively :

(a) 2.12, 0.05 (b) 1.06, 0.2

(c) 1.06, 0.1 (d) 2.12, 0.1

AP-EAMCET-2002

Ans. (c) : Given, v = 100mL, w = X g, Molarity = Y M

We know that :

$$M = \frac{w\times1000}{m\times v} \quad (m = 106 \text{ gm, } v = 100 \text{ ml})$$

∴ $Y = \frac{X\times1000}{106\times100}$

or 106Y = 10X

Dividing both sides by 100 we get–

$\boxed{1.06X = 0.1Y}$

∵ Only option (c) satisfies the relation.

487. The number of moles of $KMnO_4$ that will be needed to react with one mole of sulphite ion in acidic solution is

(a) 1 (b) 4/5

(c) 3/5 (d) 2/5

AMU-2002

Ans. (d) :

$$2MnO_4^- + 5SO_3^{2-} + 6H^+ \longrightarrow 2Mn^{2+} + 5SO_4^{2-} + 3H_2O$$

So, according to the reaction, number of moles of $KMnO_4$ that will be needed to react with one mole of sulphite ion in acidic solution is $\frac{2}{5}$.

488. The volume strength of 1.5 NH_2O_2 solution is

(a) 5.2 (b) 8.4

(c) 8.8 (d) 4.8

AMU-2002

Ans. (b) : 1N of H_2O_2 → 5.6 volume

1.5N of H_2O_2 → 5.6 × 1.5

→ 8.4 volume strength.

489. One mole of SO_2 corresponds to

(a) 6.4g of SO_2

(b) 6.02×10^{23} molecules of SO_2

(c) 2.24 L at 25°C and 1 atm

(d) all of these

AMU-2002

Ans. (b) : One mole of SO_2 corresponds to 6.023×10^{23} molecules of SO_2.

490. The number of atoms in 0.004 g of magnesium is close to

(a) 2×10^{20} (b) 6.02×10^{23}

(c) 24 (d) 10^{20}

AMU-2002

@apna_pdf

Ans. (d) : Amount of magnesium = 0.004g
molecular weight of magnesium = 24

$$\therefore \text{ Number of moles(n)} = \frac{\text{Weight of magnesium}}{\text{molecular weight}}$$

or

$$n = \frac{0.004}{24} = \frac{1}{6} \times 10^{-3} \text{moles}$$

∴ Number of atoms in 0.004g of magnesium

$$= \frac{1}{6} \times 10^{-3} \times 6.023 \times 10^{23}$$

$$= 10^{20} \text{ atoms}$$

491. Number of atoms in 560 g of Fe (atomic mass = 56 g mol^{-1}) is

(a) Twice that of 70 g N_2 (b) half that of 20 g H
(c) Both (a) and (b) (d) None of the above

[AIEEE 2002]

Ans. (c) : Suppose that N be Avogadro's number
The atomic/molar masses of Fe, N_2 and H_2 are 56g/mol, 28 g/mol and 2 g/mol respectively.

$$560 \text{ g Fe} = \frac{560\text{g}}{56\text{g/mol}} = 10 \text{ mol Fe} = 10 \text{ N atoms}$$

$$70 \text{ g}N_2 = \frac{70\text{g}}{28\text{g/mol}} = 2.5 \text{ moles } N_2 = 2 \times 2.5 \text{ N} = 5\text{N}$$

atom
Twice of this Corresponds to 2 × 5N = 10 N

$$20 \text{ g of } H_2 = \frac{20\text{g}}{2\text{g/mol}} = 10 \text{ mole } H_2 = 2 \times 10 \text{ N} = 20 \text{ N}$$

atoms.
Half of this = 0.5 × 20 N = 10 N atoms.

492. Weight of 4 L of N_2 gas as N.T.P. is

(a) 56 g (b) 2.5 g
(c) 5 g (d) 28 g

J & K CET-(2002)

Ans. (c) : We know that weight of 22.4 L of Nitrogen at NTP
= 28 g
∴ weight of 4 L of N_2 gas at

$$\text{NTP} = \frac{28}{22.4} \times 4 = 5 \text{ g}$$

493. Which has maximum molecules?

(a) 7 g N_2 (b) 2 g H_2
(c) 16 g NO_2 (d) 16 g O_2

NEET-2002

Ans. (b): 1 mole of any element contain 6.022 × 10^{23} number of molecules so
(a) 28 g N_2 = 1 mole of N_2

$$7\text{g } N_2 = \frac{7}{28} = 0.25 \text{ mole}$$

(d) 32 g O_2 = 1 mole of O_2

$$16 \text{ g } O_2 = \frac{16}{32} = 0.5 \text{ mole}$$

(b) 2g H_2 = 1 mole of H_2
(c) 46 g NO_2 = 1 mole of NO_2

$$16 \text{ g } NO_2 = \frac{16}{46} = 0.35 \text{ mole}$$

Maximum number of moles will corresponds to maximum number of molecules.
So, 2g H_2 contain maximum molecules

494. One mole of CH_4 contains

(a) 4 g atoms of hydrogen
(b) 3.0 g atoms of carbon
(c) 6.02×10^{23} atoms of hydrogen
(d) 1.81×10^{23} molecules of CH_4

UP CPMT-2002

Ans. (a): 1 mole of CH_4 contains 1 gm of carbon and 4gm of mole of hydrogen. Methane (CH_4) is a colorless, odorless, flammable gas that is the simplest hydrocarbon and is the major constituent of natural gas.

495. The incorrect statement for 14g of CO is

(a) It occupies 2.24L at NTP
(b) It corresponds to 1/2 mole of CO
(c) It corresponds to same mole of CO and N_2
(d) It corresponds to 3.01×10^{23} molecules of CO

UP CPMT-2002

Ans. (a) : For 14 gm of CO –

$$\text{No. of mole CO} = \frac{14}{28} = \frac{1}{2} \text{mole.}$$

for 14 gm of N_2 –

$$\text{No. of mole } N_2 = \frac{14}{28} = \frac{1}{2} \text{mole}$$

∵ One mole of any gas occupies 2.24 litre.

$$\therefore \frac{1}{2} \text{ mole of CO gas occupies only 11.2 litre volume.}$$

One mole of molecule contain = N_A molecule
= 6.02 × 10^{23} molecule

$$\therefore \frac{1}{2} \text{ mole of CO contain} = 3.01 \times 10^{23} \text{ molecule of CO.}$$

496. 1.2 g of Mg (At mass 24) will produce MgO equal to

(a) 40 g (b) 4 g
(c) 0.05 mol (d) 2 g

AMU–2001

Ans. (c) :

$$\underset{24}{Mg} + \frac{1}{2}O_2 \rightarrow \underset{40}{MgO}$$

24g of Mg produce MgO = 1 mol

$$\therefore 1.2 \text{ g mol Mg produce MgO } \frac{1 \times 1.2}{24}$$

= 0.05 mol

497. An aqueous solution contains 25% ethanol and 50% acetic acid by mass. Calculate the mole fraction of acetic acid in this solution.

(a) 0.196 (b) 0.301
(c) 0.392 (d) 0.503

J & K CET-(2001)

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Ans. (b) : Mole of $C_2H_5OH = \frac{25}{46} = 0.54$

Mole of $CH_3COOH = \frac{50}{60} = 0.83$

% of $H_2O = 100 - (50 + 25) = 25$

$\therefore$ Mole of $H_2O = \frac{25}{18} = 1.38$

Total number of moles = 0.54 + 0.83 + 1.39 = 2.76

$\therefore$ Mole fraction of acetic acid

$= \frac{0.83}{2.76} = 0.301$

498. 250 mL of a Na_2CO_3 solution contains 2.65 g of $Na_2CO_3 \cdot 10$ mL of this solution is added to x mL of water to obtain 0.001 M Na_2CO_3 solution. The value of x is (molecular weight of $Na_2CO_3 = 106$)

(a) 1000 mL (b) 990 mL

(c) 9990 mL (d) 90 mL

UPTU/UPSEE-2012

Ans. (b) :

Molarity of the solution of 250 ml of a sodium carbonate solution contains 2.65 gm of sodium carbonate.

$$M_1 = \frac{2.65g}{105.98g/mol \times 0.250L} = 0.1000\, mol/L$$

When 10 ml of above solution is added to x ml of water the molarity of the solution becomes 0.001 M volume of 0.1000 M solution = v_1

Molarity of the solution on dilution = m_2

Volume of the new solution = v_2 = 10 ml + x ml

$m_1 \times v_1 = m_2 \times v_2$

0.1000 M × 10ml = 0.01 M × (10+x) ml

on solving we get :

x = 990 ml

499. How many atoms of sulphur are present in 0.2 mole of sulphur (S_8) molecule?

(a) 9.64×10^{23} (b) 96.4×10^{23}

(c) 1.205×10^{23} (d) 12.05×10^{23}

J & K CET-(2001)

Ans. (a) : 1 mole of S_8 molecule = 6.022×10^{23} moles

0.2 mole of S_8 molecules = $0.2 \times 6.022 \times 10^{23}$

$= 1.2044 \times 10^{23}$ molecule

One molecule of S_8 Contains 8 atoms of sulphur

Hence, the total number of atom in S_8

$= 8 \times (1.2044 \times 10^{23})$

$= 9.6352 \times 10^{23}$

500. 120 g of urea is present in 5 L of solution. The active mass of urea is

(a) 0.06 (b) 0.2

(c) 0.4 (d) 0.8

UP CPMT-2001

Ans. (c) : Given, mass of urea = 120 g, and

Volume of solution = 5 L

Molecular mass of urea (NH_2CONH_2)

$= 14 + 2 \times 1 + 12 + 16 + 14 + 2 \times 1 = 60$

Active mass = $\frac{\text{moles}}{\text{volume}}$

$= \frac{\text{mass / molecular weight}}{\text{volume}}$

$\therefore$ Active mass of urea = $\frac{120/60}{5} = \frac{2}{5} = 0.40$

501. 7.5 g of a gas occupies 5.6 L of volume at S.T.P. The gas is:

(a) NO (b) N_2O

(c) CO (d) CO_2

AP-EAMCET (Medical), 2001

Ans. (a) : Given that, w = 7.5gm

One mole of gas of S.T.P. = 22.4 litres.

So, 5.6 litres of gas at STP contains 0.25 moles

Number of moles = $\frac{\text{Weight (grams)}}{\text{Molecular weight}}$

or $0.25 = \frac{7.5}{M}$

or $M = \frac{7.5}{0.25}$

or M=30

Then, NO has 30 number of moles.

502. How many moles of acidified $FeSO_4$ can be completely oxidised by one mole of $KMnO_4$?

(a) 10 (b) 5

(c) 6 (d) 2

AP-EAMCET (Medical), 2001

Ans. (b) : When 1 mole of $KMnO_4$ reacts with $FeSO_4$ then

$2KMnO_4 + 10FeSO_4 + 8H_2SO_4 \rightarrow K_2SO_4 + 2MnSO_4 + 5Fe_2(SO_4)_3 + 8H_2O$

$\because$ 2 moles of $KMnO_4$ react = 10 moles of $FeSO_4$

Hence, 1 mole of $KMnO_4$ = 5 moles of $FeSO_4$

503. 50g of calcium carbonate was completely burnt in air. What is the weight (in grams) of the residue? (Atomic weights of Ca, C and O are 40, 12 and 16 respectively)

(a) 2.8 (b) 28

(c) 4.4 (d) 44

AP-EAMCET (Medical), 2001

Ans. (b) : $CaCO_3(s) \xrightarrow{\Delta} CaO(s) + CO_2(g)$

Molecular weight of $CaCO_3$ = 100, CaO = 56 and CO_2 = 44

$\because$ 100 gm of $CaCO_3$ on burning provides residue = 56 gm of CaO

$\therefore$ 50 gm of $CaCO_3$ provides residue $= \frac{56}{100} \times 50$

= 28 gm

504. 10^{21} molecules are removed from 200 mg of CO_2. The moles of CO_2 left are:

(a) 2.84×10^{-3} (b) 28.4×10^{-3}

(c) 284×10^{-3} (d) 28.4×10^{3}

AIIMS-2001

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Ans. (a): Given mass = 200 mg = 0.2 g

Molar mass of CO_2 = 44 g

$$\text{Number of moles} = \frac{\text{Weight}}{\text{Mole weight}} = \frac{0.2}{44} = \frac{1}{220}$$

No. of molecules = $6.022 \times 10^{23} \times 1/220$

$= 2.73 \times 10^{21}$

As 10^{21} molecules are removed,

Hence, No. of Molecules left = $2.73 \times 10^{21} - 10^{21}$

$= 1.73 \times 10^{21}$

No. of moles = No. of molecules /Avogadro's number

$$= \frac{1.73\times10^{21}}{6.23\times10^{23}}$$

$$= 2.88\times10^{-3}$$

505. The weight of NaCl decomposed by 4.9 g of H_2SO_4, if 6g of sodium hydrogen sulphate and 1.825 g of HCl, were produced in the reaction is:

(a) 6.921g (b) 4.65g
(c) 2.925g (d) 1.4 g

AIIMS-2001

Ans. (c): NaCl(xg) + H_2SO_4(4.9g) → $NaHSO_4$(6g) + HCl (1.825g)

The law of conservation of mass states that in a chemical reaction mass is neither created nor destroyed.

∴ Mass of the reactants = Mass of Products

x + 4.9 = 6 + 1.825 g

x = 2.925 g

506. Temperature does not affect:

(a) Molality (b) Formality
(c) Molarity (d) Normality

AIIMS-1997-2001

Ans. (a): Since molality is defined in terms of the solvent's mass not its volume, the temperature does not change the molality of a solution.

Where as in case of formality molarity and normality the concentration of solution is expressed in terms of volume which change with the change of temperature.

507. The molarity of 98% by weight H_2SO_4 solution, which has a density 1.84 g/cc at 35º C is:

(a) 1.84 M (b) 18.4 M
(c) 20.6 M (d) 24.5 M

AIIMS-2001

Ans. (b): The solution contains 98% H_2SO_4 by weight/mass that means 100 gram of solutions 98 grams of H_2SO_4.

Density is 1.84 gm/ml (cc = ml)

$$\text{So, volume of the solution} = \frac{\text{mass of the solution}}{\text{density of solution}}$$

$$= \frac{100\,\text{gram}}{1.84} = 54.34\ \text{ml}$$

$$\text{No. of moles of } H_2SO_4 = \frac{\text{weight of } H_2SO_4}{\text{molar mass of } H_2SO_4}$$

$$= \frac{98}{98} = 1\ \text{moles}$$

$$\text{Molarity} = \frac{1\,\text{mole}}{54.3\,\text{ml}\times1000} = 18.41\ \text{M}$$

508. The normality of orthophosphoric acid having purity of 70% by weight and specific gravity 1.54 is:

(a) 11 N (b) 22 N
(c) 33 N (d) 44 N

AIIMS-2001

Ans. (c): Density of orthophosphoric acid (H_3PO_4) = specific gravity × density of water.

Density of orthophosphoric acid = 1.54 × 0.998

= 1.54 g/ml

Mass in 1000 ml = 1.54 × 1000 = 1540 g

Gram equivalent weight of orthophosphoric acid =

$$\frac{\text{Molar mass}}{\text{N}-\text{factor}} = \frac{98}{3} = 32.66\ \text{g eq.}$$

orthophosphoric acid is only 70% pure so the weight of orthophosphoric acid = $1540 \times \frac{70}{100} = 1078\,\text{g}$

Number of gram equivalents of orthophosphoric acid

$$= \frac{1078}{32.66} = 33$$

$$\text{Normality} = \frac{(\text{number of gram equivalents})}{(\text{volume of solution in L})}$$

Normality = 33 N.

509. 0.4 moles of HCl and 0.2 moles of $CaCl_2$ were dissolved in water to have 500ml of solution, the morality of Cl^- ion is:

(a) 0.8 M (b) 1.6 M
(c) 1.2 M (d) 10.0 M

AIIMS-2000

Ans. (b): $HCl \rightleftharpoons H^+ + Cl^-$

$CaCl_2 \rightleftharpoons Ca^{2+} + \underset{2\times0.2=0.4\,\text{moles}}{2Cl^-}$

Total moles of Cl^- = 0.4 + 0.4 = 0.8 moles

Volume of solution of 500ml = 0.5 L

Molarity of Cl^- = moles Cl^- /volume of solution

$$\text{Molarity of } Cl^- = \frac{0.8}{0.5} = 1.6\,\text{M}$$

510. Number of molecules in one litre of water is close to

(a) $55.5 \times 6.023 \times 10^{23}$
(b) $18 \times 6.023 \times 10^{23}$
(c) $18 \div 22.4\times10^{23}$
(d) 1.8×10^{23}

J & K CET-(2000)

Ans. (a) : 1 L H_2O = 1000 g

∴ 18 g of H_2O = 6.023×10^{23} molecules

$$\therefore\ 1000\ \text{g of } H_2O = \frac{6.023\times10^{23}\times1000}{18}$$

$$= 55.5\times6.023\times10^{23}\ \text{molecules}$$

@apna_pdf

511. 2.0 g of oxygen contains number of atoms equal to that in

(a) 4.0 g of sulphur (b) 7.0 g of nitrogen
(c) 0.5 g of hydrogen (d) 2.3 g of sodium

J & K CET-(2000)

Ans. (a) : No. of moles in 2 g of oxygen = $\frac{2}{16} = \frac{1}{8}$ mole

No. of atoms of oxygen = $\frac{1}{8}$ ×Ma atoms

No. of moles in 4g of sulphur $\frac{4}{32} = \frac{1}{8}$ mole

No. of atom of sulphur = $\frac{1}{8}$ ×Ma atoms.

Therefor, 4g of Sulphur Contain equal atoms 2g of oxygen atoms.

512. Volume of CO_2 obtained by the complete decomposition of 9.85 g of $BaCO_3$ is

(a) 2.24 L (b) 1.12 L
(c) 0.84 L (d) 0.56 L

NEET-2000

Ans. (b) :

$$BaCO_3 \longrightarrow BaO + CO_2 \uparrow$$

1mole 1 mole mole

$$\text{Moles} = \frac{\text{Given weight}}{\text{molecular weight}} = \frac{9.85}{197 g/mol.}$$

=0.05 mole

At STP. 1 mole = 22.4 L

0.05 mole = 22.4 × 0.05 L = 1.12 L

513. The amount of zinc required to produce 224 ml. of H_2 at STP on treatment with dilute H_2SO_4 will be

(a) 65 g (b) 0.065 g
(c) 0.65 g (d) 6.5 g

NEET-1996

Ans. (c) : When Zinc react with H_2SO_4

$$Zn + H_2SO_4 \rightarrow ZnSO_4 + H_2$$

1 mole of Zinc will react to give 1 moles of hydrogen

Volume of 1 mole of hydrogen at STP = 22400 ml

1 mole of Zn = 65 grams = $\frac{65 \times 224}{22400} = 0.65g$

0.65 grams of Zinc can react to give 224 ml of hydrogen.

514. 0.2 mole of sodium chloride is dissolved in 0.6 mole of water. The mole fraction of water in the solution is

(a) 0.25 (b) 0.33
(c) 0.67 (d) 0.75

J & K CET-(1999)

Ans. (d) : Mole fraction of water

$$= \frac{\text{Mole of water}}{\text{mole of sodium chloride} + \text{mole of water}}$$

$$= \frac{0.6}{0.2 + 0.6}$$

= 0.75

515. What is the number of moles of hydrogen atoms in 3.2 g of methane?

(a) 0.2 (b) 0.4
(c) 0.8 (d) 2.0

J & K CET-(1999)

Ans. (c) : CH_4

(12 + 4) = 16 g

∵ 16 g of CH_4 Contains → 4 g of H

∴ 3.2 g CH_4 Contains → $\frac{4}{16} \times 3.2$

= 0.8 g H atoms.

516. The number of atoms in 4.25 g of NH_3 is approximately

(a) 4×10^{23} (b) 2×10^{23}
(c) 1×10^{23} (d) 6×10^{23}

NEET-1999

Ans. (d) : Given that,

Weight of NH_3 =4.25g

$$\text{Number of moles of } NH_3 = \frac{\text{Weight}}{\text{Molecular Weight}}$$

$$= \frac{4.25}{17} = 0.25\text{mole}$$

Number of molecules in 0.25 moles of NH_3

$= 0.25 \times 6.023 \times 10^{23}$

So, number of atoms = $4 \times 0.25 \times 6.023 \times 10^{23}$

$= 6.023 \times 10^{23}$

$\approx 6 \times 10^{23}$

517. The normality of a solution obtained by mixing 10 mL of N/5 HCI and 30mL of N/10HCI is:

(a) $\frac{N}{15}$ (b) $\frac{N}{5}$
(c) $\frac{N}{7.5}$ (d) $\frac{N}{8}$

AIIMS-1999

Ans. (d): N = M × n – factor

$$NV = N_1V_1 + N_2V_2 \quad \begin{cases} \text{where } N = \text{Normality of mixture} \\ V = \text{Volume of mixture} \end{cases}$$

$$NV = \frac{1}{5} \times 10 + \frac{1}{10} \times 30$$

N × 40 = 2 + 3

$$N = \frac{5}{40}$$

$$N = \frac{1}{8}$$

518. The molar concentration of 20g of NaOH present in 5 litre of solution is:

(a) 0.1 mols/litre (b) 0.2 mols/litre
(c) 1.0 mols/litre (d) 2.0 mols/litre

AIIMS-1998

Ans. (a) : Molar mass of NaOH : 39.997 g/mol

$$20g \text{ NaOH } \frac{1 \text{mol NaOH}}{39.997 \text{ g NaOH}} = 0.5 \text{ mol NaOH}$$

Convert liters of H_2O to kg

@apna_pdf

Density of H_2O – 1g/ml → 1 kg/L

$$\text{SL } H_2O — \frac{1\text{kg } H_2O}{1\text{L } H_2O} = 5\text{kg} H_2O$$

$$\text{Molarity of NaOH} = \frac{.5\,\text{mol}}{5\,\text{kg}}$$

m = 0.1 mols/liter

519. Volume of a gas at NTP is 1.12×10^{-7} cc. The number of molecule in it is:

(a) 3.01×10^{12} (b) 3.01×10^{18}
(c) 3.01×10^{24} (d) 3.01×10^{30}

AIIMS-1998

Ans. (a): Given that,

$\therefore$ 22400 cm^3 of the gas at STP has molecules

$= 6.02 \times 10^{23}$

$\therefore$ 1.12×10^{-7} cm^3 of the gas at STP will have molecules.

$$= \frac{6.02\times10^{23}}{22400}\times1.12\times10^{-7}$$

$= 3.01 \times 10^{12}$ molecules

520. Which one of the following quantities of ionic compounds contains greater number of ions?

(a) 100 g NaCl (formula mass 58)
(b) 100 g Na_2O (formula mass 62)
(c) 100 g K_2O (formula mass 94)
(d) 100 g CaI_2 (formula mass 111)

J & K CET-(1998)

Ans. (b) : In ionic compounds the formula of an ionic compound represents the ratio between Constituent ions.

The mass of 6.02×10^{23} formula unit reperesents one mole of an ionic Compound.

100 g NaCl (Formula mass 58) = 1.72 mol NaCl

$= 2 \times 1.72 \times 6.023 \times 10^{23}$ ions

$= 20.71 \times 10^{23}$ ions

100 g Na_2O (formula mass 62) = 1.06 mol Na_2O

$= 3 \times 1.61 \times 6.023 \times 10^{23}$ ions

$= 29.09 \times 10^{23}$ ions

100 g K_2O (formula mass 94) = 1.06 mol K_2O

$= 3 \times 1.06 \times 6.023 \times 10^{23}$ ions

$= 19.15 \times 10^{23}$ ions

100 g $CaCl_2$ (formula mass 111) = 0.90 mol $CaCl_2$

$= 3 \times 0.90\times 6.023 \times 10^{23}$ ions

$= 16.26 \times 10^{23}$ ions

521. At STP, the density of a gas (molecular weight 45) is

(a) 2 g/litres (b) 11.2 g/litres
(c) 22.4 g/litres (d) 26.6 g/litres

J & K CET-(1997)

Ans. (a) : As we know that,

At STP, P = 1 atm T = 273 K

Ideal gas equation –

PV = nRT

$$= \frac{m}{M}RT$$

$$PM = \frac{m}{v}RT \qquad \left[\frac{m}{v} = d(\text{density})\right]$$

$= dRT$

$$d = \frac{PM}{RT}$$

$$d = \frac{45}{0.0832\times273}$$

So, d = 2 gm/lit

522. When 6 volumes of oxygen undergoes complete reaction to ozone, the number of moles of ozone formed are

(a) 6 (b) 3
(c) 4 (d) 2

AP EAMCET- 1995

Ans. (c) : $3O_2 \rightarrow 2O_3$

No. of moles of O_3 produced by 3 moles of O_2 = 2

No. of moles of O_3 produced by 6 moles of

$$O_2 = \frac{2}{3}\times6 = 4\,\text{mol.}$$

523. The number of moles of AgCl precipitated when excess $AgNO_3$ is mixed with one mole of $[Cr(NH_3)_4Cl_2]Cl$, is

(a) 0 (b) 1.0
(c) 2.0 (d) 3.0

AMCET-1998, 1996

Ans. (b) : When excess $AgNO_3$ is mixed with one mole of $[Cr(NH_3)_4Cl_2]Cl$ than one mole of AgCl precipitated.

$$[Cr(NH_3)_4Cl_2]Cl + AgNO_3 \rightarrow$$

$$\left[Cr(NH_3)_4Cl_2\right]NO_3 + AgCl\text{-}$$

In this complex chloride ion form ionic isomerism and shows primary valency.

$AgNO_3$ is added in excess then result precipitation will occur.

524. The number of molecules in 4.25 g of ammonia is approximately

(a) 3.5×10^{23} (b) 0.5×10^{23}
(c) 2.5×10^{23} (d) 1.5×10^{23}

AIIMS-1996

Ans. (d): We know that 17 g of ammonia (NH_3) Contains 6.02×10^{23} molecules.

Therefore number of molecules in 4.25 of

$$NH_3 = \frac{6.02\times10^{23}\times4.25}{17}$$

$$NH_3 = 1.50\times10^{23}$$

$$NH_3 = 1.5\times10^{23}$$

525. Avogadro's number of oxygen atom weighs

(a) 32 g (b) 8 g
(c) 56 g (d) 16 g

AIIMS-1996

Ans. (d): Avogadro's number, number of units is one mole of any substance (defined as its molecular weight is grams), equal to 6.023×10^{23}.

Weight of 6.023×10^{23} molecular of oxygen (O_2) = 32g

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Since the oxygen is diatomic, therefore weight of Avogadro's number of oxygen atom = $\frac{32}{2}$ = 16 g

526. The number of moles of water present in 180 gm of water is

(a) 18 (b) 5
(c) 100 (d) 10

AIIMS-1996

Ans. (d): Given that, Molecular weight of water = 18

$\therefore$ No of moles of water = $\frac{\text{Mass}}{\text{Molecular mass}}$

$= \frac{180}{18} = 10$ moles

527. Which one of the following gases contains the least number of molecules ?

(a) 4.0 g laughing gas (b) 3.0 g phosphorus
(c) 2.0 g marsh gas (d) 10.0 g phosgene

AP-EAMCET-1994

Ans. (a) : Mass of N_2O = 44
Mass of P = 31
Mass of CH_4 = 16
Mass of $COCl_2$ = 99

$\therefore$ Number of molecules in N_2O

$= 4\times\frac{N}{44} = \frac{N}{11}$ molecules

Number of molecules in 3 gm of

$P = 3\times\frac{N}{31}$ molecules

Number of molecules in 2 gm of CH_4

$= 2\times\frac{N}{16} = \frac{N}{8}$

Number of molecules in 10 gm $COCl_2$ $= 10\times\frac{N}{99}$

$\therefore$ 4 gm N_2O (Laughing gas) contains least number of molecules.

528. The mole fraction of solute in 20% aqueous H_2O_2 solution is

(a) 0.588 (b) 0.444
(c) 0.1168 (d) 4.44

AP EAMCET- 1992

Ans. (c) : Given that,
20% aqueous H_2O_2

No. of moles of H_2O_2 = $\frac{20}{34}$ =0.588

No. of moles of H_2O = $\frac{80}{18}$ = 4.44

$\therefore$ Mole fraction of H_2O_2= $\frac{0.588}{0.588+4.44}$ = 0.1168

529. The number of moles of barium carbonate which contains 1.5 moles of oxygen atoms is :

(a) 1.5 (b) 1
(c) 2 (d) 0.5

AP-EAMCET-1991

Ans. (d) : The number of moles of oxygen atom in $BaCO_3$ = 3

$\therefore$ 1.5 moles of oxygen atom in $BaCO_3$ $= \frac{1}{3}\times 1.5$

= 0.5 mole.

530. The number of moles of oxygen in one litre of air containing 21% oxygen by volume, under standard conditions, is

(a) 0.0093 mol (b) 2.10 mol
(c) 0.186 mol (d) 0.21 mol

NEET-1995

Ans. (a) : Volume of oxygen in 1L of air

$\frac{21}{100}\times 1000 = 210\text{mL}$

$\therefore$ 22400 mL volume at STP is occupied by oxygen = 1 mole

number of moles occupied by 210 mL

$\frac{210}{22400} = 0.0093\,\text{mol.}$

531. In the reaction,

$$4NH_{3(g)} + 5O_{2(g)} \longrightarrow 4NO_{(g)} + 6H_2O_{(i)}$$

when 1 mole of ammonia and 1 mole of O_2 are made to react to completion

(a) all the oxygen will be consumed
(b) 1.0 mole of NO will be produced
(c) 1.0 mole of H_2O is produced
(d) all the ammonia will be consumed

NEET-1998

Ans. (a) :
$4NH_3 + 5O_2 \rightarrow 4NO + 6H_2O$
$1\ NH_3 + 1.25O_2 \rightarrow 1NO + 1.5\ H_2O$
When 1 mole of NH_3 reacts with 1.25 moles of O_2 it produces 1 mole of NO and 1.5 moles of H_2O. When one mole of ammonia and one mole of oxygen are made to react to completion, then all the oxygen is consumed.

532. Which of the gases contains the same number of molecules as that of 16 g oxygen ?

(a) 16 g of O_3 (b) 32 g of SO_2
(c) 16 g of SO_2 (d) All of these

AP-EAMCET-1991

Ans. (b) : Number of moles of O_2 $= \frac{\text{weight of } O_2}{\text{M. weight of } O_2}$

$= \frac{16}{32} = 0.5$ mole

Number of moles of 32 gm SO_2 $= \frac{32}{64} = 0.5$ mole

Hence, the 32 gm of SO_2 moles equal to the 16 gm of O_2 moles.

533. The number of gram molecules of oxygen is 6.02×10^{24} CO molecules is

(a) 10 g molecules (b) 5 g molecules
(c) 1 g molecules (d) 0.5 g molecules

NEET-1990

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Ans. (b) : No. of CO molecules = 6.022×10^{24}
Number of oxygen atoms = Number of CO molecules = 6.022×10^{24}

Number of Oxygen molecule = $\frac{1}{2} \times$ number of oxy
$= 3.011\times10^{24}$

Number of molecules of O_2 molecules

$$= \frac{\text{No.of molecules}}{\text{Avogadro's No.}} = \frac{3.011\times10^{24}}{6.022\times10^{23}} = 5\text{g molecule}$$

(Note: mole also called gram-molecule)

534. Boron has two stable isotopes, $^{10}B(19\%)$ and $^{11}B(81\%)$. Calculate average at. wt. of boron in the periodic table.

(a) 10.8	(b) 10.2
(c) 11.2	(d) 10.2

NEET-1990

Ans. (a) : Average atomic weight

$$= \frac{\sum \%\,\text{abundant} \times \text{atomic mass}}{100}$$

$$= \frac{19\times10+81\times11}{100} = 10.81$$

535. When 22.4 litres of $H_{2(g)}$ is mixed with, 11.2 litres of $Cl_{2(g)}$, each at STP, the moles of $HCl_{(g)}$ found is equal to

(a) 1 mol of HCl(g)	(b) 2 mol of HCl(g)
(c) 0.5 ml of HCl(g)	(d) 1.5 mol of HCl(g)

AIPMT-1990, AMU-2014

Ans. (a) : $H_2(g) + Cl_2(g) \rightarrow 2HCl(g)$
initial vol. 22.4 L   11.2L   2 mol
∴ 22.4 L volume of STP is occupied by Cl_2 = 1 mole
∴ 11.2 L volume will be occupied by Cl_2 = $\frac{1\times11.2}{22.4}$ mole = 0.5 mol
22.4 L volume of STP is occupied by H_2= 1mol
Thus, $H_2(g) + Cl_2(g) \rightarrow 2HCl(g)$
1 mol   0.5 mol
Since, Cl_2 possesses minimum number of moles,
thus it is the limiting reagent.
As per equation,
1 mole of Cl_2 = 2mol of HCl
∴ 0.5 mole of Cl_2 = 2 × 0.5 mole of HCl
= 1.0 mole of HCl

536. Ratio of C_P and C_v of a gas 'X' is 1.4. The number of atoms of the gas 'X' present in 11.2 litres of it at NTP will be

(a) 6.02×10^{23}	(b) 1.2×10^{23}
(c) 3.01×10^{23}	(d) 2.01×10^{23}

NEET-1989

Ans. (a) : Ratio of C_p/C_v = 1:4
The gas is diatomic
At NTP, volume of 1 mole of a gas = 22.4 L
At NTP 22.4 L contains = 6.023×10^{23} molecules

At NTP 11.2 L contains = $\frac{6.023\times10^{23}\times11.2}{2}$
$= 3.01 \times 10^{23}$ molecules

Hence, number of atoms of gas 'x' (diatomic)
$= 3.01 \times 10^{23} \times 2$ atoms
$= 6.02 \times 10^{23}$ atoms.

537. The number of oxygen atoms in 4.4 g of CO_2 is

(a) 1.2×10^{23}	(b) 6×10^{22}
(c) 6×10^{23}	(d) 0.12×10^{23}

NEET-1989

Ans. (a) : Moles of CO_2 = $\frac{4.4}{44} = 0.1$moles
∴ Number of molecules of CO_2 = $0.1\times6.022\times10^{23}$
$= 6.022 \times 10^{22}$ molucules
1 molecule of CO_2 contains 2 oxygen atoms.
∴ Number of oxygen atoms = $2 \times 6.022 \times 10^{22}$
$= 12.044 \times 10^{22}$
$= 1.2 \times 10^{23}$ atoms

538. 1 cc N_2O at NTP contains

(a) $\frac{1.8}{224}\times10^{22}$ atoms

(b) $\frac{6.02}{22400}\times10^{23}$ molecules

(c) $\frac{1.32}{224}\times10^{23}$ electrons

(d) All of the above

NEET-1988

Ans. (d) : At NTP 22400 cc of N_2O contains = 6.02×10^{23} molecules

∴ 1 cc N_2O will contain = $\frac{6.02\times10^{23}}{22400}$molecules

In N_2O molecule, number of atoms = 2 + 1 = 3

Thus, the number of atoms = $\frac{3\times6.02\times10^{23}}{22400}$ atoms

$= \frac{1.8\times10^{22}}{224}$atoms

In an N_2O molecule, the number of electrons = 7 + 7 + 8 = 22

Hence, the number of electrons, = $\frac{6.02\times10^{23}}{22400}\times22$

$= \frac{1.32\times10^{23}}{224}$ electrons.

539. At STP the density of CCl_4 vapour of g/L will be nearest to

(a) 6.87	(b) 3.42
(c) 10.26	(d) 4.57

NEET-1988

Ans. (a) : We know that, mass of C = 12g, Cl = 35.5 g
1 mole CCl_4 vapours = 12 + 4 × 35.5
= 154g
At STP, volume of 1 mole of gas = 22.4 L
Thus, 154g = 22.4 L

∴ Density of CCl_4 vapours = $\frac{154}{22.4}\text{gL}^{-1}$
$= 6.87\text{ g L}^{-1}$

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540. **Sodium bicarbonate on heating decomposes to from sodium carbonate, CO_2 and water. If 0.2 moles of sodium bicarbonate is completely decomposed how many moles of sodium carbonate is formed?**

(a) 0.1 (b) 0.2

(c) 0.05 (d) 0.025

UPSEE/UPTU 2012

Ans. (a) : In this reaction –

$$2NaHCO_3(s) \xrightarrow{\Delta} Na_2CO_3(s) + CO_2(g) + H_2O(l)$$

2 mole of sodium bicarbonate $(NaHCO_3)$

Form 1 mole of sodium carbonate (Na_2CO_3)

Then, for 0.2 mole of $Na_2CO_3 = \frac{1}{2} \times 0.2$

$= 0.1$ mole of Na_2CO_3

Hence according to the given balanced reaction 0.1 moles of sodium Carbonate is formed.

4. Laws of Chemical Combinations

541. **Among the following pairs of compounds, the one that does not illustrate the law of multiple proportions, is**

(a) NO and NO_2 (b) CuO and Cu_2O

(c) FeO and Fe_2O_3 (d) H_2O and H_2S

(e) NO and N_2O

Kerala CEE -03.07.2022

Ans. (d) : Law of multiple proportion- it state that when two elements combine to form more than one compound, the weight of one element that combines with a fixed weight of the other is in the ratio of small whole numbers.

Here, in option (b), hydrogen is present in both compounds but oxygen is present in the first compound and sulphur is present in second compound. Hence, this pair cannot illustrate the law of multiple proportion.

542. **Calculate the amount of hydrogen gas required in order to produce 100g of ammonia by the reaction of $N_2(g)$ and $H_2(g)$ gases.**

(a) 35.29 g (b) 17.65 g

(c) 28.11g (d) 34 g

AP EAPCET 24.08.2021 Shift-II

Ans. (b) : Given, NH_3 Produce 100 gm.

$$N_2(g) + 3H_2(g) \longrightarrow 2NH_3$$

So, the number of moles of

$$NH_3 = \frac{\text{Weight}}{\text{Molecular weight}}$$

$$n_{NH_3} = \frac{100}{17}$$

$$n_{NH_3} = 5.88 \text{ mole.}$$

So, the amount of hydrogen gas

Required is = 3 × 5.88 = 17. 65 gm.

543. **When 20 g of $CaCO_3$ is treated with 20g of HC*l* the mass of CO_2 formed would be ——**

(a) 10 g (b) 8.8 g

(c) 22.2 g (d) 20 g

AP EAPCET 19-08-2021 Shift-I

Ans. (b) :

$$\underset{\substack{1\text{mol}\\100\text{g}}}{CaCO_3(s)} + \underset{\substack{2\text{mol}\\73\text{g}}}{2HCl(aq)} \rightarrow CaCl_2(aq) + H_2O(l) + \underset{\substack{1\text{mol}\\44\text{g}}}{CO_2(g)}$$

Let $CaCO_3(s)$ be completely consumed in the reaction.

∴ 100g $CaCO_3$ give 44g CO_2

∴ 20 g $CaCO_3$ will give $\frac{44}{100} \times 20\text{g}\, CO_2 = 8.8\text{g}\, CO_2$

544. **The complete combustion of one mole of benzene produces _______ grams of carbon dioxide.**

(a) 164 (b) 220

(c) 264 (d) 308

AP EAPCET 20.08.2021 Shift-II

Ans. (c): Combustion reaction of benzene to carbon dioxide is-

$$C_6H_6 + \frac{15}{2}O_2(g) \longrightarrow 6CO_2(g) + 3H_2O(g)$$

Find grams of carbon dioxide.

$$\therefore \text{mole} = \frac{\text{weight}}{\text{moleculor weight}}$$

$$6 = \frac{\text{weight}}{44}$$

Weight = 44 × 6 = 264 gm

So, 1 mole of benzene produces 264 gm of carbon dioxide.

545. **From the given reactions identify the disproportionation reaction**

(i) $Cl_2(g) + 2\,KI(aq) \longrightarrow 2KCl(aq) + I_2(s)$

(ii) $Cl_2(g) + 2OH^-(aq) \longrightarrow ClO^-(aq) + Cl^-(aq) + H_2O(l)$

(iii) $Mg(s) + 2HCl(aq) \longrightarrow MgCl_2(aq) + H_2(g)$

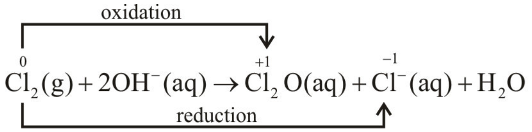
(iv) $2H_2O_2(aq) \longrightarrow 2H_2O(l) + O_2(g)$

(a) (i) and (iv) (b) (ii) and (iv)

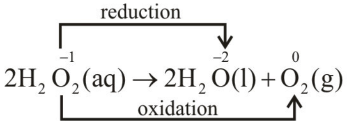
(c) (ii) and (iii) (d) (i) and (ii)

TS EAMCET 05.08.2021, Shift-I

Ans. (b) : A disproportionation reaction is a redox reaction in which one species is simultaneously oxidized and reduced.



$$\overset{0}{Cl_2}(g) + 2OH^-(aq) \rightarrow \overset{+1}{Cl_2}O(aq) + \overset{-1}{Cl^-}(aq) + H_2O$$



$$2H_2\overset{-1}{O_2}(aq) \rightarrow 2H_2\overset{-2}{O}(l) + \overset{0}{O_2}(g)$$

546. **In which one of the following sets all species show disproportionation reaction**

(a) ClO_2^-, F_2, MnO_4^{2-} and $Cr_2O_7^{2-}$

(b) $Cr_2O_7^{2-}, MnO_4^-, ClO_2^-$ and Cl_2

(c) MnO_4^-, ClO_2^-, Cl_2 and Mn^{3+}

(d) $ClO_4^-, MnO_4^{2-}, ClO_2^-$ and F_2

(JEE Main 2021, 31 Aug Shift-II)

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Ans. (c) : No option contains all species that show disproportionation reaction.

$MnO_4^-, ClO_4^-, Cr_2O_7^{2-} - Cl, Mn, Cr$ in these anions are present in highest oxidation state. These will not undergo disproportionation. Mn is in +7 oxidation state (highest) hence cannot be simultaneously oxidized or reduced.

547. 250 mL of 0.5 M NaOH was added to 500 mL of 1M HCl. The number of unreached HCl molecules in the solution after complete reaction is……x 10^{21}. (Nearest integer)

$\left(N_A = 6.022 \times 10^{23}\right)$

[JEE Main 2021, 20 July Shift-I]

Ans. (226) : Number of moles = V_L × molarity and number of millimoles = V_{mL} ×molarity millimoles of NaOH = 250 × 0.5 = 125

Millimoles of HCl = 500 × 1 = 500

	NaOH	+ HCl	→ NaCl	+ H_2O
At t = 0,	125	500	0	0
At t = t,	0	375	125	125

So, millimoles of HCl left = 375

Moles of HCl = 375 × 10^{-3}

Number of HCl molecules = Avogadro's constant (N_A) × moles of HCl

$= 6.022 \times 10^{23} \times 375 \times 10^{-3}$

$= 225.8 \times 10^{21} = 226 \times 10^{21}$

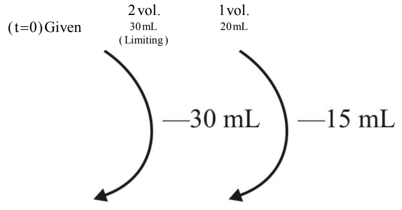
Therefore, answer is 226×10^{21} molecules

548. When 30 mL of H_2 reacts with 20 mL of O_2 to form water, what is leftover when the reaction ends ?

(a) 10 mL H_2
(b) 5 mL H_2
(c) 10 mL O_2
(d) 5 mL O_2

AP EAMCET (Engg.) 18.9.2020 Shift-I

Ans. (d) : Given, $2H_2(g) + O_2(g) \rightarrow 2H_2O(g)$



(t = ∝) after r × h: 30 – 30 = 0 (20 – 15) mL = 5 mL

Here, H_2 is the limiting reactant. So, 30 mL H_2 consumes 15 mL of O_2 as H_2 and O_2 react in 2 : 1 volume ratio (at constant pressure and temperature).

549. The minimum amount of O_2 (g) consumed per gram of reactant is for the reaction (Given atomic mass : Fe = 56, O = 16, Mg = 24, P = 31,) C =12, H = 1)

(a) $C_3H_8(g) + 5O_2(g) \rightarrow 3CO_2(g) + 4H_2O(l)$
(b) $P_4(s) + 5O_2(g) \rightarrow P_4O_{10}(s)$
(c) $4Fe(s) + 3O_2(g) \rightarrow 2Fe_2O_3(s)$
(d) $2Mg(s) + O_2(g) \rightarrow 2MgO(s)$

[JEE Main 2019, 10 April Shift-II]

Ans. (c) :

Option (a)- $C_3H_8(g) + 5O_2(g) \rightarrow 3XO_2(g) + 4H_2O(l)$

(1×36gm) + (1×8gm) = 5×32gm

36+8=160

$1gm = \frac{160}{44} = 3.63\,gm$

Each 1g of C_3H_8 requires 3.63 g of O_2

Option (b)- $P_4(S) + 5O_2(g) \rightarrow P_4O_{10}(s)$

4×31gm = 5×32 gm

$1gm = \frac{5 \times 32}{4 \times 31} = 1.29\,gm$

Each 1g of p requires 1.29 g of O_2.

Option (c)- $4Fe(s) + 3O_2(g) \rightarrow 2Fe_2O_3(s)$:

4×56gm = 3×32 gm

$1gm = \frac{3 \times 32}{4 \times 56} = 0.428\,gm$

Each 1g of Fe requires 0.428 g of O_2

Option (d)- $2Mg(s) + O_2(g) \rightarrow 2MgO(s)$

2×24gm = 1×32gm

$1gm = \frac{1 \times 32}{2 \times 24} = 0.67\,gm$

Each 1g of Mg requires 0.67 of O_2.

550. 25 g of an unknown hydrocarbon upon burning produces 88 g of CO_2 and 9 g of H_2O. This unknown hydrocarbon contains

(a) 20 g of carbon and 5 g of hydrogen
(b) 22 g of carbon and 3 g of hydrogen
(c) 24 g of carbon and 1 g of hydrogen
(d) 18 g of carbon and 7 g of hydrogen

[JEE Main 2019, 12 April Shift-II]

Ans. (c): Let the hydrocarbon is C_xH_y.

$$C_xH_y + O_2 \longrightarrow xCO_2 + \frac{y}{2}H_2O$$

The weight of Carbon $= \frac{88}{44} \times 12$

$= 24g$

The weight of hydrogen $= \frac{9}{18} \times 1$

$= 24g$

$$C_xH_y + \left(x + \frac{y}{4}\right)O_2 \rightarrow xCO_2 + \frac{y}{2}H_2O$$

$C = x \times \frac{25}{M} = 2$

$H = \frac{y}{2} \times \frac{25}{M} = 1$

⇒ 24:1 ratio by mass

551. An example of a disproportionation reaction is

(a) $2MnO_4^- + 10I^- + 16H^+ \rightarrow 2Mn^{2+} + 5I_2 + 8H_2O$
(b) $2NaBr + Cl_2 \rightarrow 2NaCl + Br_2$
(c) $2KMnO_4 \rightarrow K_2MnO_4 + MnO_2 + O_2$
(d) $2CuBr \rightarrow CuBr_2 + Cu$

[JEE Main 2019, 12 April Shift-I]

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Ans. (d):

(a) $$2MnO_4^- + 10I^- + 16H^+ \longrightarrow 2Mn^{2+} + 5I_2 + 8H_2O$$

Oxidation= +7 +2
State

In this reaction manganese is getting reduced. So, this reaction is not a disproportionation reaction

(b) $2\ NaBr + Cl_2 \longrightarrow 2NaCl + Br_2$

Oxidation +1 +1
state

This is just an example of a displacement reaction not a disproportionation reaction.

(c) $2\ KMnO_4 \longrightarrow K_2MnO_4 + MnO_2 + O_2$

Oxidation +7 +6 +4
state

This indicate manganese is only getting reduced. So, this reaction is not a disproportionation reaction.

(d) $2\ CuBr \longrightarrow CuBr_2 + Cu$

Oxidation +1 +2 0
state

In this reaction copper is getting both oxidized as well as reduced Therefore, this reaction is an example of a dioproportionation reaction.

552. For a reaction,
$N_2(g)+3H_2(g) \rightarrow 2NH_3(g)$,
identify di-hydrogen (H_2) as a limiting reagent in the following reaction mixture.

(a) 56 g of N_2 + 10 g of H_2
(b) 35 g of N_2 + 8 g of H_2
(c) 14 g of N_2 + 4 g of H_2
(d) 28 g of N_2 + 6 g of H_2

[JEE Main 2019, 9 April Shift-I]

Ans. (a) :

$$\underset{\substack{2\times14g \\ 28g}}{N_2(g)} + \underset{\substack{3\times2g \\ 6g}}{3H_2(g)} \longrightarrow \underset{\substack{2(14+3) \\ 34g}}{2NH_3(g)} \quad ....(i)$$

28g N_2 requires 6g H_2 gas.

56g of N_2 requires $\frac{6g}{28g} \times 56g = 12g \text{ of } H_2$

12g of H_2 gas is required for 56g of N_2 gas but only 10g of H_2 gas is present in option (a).

Hence, H_2 gas is the limiting reagent

(b) 35g of N_2 + 8g of H_2.
28g N_2 required 6g of H_2

35g N_2 required $\frac{6g}{28g} \times 35g\,H_2$

$\Rightarrow$ 7.5g of H_2

Here, H_2 gas does not act as limiting reagent since 7.5g of H_2 is present in reaction mixture similarly, in option (c) and (d), H_2 doesnot act as limiting reagent.

For 14g of N_2 + 4g of H_2.
28g of N_2 reacts will 6g of H_2.

14g of N_2 reacts with $\frac{6}{28} \times 14g \text{ of } H_2 \Rightarrow 3g \text{ of } H_2$

For 28g of N_2 + 6g or H_2,
i.e. 28g of N_2 reacts with 6g of H_2.

553. Which of the following sets of components form homogeneous mixture?

(a) Phenol + Water
(b) Sugar + Benzene
(c) Silver chloride + Water
(d) Ethyl alcohol + water

MHT CET-02.05.2019, SHIFT-III

Ans. (d) : We know that these two are different compounds and phenol is only partially soluble in water. So the composition would not be uniform throughout the mixture making phenol water a heterogenous system.

554. Which one of the following statements about the law of conservation of mass is correct?

(a) A given compound always contains exactly same proportion of elements
(b) When gases combine in a reaction, they do so in a simple ratio by volume, provided all gases are all room temperature
(c) Matter can neither be created nor destroyed
(d) Equal volumes of all gases at same temperature and pressure contain equal number of molecules

NDA (II)-2018

Ans. (c) : According to law of conservation of mass, 'Matter can neither be created nor be destroyed' in chemical reactions.

555. Volume of water needed to mix with 10 mL 10N HNO_3 to get 0.1N HNO_3 is

(a) 1000mL (b) 990mL
(c) 1010mL (d) 10mL

AIIMS-2017

Ans. (b): Given, N_1 = 10 N, V_1 = mL, N_2 = 0.1 N and V_2 = ?

By law of conservation

$$N_1V_1 = N_2V_2$$

$$10 \times 10 = 0.1\ (10 + V)$$

$$V = \frac{10\times10}{0.1} - 10 = 1000 - 10 = 990\,mL$$

556. The proposition 'equal volumes of different gases contain equal numbers of molecules at the same temperature and pressure' is known as

(a) Avogadro's hypothesis
(b) Gay-Lussac's hypothesis
(c) Planck's hypothesis
(d) Kirchhoff's theory

NDA (II)-2017

Ans. (a) : Avogadro's hypothesis state that equal volume of different gases contain equal number of molecules at the same temperature and pressure.

557. On combustion of x-g of ethanol in bomb calorimeter, y-joules of heat energy is produced. The heat of combustion of ethanol (ΔH_{comb}) is–

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(a) $\Delta H_{comb} = -x.J$

(b) $\Delta H_{comb} = -yJ$

(c) $\Delta H_{comb} = -\frac{x}{y} \times 44\,Jmol^{-1}$

(d) $\Delta H_{comb} = -\frac{y}{x} \times 44\,Jmol^{-1}$

BCECE-2017

Ans. (d) Mass of ethanol = y g

Heat product = yJ

$CH_3CHO + \frac{1}{2}O_2 \rightarrow 2CO_2 + 2H_2O$

Molar mass of $CH_3CHO = (12 + 3 + 12 + 1 + 16)$ g

$= 44g$

$\therefore$ 1 mole - 44g ethanol

yg produes yJ heat

$\therefore$ 44g produes $\frac{y}{x} \times 44J$

Also, this is exotherimic reaction as heat is produed

$\therefore$ $\Delta H_{(Combustion)} = \frac{-44y}{X} J/mole.$

558. When 'Z' grams of calcium carbonate completely burnt in air gives 28g of a solid compound. The mass of calcium carbonate used will be–

(a) 200 g
(b) 100 g
(c) 56 g
(d) 50 g

BCECE-2017

Ans. (d) : $CaCO_3 \xrightarrow{\Delta}$ heat $CaO + CO_2$

1 mole $CaCO_3$ produces 1 mole CaO molar mass CaO = 40g + 16 g = 56 g/mol

28g CaO = 28g/56g/mol = 0.5 mol CaO

Molar mass $CaCO_3 = 40 + 12 + 16 \times 3 = 100$ g/mol

Mass of 0.5 Mol $CaCO_3 = 100 \times 0.5$ mol = 50 g $CaCO_3$ was burnt.

559. Calculate the mass of oxygen obtained by complete decomposition of 10 kg of pure potassium chlorate. (Atomic mass : K = 39, O = 16 and C1 = 35.5)

(a) 39.2 kg
(b) 392 kg
(c) 3.92 kg
(d) 3 kg

SRMJEEE – 2016

Ans. (c) : The following reaction take place :

$2KClO_3 \longrightarrow 2KCl + 3O_2$

potassium chlorate– $KClO_3$

$\because$ 2 moles of $KClO_3$ form 3 moles of O_2.

$\therefore$ 2 × 122.5g of $KClO_3$ form 3 × 32g of O_2.

$\therefore$ 10×10^3g of $KClO_3$ form $\frac{3\times32}{2\times122\cdot5}\times10\times10^3$

$= 3.92$ kg

560. Combination of one volume of nitrogen with three volumes of hydrogen produces

(a) one volume of ammonia
(b) two volumes of ammonia
(c) three volumes of ammonia
(d) one and a half volumes of ammonia

NDA (II)-2016

Ans. (b) Two volume of Ammonia (NH_3) formed when combination of one volume of nitrogen with three volumes of hydrogen takes place.

$$\underset{(1\,volume)}{N_2} + \underset{(3\,Volume)}{3H_2} \xrightarrow[(200\,atm)]{Fe/Mo} \underset{\substack{Ammonia\\(2\,volume)}}{2NH_3} + Heat$$

561. Match List-I with List-II and select the correct answer using the code given below the Lists:

	List-I Process		List-II Type of change
A.	**Heating of Camphor**	**1.**	**Chemical**
B.	**Cooling of water vapour upto room temperature**	**2.**	**Evaporation**
C.	**Cooking an egg**	**3.**	**Condensation**
D.	**Formation of water vapour at room temperature**	**4.**	**Sublimation**

Code:

	A	B	C	D
(a)	4	3	1	2
(b)	4	1	3	2
(c)	2	1	3	4
(d)	2	3	1	4

NDA (II)-2016

Ans. (a) :

List I Process	List II Type of change
A. Heating of camphor	Sublimation
B. Cooling of water vapour upto room temperature	Condensation
C. Cooking an egg	Chemical
D. Formation of water vapour at room temperature	Evaporation

562. 25 mL of a solution of barium hydroxide on titration with a 0.1 molar solution of hydrochloric acid gave a titre value of 35 mL. The molarity of barium hydroxide solution was

(a) 0.07 M
(b) 0.14 M
(c) 0.28 M
(d) 0.35 M

SRMJEEE – 2014

Ans. (a) : The reaction is :

$Ba(OH)_2 + 2HCl\,(aq.) \longrightarrow BaCl_2 + 2H_2O\,(l)$

Given – $M_1 = ?$ $M_2 = 0.1M$

$V_1 = 25$ mL $V_2 = 35$ mL

From the molarity equation :-

$M_1V_1 = M_2V_2$

$$M_1 = \frac{M_2V_2}{V_1} = \frac{0.1\times35}{25} = 0.14M$$

$$\therefore \text{Molarity of } Ba(OH)_2 = \frac{M_1}{\text{Acidity of } Ba(OH)_2}$$

$$\therefore \text{Molarity of } Ba(OH)_2 = \frac{0.14}{2} = 0.07M$$

@apna_pdf

563. The formation of CO and CO_2 illustrates the law of

(a) reciprocal proportion
(b) conservation of mass
(c) multiple proportion
(d) constant composition

BITSAT 2014

Ans. (c) : Law of multiple proportions states that if two element can combine to form more than one compound with each other, the masses of one element that combine with a fixed mass of the other element are in ratios of small whole numbers.

Example -

$$\frac{\text{Ratio of O to C in corbon dioxide}}{\text{Ratio of O to C in corbon monoxide}} = \frac{2.66}{1.33} = 2:1$$

564. An aqueous solution of 6.3 g of oxalic acid dihydrate is made up to 250 mL. The volume of 0.1 N NaOH required to completely neutralise 10 mL of this solution is

(a) 20 mL (b) 40 mL
(c) 10 mL (d) 4 mL

AIIMS-2013

Ans. (b): As we know,

n- factor for $H_2C_2O_4.2H_2O = 2$

$$\text{Normality} = \frac{\text{weight} \times 2 \times 1000}{\text{molecular weight} \times 250} = \frac{6.3 \times 2000}{126 \times 250} = 0.4$$

$N_1V_2 = N_2V_2$

$0.4 \times 10 = V_2 \times 0.1 \Rightarrow$ Volume $(V_2) = 40$ mL.

565. Which one of the following is an example of disproportionation reaction?

(a) $3Cl_2(g) + 6OH^-(aq) \longrightarrow ClO_3^-(aq) + 5Cl^-(aq) + 3H_2O(l)$

(b) $Ag^{2+}(aq) + Ag(s) \longrightarrow 2Ag^+(aq)$

(c) $Zn(s) + CuSO_4(aq) \longrightarrow Cu(s) + ZnSO_4(aq)$

(d) $2KClO_3(s) \longrightarrow 2KCl(s) + 3O_2(g)$

AP-EAMCET (Engg.) 2013

Ans. (a) : Those reaction in which a compound undergoes oxidation as well as reduction is known as disproportionation reaction.

reduction

$$3\overset{0}{Cl}_2(g) + 6OH^-_{(aq)} \rightarrow ClO^-_{3(aq)} + 5\overset{+5}{Cl}^-_{(aq)} + 3H_2O(l)$$

oxidation

566. Which of the following species do not show disproportination on reaction?

ClO^-, ClO_2^-, ClO_3^-

(a) ClO_4^- (b) ClO_3^-
(c) ClO^- (d) None of these

JIPMER-2013

Ans. (a) :

$$3\overset{+1}{Cl}O \longrightarrow 2\overset{-1}{Cl} + \overset{+5}{Cl}O_3^-$$

ClO_2^- (chlorite ion):

$$3\overset{+3}{Cl}O_2^- \longrightarrow \overset{-1}{Cl^-} + 2\overset{+5}{Cl}O_4^{-1}$$

ClO_3^- (chlorate ion):

$$3\overset{+5}{Cl}O_2^- \longrightarrow \overset{-1}{Cl^-} + 4\overset{+7}{Cl}O_4^{-1}$$

ClO_4^- does not disproportionate because in this oxo anion chlorine is present in its highest oxidation state (+7).

567. $K_2Cr_2O_7 + xKCl + 6H_2SO_4$ × $yCrO_2Cl_2 + 6KHSO_4 + zH_2O$, x, y and z are respectively

(a) 4, 2, 3 (b) 6, 2, 6
(c) 8, 2, 4 (d) 4, 1, 6

SRMJEEE – 2012

Ans. (a) : The given equation is :

$$K_2Cr_2O_7 + xKCl + 6H_2SO_4 \longrightarrow y\,CrO_2Cl_2 + 6KHSO_4 + zH_2O$$

We find the moles i.e. x, y and z.

Firstly, count the specific atom both the side and balanced on the basis of the number of atom.

Hence, the balanced chemical reaction will be.

$$K_2Cr_2O_7 + 4KCl + 6H_2SO_4 \longrightarrow 2CrO_2Cl_2 + 6KHSO_4 + 3H_2O$$

568. Equal volumes of 1 M HCl and 1 M H_2SO_4 are neutralised by dil. NaOH solution separately. If X kcal and Y kcal of heat are liberated respectively, then which of the following relation is correct?

(a) X=Y (b) $X = \frac{1}{2}Y$
(c) X=2Y (d) $X = \frac{1}{3}Y$

CG PET -2019

Ans. (b) : Since H_2SO_4 give 2 moles H^+, HCl gives 1 mole H^+ from 1 mole after ionisation. Hence, H_2SO_4 will release double amount of heat as compared to HCl.

i.e. $y = 2X$ or $X = \frac{Y}{2}$

569. If Avogadro number N_A, is changed from 6.022×10^{23} mol^{-1} to 6.022×10^{20} mol^{-1}, this would change

(a) the mass of one mole of carbon
(b) the ratio of chemical species to each other in a balanced equation.
(c) the ratio of elements to each other in a compound
(d) the definition of mass in units of grams.

NEET-2012

Ans. (a) :

Mass of 1 mole (6.022×10^{23}) atoms of carbon = 12 g

If Avogadro Number (N_A) is changed than mass of 1 mol $(6.022 \times 10^{20}$ atom) of carbon

$$= \frac{12 \times 6.022 \times 10^{20}}{6.022 \times 10^{23}} = 12 \times 10^{-3}\,g$$

Therefore, Mass of 1 mol of carbon is changed.

@apna_pdf

570. KMnO$_4$ reacts with oxalic acid according to the equation:

$$2MnO_4^- + 5C_2O_4^{2-} + 16H^+ \rightarrow 2Mn^{2+} + 10CO_2 + 8H_2O$$

Here 20 mL of 0.1 M KMnO$_4$ is equivalent to:

(a) 20mL of 0.5M $H_2C_2O_4$

(b) 50mL of 0.5M $H_2C_2O_4$

(c) 50mL of 0.1M $H_2C_2O_4$

(d) 20mL of 0.1M $H_2C_2O_4$

AIIMS-2013

Ans. (c):

$$2MnO_4^- + 5C_2O_4^{2-} + 16H^+ \longrightarrow 2Mn^{2+} + 10CO_2 + 8H_2O$$

At NTP

∵ 2 × 22.4 L reacts with 5×22.4 L of oxalic acid.

∴ 20 ml of 0.1 KMnO$_4$ reacts with oxalic acid,

$$= \frac{5 \times 22.4 \times 20}{2 \times 22.4} = 50\,ml$$

So, the correct option is 50 ml of 0.1 M oxalic acid.

571. The volume of 0.1 M oxalic acid that can be completely oxidized by 20 mL of 0.025 M KMnO$_4$ solution is

(a) 25 mL
(b) 12.5 mL
(c) 37.5 mL
(d) 125 mL

Karnataka-CET-2012

Ans. (b) :

$2KMnO_4 + 3H_2SO_4 + 5H_2C_2O_4 \rightarrow K_2SO_4 + 2MnSO_4 + 8H_2O + 10CO_2$

$$\because \quad \text{Molarity} = \frac{n_B}{V_{ml}} \times 1000$$

$$\therefore \quad 0.025 = \frac{n_B}{V_{ml}} \times 1000$$

$$\therefore \quad n_B = \frac{0.025}{50} = 5 \times 10^{-4} \text{ of } KMnO_4$$

2 moles of KMnO$_4$ completely oxidizes 5 moles of oxalic acid.

∴ 5×10^{-4} mol of KMnO$_4$ will completely

$$\text{oxidize} = \frac{5}{2} \times 5 \times 10^{-4} \text{ mol of oxalic acid}$$

$$= 1.25 \times 10^{-3} \text{ mol of oxalic acid}$$

$$\because \quad \text{Molarity} = \frac{n_B}{V_{ml}} \times 1000$$

$$\therefore \quad V_{ml} = \frac{n_B}{\text{molarity}} \times 1000 = \frac{1.25 \times 10^{-3}}{0.1} \times 1000$$

$$= 12.5\,mL$$

572. l(FeO·Cr$_2$O$_3$) + mNa$_2$CO$_3$ + nO$_2$ × xNa$_2$CrO$_4$ + yFe$_2$O$_3$ + zCO$_2$

l, m, n, x, y and z respectively are

(a) 4, 8, 7, 8, 2 and 8
(b) 4, 8, 7, 8, 8 and 2
(c) 8, 8, 8, 2, 4 and 7
(d) 2, 4, 7, 8, 8 and 8

SRMJEEE – 2011

Ans. (a) : The given reaction is :

$l(FeO{\cdot}Cr_2O_3) + mNa_2CO_3 + nO_2 \longrightarrow xNa_2CrO_4 + yFe_2O_3 + zCO_2$

after balancing the equation we get –

l = 4, m = 8, n = 7, x = 8, y = 2 and z = 8

$$\therefore\ 4(FeO.\ Cr_2O_3) + 8Na_2CO_3 + 7O_2 \longrightarrow 8Na_2CrO_4 + 2Fe_2O_3 + 8CO_2$$

573. The product of atomic weight and specific heat of any element is a constant, approximately 6.4. This is known as :

(a) Dalton's law
(b) Avogadro's law
(c) Newton's law
(d) Dulong Pettit law

BITSAT-2011

Ans. (d) : According to Dulong and Pettit's law Atomic weight × Specific heat = 6.4 (approx)

This law is applicable only to solid elements but it fails to explain very high specific heat of diamond.

574. 0.14 g of an element on combustion gives 0.28 gm of its oxide. What is that element?

(a) Nitrogen
(b) Carbon
(c) Fluorine
(d) Sulphur

AP- EAMCET(Medical) -2010

Ans. (d): The formula used to calculate the equivalent weight of an element in its oxide :

$$\text{The equivalent weight of element} = \frac{\text{wt. of element}}{\text{wt. of oxygen}} \times$$

equivalent wt. of O atom.

$$\text{The equivalent wt. of O atom} = \frac{16}{2} = 8g$$

$$\text{Equivalent weight of element} = \frac{\text{weight of element}}{\text{weight of oxygen}} \times 8$$

$$= \frac{0.14}{0.28 - 0.14} \times 8$$

$$= 1 \times 8$$

$$= 8 \text{ amu}$$

Also, by the balanced reaction:

$$S + O_2 \longrightarrow SO_2$$

Valency of sulphur = 4

$$\text{Equivalent weight of sulphur} = \frac{32}{4} \text{amu} = 8 \text{ amu}$$

So, the element is sulphur.

575. How many 'mL' of perhydrol is required to produce sufficient oxygen which can be used to completely convert 2 L of SO$_2$ Gas to SO$_3$ gas?

(a) 10 mL
(b) 5 mL
(c) 20 mL
(d) 30 mL

AP EAMCET (Engg.)-2009
VITEEE- 2009

Ans. (a): Perhydrol means 30% solution of H_2O_2.

H_2O_2 decomposes as

$2H_2O_2 \rightarrow 2H_2O + O_2$

Volume strength of 30% H_2O_2 solution is 100 that mean 1 mL of this solution on decomposition gives 100 mL oxygen.

@apna_pdf

$$SO_2+\frac{1}{2}O_2 \longrightarrow SO_3$$

$$1L \quad \frac{1}{2}L \qquad 1L$$

$$2L \quad 1L \qquad 2L$$

Since, 100 mL of oxygen is obtained by 1 mL of H_2O_2

$\therefore$ 1000 mL of oxygen will be obtained by

$$=\frac{1}{100}\times 1000\,\text{mL of } H_2O_2$$

$$=10\,\text{mL of } H_2O_2$$

576. Which of the following processes involves absorption of energy?

(a) $Cl+e^- \longrightarrow Cl^-$ (b) $O^- + e^- \longrightarrow O^{2-}$

(c) $O+e^- \longrightarrow O^-$ (d) $S+e^- \longrightarrow S^-$

BCECE-2009

Ans. (b) : Processes (a), (c) and (d) represent EA_1 of the atoms which is their natural tendency and hence energy is evolved. But (b) process is EA_2 of O atom and involves absorption of energy.

O^- to O^{-2} because of interelectronic repulsion, it will require energy to add an electron to its outermost shell.

577. Gram molecular volume of oxygen at STP is

(a) 3200 cm^3 (b) 5600 cm^3

(c) 22400 cm^3 (d) 11200 cm^3

Karnataka-CET-2007

Ans. (c) : Gram molecular volume of oxygen at STP is

GMV = 22.4 litre = 22.4

$\therefore$GMV = 22400 cm^3.

578. Dalton's law of partial pressure is applicable to which one of the following system?

(a) $NH_3 + HCl$ (b) $NO + O_2$

(c) $H_2 + Cl_2$ (d) $CO + H_2$

Karnataka-CET-2007

Ans. (d) : According to this law the total pressure exerted by mixture of non-reactive gases at a particular temperature & given volume of container in equal to summation of partial pressure of all gases. e.g. $CO + H_2$ are non-reacting gases. Hence, Dalton's law of partial pressure is applicable to this system.

579. x grams of calcium carbonate was completely burnt in air. The weight of the solid residue formed is 28 g. What is the value of x (in grams)?

(a) 44 (b) 200

(c) 150 (d) 50

AP-EAMCET-2005

Ans. (d) : $CaCO_3 \xrightarrow{\Delta} CaO(s)+CO_2(g)$

56 g o CaO is formed form 100 g of $CaCO_3$

28g will be formed

$$=\frac{28\times 100}{56}=50g$$

580. Law of multiple proportions is illustrated by one of the following pairs:

(a) H_2S and SO_2 (b) NH_3 and NO_2

(c) Na_2S and Na_2O (d) N_2O and NO

JCECE - 2005

Ans. (d) : According to the law of multiple proportions that if two element combine to form more than one compound, the fixed amount of one element combining with other element have simple whole number ratio.

(i) H_2S and SO_2 are not example of law of multiple proportion because elements are different

(ii) NH_3 and NO_2 are not examples of law of multiple proportion because elements are different

(iii) Na_2S and Na_2O are not NO here 16 parts of oxygen react with 14 and 28 parts of nitrogen. 14:28 is 1:2 which is simple whole number ratio.

$\therefore$ It follows law of multiple proportion.

581. What is the volume (in L) of oxygen required at STP to completely convert 1.5 moles of sulphur into sulphur dioxide ?

(a) 11.2 (b) 22.4

(c) 33.6 (d) 44.8

AP-EAMCET-2004

Ans. (c) : The reaction is $\underset{32gm}{S} + \underset{32gm}{O_2} \rightarrow SO_2$

$\because$ 1 mole of sulphur required = 22.4 L of O_2 at STP

$\therefore$ 1.5 moles of S required = 22.4 × 1.5

= 33.6 L of O_2.

582. What is the volume (in litres) of oxygen at STP required for complete combustion of 32 g of CH_4? (Molecular weight of CH_4 is 16.)

(a) 44.8 (b) 89.6

(c) 22.4 (d) 179.2

AP-EAMCET-2001

Ans. (b) : $\underset{16}{CH_4} + \underset{2\times 22.4L}{2O_2} \rightarrow CO_2+2H_2O$

$\therefore$ Volume of O_2 required for 32 g CH_4 is = 2 × 22.4 L and volume of O_2 required for 32 g CH_4 is $\frac{2\times 22.4}{16}\times 32$

= 89.6 L

583. How many moles of potassium chlorate should be decomposed completely to obtain 67.2 L of oxygen at NTP ?

(a) 3 (b) 4

(c) 1 (d) 2

AP-EAMCET-1999

Ans. (d) : $\underset{2\,mol}{2KClO_3} \rightarrow 2KCl+\underset{\substack{3\times 22.4\\67.2L}}{3O_2}$

$\because$ 3×22.4 L of O_2 required to 2 mole of $KClO_3$

$\therefore$ For obtaining 67.2 L of O_2, number of moles of $KClO_3$ required $=\frac{2}{3\times 22.4}\times 67.2$ = 2 mol.

584. How much litres of CO_2 at STP will be formed when 100 mL of 0.1M H_2SO_4 reacts with excess of Na_2CO_3?

(a) 22.4 (b) 2.24

(c) 0.224 (d) 5.6

AP-EAMCET-1998

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Ans. (c) : $\underset{\substack{1mol\\100mL}}{H_2SO_4} + Na_2CO_3 \rightarrow \underset{\substack{22.4L\\?}}{CO_2} + Na_2SO_4 + H_2O$

1 mole of sulfuric acid will produce 1 mole (22.42 at STP) of carbon dioxide.

100 ml of 0.1 M H_2SO_4 = 10 million mole of H_2SO_4

$= 10 \times 10^{-3}$

$= 10^{-2}$ moles of H_2SO_4

$\because$ 1 mole of H_2SO_4 liberate CO_2 = 22.4 L

$\therefore$ 10^{-2} moles of H_2SO_4 liberates CO_2

$= 22.4 \times 10^{-2}$

$= 0.224$ L

Thus, 0.01 mole of sulfuric acid will produce 0.01 mole (0.224 L at STP) of CO_2.

585. $KMnO_4$ oxidizes oxalic acid in acid medium. The number of CO_2 molecules produced as per the balanced equation is:

(a) 10 (b) 8

(c) 6 (d) 3

AP EAMCET (Medical) -1998

Ans. (a): When potassium permanganate ($KMnO_4$) oxidize the oxalic acid then following reaction take place during the reaction–

$$2KMnO_4 + 3H_2SO_4 + 5H_2C_2O_4 \longrightarrow K_2SO_4 + 2MnSO_4 + 10CO_2 + 8H_2O.$$

In a balanced chemical equation of oxidation of oxalic acid by $KMnO_4$ in acidic medium evolve 10 molecules of CO_2.

586. The volume in litres of CO_2 liberated at STP when 10 g of 90% pure lime stone is heated completely is:

(a) 2.016 (b) 20.16

(c) 2.24 (d) 22.4

AP EAMCET (Medical) -1998

AP-EAMCET-1996

Ans. (a): $CaCO_3 \xrightarrow{\Delta} CaO + \underset{\substack{22.4L\,at\,STP\\(1mole)}}{CO_2}$

$\therefore$ Molecular weight of $CaCO_3$ = 100g/mole

Weight of 10gm of 90% pure limestone $= \dfrac{10 \times 90}{100}$

= 9 gm pure $CaCO_3$

$\therefore$ 9 gm pure $CaCO_3$

$CO_2 = \dfrac{22.4 \times 9}{100} = 2.016L$.

587. The total number of valence electrons in 4.2 g of N_3^- ion is (N_A is the Avogadro's number)

(a) 2.1 N_A (b) 4.2 N_A

(c) 1.6 N_A (d) 3.2 N_A

NEET-1994

Ans. (c) : Molecular wt of $N_3^- = 3 \times 14 = 42g$

Moles of N_3^- ion $= \dfrac{4.2}{42} = 0.1$

Each nitrogen atom has 5 valence electrons, total number of electrons in N_3^- ion $= 16$

Total number of electrons in 0.1 mole,

4.2g of N_3^- ion = 0.1 × 16 × N_A = 1.6 N_A

588. A compound X on heating gives a colourless gas. The residue is dissolved in water to obtain Y. Excess CO_2 is passed through aqueous solution of Y when Z is formed. Z on gentle heating gives back X. the compound X is

(a) $Ca(HCO_3)_2$ (b) $CaCO_3$

(c) $NaHCO_3$ (d) $Na_2\,CO_3$

VITEEE 2015

Ans. (b) :

$$\underset{(x)}{CaCO_3} \xrightarrow{\Delta} CaO + CO_2 \uparrow(\text{Colourless gas})$$

$$CaO + H_2O \longrightarrow \underset{(Y)}{Ca(OH)_2}$$

$$Ca(OH)_2 + 2\,CO_2 \longrightarrow \underset{(Z)}{Ca(HCO_3)_2}$$

$$\underset{(z)}{Ca(HCO_3)_2} \xrightarrow{\Delta} \underset{(x)}{CaCO_3} + CO_2 + H_2O$$

$CaCO_3$ on heating gives a colourless gas CO_2 and CaO as the residue. CaO with water will form $Ca(OH)_2$ and when treated with excess CO_2 will given $Ca(OH_3)_2$ which on heating gives back $CaCO_3$

5. Percentage Composition and Molecular Formula

589. 0.2 g of an organic compound was subjected to estimation of nitrogen by Duma's method in which volume of N_2 evolved (at STP) was found to be 22.400 mL. The percentage of nitrogen in the compound is_____. [nearest integer]

(Given : Molar mass of N_2 is 28 g mol^{-1}, Molar volume of N_2 at STP : 22.4L)

JEE Main-24.06.2022, Shift-II

Ans. (14) : Given,

Mass of organic compound = 0.2g

Molar volume of N_2 at STP = 22.4L = 22400mL

Given volume of N_2 = 22.400 mL

Then, Mole of $N_2(g) = \dfrac{22.4}{22400} = \dfrac{1}{1000}$

Weight of $N_2(g) = \dfrac{1}{1000} \times 28 = 0.028g$

% of N in organic compound $= \dfrac{0.028}{0.2} \times 100 = 14\%$

590. 120 g of an organic compound that contains only carbon and hydrogen gives 330 g of CO_2 and 270 g of water on complete combustion. The percentage of carbon and hydrogen, respectively are

(a) 25 and 75 (b) 40 and 60

(c) 60 and 40 (d) 75 and 25

JEE Main-24.06.2022, Shift-II

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Ans. (d) : Given,

Mass of organic compound = 120g

Mass of CO_2 = 330g

Mass of H_2O = 270g

Mole of $CO_2 = \frac{330}{40}$

Weight of carbon = $\frac{330}{40} \times 12 = 90g$

% of C = $\frac{90}{120} \times 100 = 75\%$

Mole of $H_2O = \frac{270}{18}$

Weight of hydrogen = $\frac{270}{18} \times 1 = 15g$

% of hydrogen = $\frac{15}{120} \times 100 = 25\%$

591. The complete combustion of 0.492 g of an organic compound containing 'C', 'H' and 'O' gives 0.793 g of CO_2 and 0.442 g of H_2O. The percentage of oxygen composition in the organic compound is _____.[nearest integer]

JEE Main-28.06.2022, Shift-II

Ans. (46) : Given, organic compound = 0.492 g

CO_2 = 0.793 g

H_2O = 0.442 g

Reaction of complete combustion-

Organic compound + $O_2 \longrightarrow CO_2 + H_2O$

Weight of carbon in $CO_2 = \frac{0.793}{44} \times 12 = 0.216$ gm

Weight of hydrogen in $H_2O = \frac{0.442}{48} \times 2 = 0.0491$ gm

Weight of oxygen in organic compound

$\Rightarrow$ 0.492 – 0.2651

$\Rightarrow$ 0.2269

% of O = $\frac{0.442}{48} \times 100$

% of O = $45.71 \approx 46$

592. On complete combustion 0.30 g of an organic compound gave 0.20 g of carbon dioxide and 0.10 g of water. The percentage of carbon in the given organic compound is ______. (Nearest Integer)

JEE Main-26.06.2022, Shift-I

Ans. (18) : Reaction of complete combustion–

Organic compound + $O_2 \longrightarrow CO_2 + H_2O$

Given,

Mass of organic compound = 0.30g

Mass of CO_2 = 0.20g

Mass of H_2O = 0.10g

Moles of $CO_2 = \frac{0.20}{44}$

Weight of carbon = $\frac{0.20}{44} \times 12$

% of carbon in organic compound = $\frac{0.2}{44} \times 12 \times \frac{100}{0.3}$

= 18.11%

593. A 2.0 g sample containing MnO_2 is treated with HCl liberating Cl_2. The Cl_2 gas is passed into a solution of KI and 60.0 mL of 0.1 M $Na_2S_2O_3$ is required to titrate the liberated iodine. The percentage of MnO_2 in the sample is ——. (Nearest integer)

[Atomic masses (in u) Mn = 55; Cl = 35.5; O = 16, I = 127, Na = 23, K = 39, S = 32]

JEE Main-28.06.2022, Shift-I

Ans. (13) : Given,

Weight of sample = 2.0g

Volume of $Na_2S_2O_3$ = 60 mL

Molarity of $Na_2S_2O_3$ = 0.1 M

The complete reaction are-

$$MnO_2 + 4HCl \longrightarrow MnCl_2 + Cl_2(g) + H_2O$$

$$Cl_2 + 2KI \longrightarrow I_2 + 2KCl$$

$$I_2 + 2Na_2S_2O_3 \rightarrow 2NaI + Na_2S_4O_6$$

milli eq. of MnO_2 = milli eq. of Cl_2 = milli eq. of I_2 = milli eq. of Hypo

$$2 \times \left(\frac{w}{87}\right) = [0.1 \times 60]$$

w = 261 milligram

% of $MnO_2 = \frac{0.261}{2} \times 100 = 13.05\% = 13$

594. In the estimation of bromine, 0.5 g of an organic compound gave 0.40 g of silver bromide. The percentage of bromine in the given compound is ——— % (nearest integer) (Relative atomic masses of Ag and Br are 108 u and 80 u, respectively).

JEE Main-28.06.2022, Shift-I

Ans. (34) : Given,

Mass of organic compound = 0.5 g

mass of silver bromide (AgBr) = 0.40 g

moles of AgBr = $\frac{0.40}{188}$

Weight of Br = $\frac{0.40}{188} \times 80$

% of Br = $\frac{0.40}{188} \times \frac{80}{0.5} \times 100$

= 34%

595. Kjeldahl's method was used for the estimation of nitrogen in an organic compound. The ammonia evolved from 0.55 g of the compound neutralized 12.5 mL of 1 M H_2SO_4 solution. The percentage of nitrogen in the compound is ——. (nearest integer)

JEE Main-29.06.2022, Shift-I

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Ans. (64) : Mili equivalent of H_2SO_4 used by NH_3 = 12.5 × 1 × 2

$$\%\text{ of N in the compound} = \frac{25\times10^{-3}\times14\times100}{0.55}$$

$$= 63.66$$

$$\approx 64\%$$

So, answer will be 64%

596. 0.25 g of an organic compound containing chlorine gave 0.40 g of silver chloride in Carius estimation. Te percentage of chlorine present in the compound is______ [in nearest integer] (Given: Molar mass of Ag is 108 g mol^{-1} and that of Cl is 35.5 g mol^{-1})

JEE Main-27.06.2022, Shift-II

Ans. (40) : Organic compound $\xrightarrow{AgNO_3}$ AgCl

(Containing chlorine)

0.25 gram 0.4 gram

$$\text{Mole of AgCl} = \left(\frac{0.4}{143.5}\right)$$

$$W_{Cl} = \left(\frac{0.4}{143.5}\right)\times 35.5$$

$$\%\text{ of Cl} = \left[\frac{0.4}{143.5}\times35.5\right]\times\frac{100}{0.25} = 39.58 \approx 40$$

597. The moles of methane required to produce 81 g of water after complete combustion is———— ×10^{-2} mol. [nearest integer]

JEE Main-26.06.2022, Shift-II

Ans. (225) : $CH_4 + 2O_2 \longrightarrow CO_3 + 2H_2O$

mole = 2.25 mass = 81

$$\text{mole} = \frac{81}{18}$$

$$= 4.5$$

So, 225 × 10^{-2} moles of CH_4 are required to produce 81g of water after complete combination.

598. A 0.166 g sample of an organic compound was digested with conc. H_2SO_4 and then distilled with NaOH. The ammonia gas evolved was passed through 50.0 mL of 0.5 N H_2SO_4. The used acid required 30.0 mL of 0.25 N NaOH for complete neutralization. The mass percentage of nitrogen in the organic compound is _____.

JEE Main-24.06.2022, Shift-I

Ans. (63) :

$$\begin{tikzcd}[column sep=small]
\underset{\substack{\text{(Containing nitrogen)}\\ 0.166\text{ gram}}}{\text{Organic compound}} + \text{Conc. } H_2SO_4 \arrow[r, "NaOH"] & NH_3 + CH_3 \arrow[d, "\substack{\text{Pass through}\\ H_2SO_4}"] \\
\text{Remaining acid} + NaOH \arrow[r] & \text{Complete neutralization}
\end{tikzcd}$$

Mili eq. of NH_3 = Mili eq. of used H_2SO_4 = Mili eq. of NaOH

$$= 0.25 \times 30 = 7.5$$

Milimole of nitrogen = 7.5

$$W_{nitrogen} = 7.5 \times 14 \times 10^{-3}$$

$$= 0.105 \text{ gram}$$

$$\%\text{ of nitrogen} = \frac{0.105}{0.166}\times100$$

$$= 63.25 \approx 63$$

599. The empirical formula of a non-electrolyte is CH_2O. A solution containing 6 g of the compound exerts the same osmotic pressure as that of 0.05 M glucose solution at the same temperature. The molecular formula of the compound is

(a) $C_2H_4O_2$ (b) $C_3H_6O_3$

(c) $C_5H_{10}O_5$ (d) $C_4H_8O_4$

BCECE-2014

Karnataka-CET, 2009

Ans. (d) : For isotonic : $\frac{w_1}{m_1V_1} = \frac{w_2}{m_2V_2}$

w_1 = mass of glucose = 0.05×180g = 9g

m_1 = molecular mass of glucose = 180 g

Assuming V_1= V_2 = 1L

$$\therefore \frac{\text{Molecularmass}}{\text{Empirical mas}} = n \Rightarrow n = \frac{120}{30} = 4$$

∴ Molecular formula = $C_4H_8O_4$

600. 1 g of silver gets distributed between 10 cm^3 of molten zinc and 100 cm^3 of molten lead at 800^{o}C. The percentage of silver in the zinc layer is approximately

(a) 89 (b) 91

(c) 97 (d) 94

BCECE-2014, Karnataka-CET, 2010

Ans. (c) : Let mass of Ag in Zn layer = x

∴Mass of Ag in lead layer = 1 – x

$$\text{Concentration of Ag is zinc} = \frac{x}{10}$$

$$\therefore \text{ Concentration of Ag in Pb} = \frac{1-x}{100}$$

$$\frac{\frac{x}{10}}{\frac{1-x}{100}} = 300$$

%v of Ag in Zinc layer = 97%

601. In Dumas' method of estimation of nitrogen 0.35 g of an organic compound gave 55 mL. of nitrogen collected at 300 K temperature and 715 mm pressure. The percentage composition of nitrogen in the compound would be (aqueous tension at 300 K = 15 mm)

(a) 15.44 (b) 16.45

(c) 17.45 (d) 14.45

JIPMER-2014

NEET-2011

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Ans. (b): $\frac{P_1V_1}{T_1}=\frac{P_2V_2}{T_2}$

Given,

Where, p_2 = pressure of N_2 at STP = 760 mm

T_2 = Temperature of N_2 at STP = 273 K

Volume of N_2 at STP (by gas equation)

$$\left(\frac{P-P_1}{t+273}\right)V_1\times\frac{273}{160}=V_2$$

P = 715 mm (pressure at which N_2 collected)

P_1= aqueous tension of water = 15mm

T_1 = t + 273 = 300K

V_1 = 55 ml

$$\therefore\ V_2=\frac{(715-15)\times55}{300}\times\frac{273}{760}=46.098\,\text{mL}$$

% of nitrogen in given compound

$$=\frac{28}{22400}\times\frac{V_2}{W}\times100=\frac{28}{22400}\times\frac{46.09}{0.35}\times100$$

= 16.45%

602. 3.92 g of ferrous ammonium sulphate reacts completely with 50 ml $\frac{N}{10}$ KMnO$_4$ solution. The percentage purity of the sample is

(a) 50 (b) 78.4

(c) 80 (d) 39.2

[BITSAT-2014, 2006]

Ans. (a) : Given that,

V_1 = 1000

$N_2=\frac{1}{10}$

V_2 = 50

N_1 = ?

N_1V_1 (Ferrous ammonium sulphate) = N_2V_2 (KMnO$_4$)

$N_1\times1000=\frac{1}{10}\times50$

$N_1=\frac{50\times1}{1000\times10}=\frac{1}{200}$

Eq. wt of $Fe_2SO_4.(NH_4)_2SO_4.6H_2O$ = mol .wt = 392

$\therefore$ Strength of pure salt $=392\times\frac{1}{200}=1.96\,g\,L^{-1}$

$\therefore$ % purity $=\frac{1.96}{3.92}\times100=50\%$

603. The molecular formulae for phosgene and tear gas are …. and …. respectively,

(a) $COCl_2$ and CCl_2NO_2

(b) $SOCl_2$ and CCl_2NO_2

(c) $COCl_2$ and CCl_3NO_2

(d) $SOCl_2$ and CCl_3NO_2

GUJCET-2015, 2016

Ans. (c): Phosgene is the organic chemical compound with the formula $COCl_2$. It is a colourless gas.

Chloropicrin (CCl_3NO_2) is one of the tear gas which also called trichloronitromethane, toxic organic compound. Its vapours are irritating to the skin, eyes, and upper respiratory tract, and it has been used in chemical warfare and as tear gas.

604. A mixture of CaCl$_2$ and NaCl weighing 4.44 g is treated with sodium carbonate solution to precipitate all the calcium ions as calcium carbonate. The calcium carbonate so obtained is heated strongly to set 0.56 g of CaO. The percentage of NaCl in the mixture is (atomic mass of Ca = 40)

(a) 75 (b) 31.5

(c) 40.2 (d) 25

Karnataka-CET-2011, 2010

Ans. (a) : Concerned reaction is.

$$\underset{4.44g}{CaCl_2+NaCl}+Na_2CO_3\longrightarrow CaO_3+2NaCl+NaCl$$

$$\underset{1}{CaCO_3}\xrightarrow{\Delta}\underset{0.56g}{CaO}+CO_2$$

$(100\,CaCO_3=111\,g\,CaCl_2)$

$1\,g\,CaCO_3=1.11\,g\,CaCl_2$

weight of $CaCl_2$ = 1.11g, weight fo NaCl = 4.44 − 1.11 = 3.33g

$\%\,NaCl=\frac{3.33}{4.44}\times100=75\%$

605. An organic compound contains 60% C; 4.48% H and 35.5% O. Its empirical formula is

(a) $C_9H_8O_4$ (b) $C_5H_4O_2$

(c) $C_5H_4O_4$ (d) $C_9H_7O_6$

TS-EAMCET (Engg.), 05.08.2021 Shift-II

Ans. (a) :

Element	**%**	**Atomic mass**	**Moles**
Carbon	60	12	$\frac{60}{12}\Rightarrow5$
Hydrogen	4.48	1	$\frac{4.48}{1}\Rightarrow4.48$
Oxygen	35.5	16	$\frac{35.5}{16}\Rightarrow2.2$

Empirical formula = C : H : O

$=\frac{5}{2.2}:\frac{4.48}{2.2}:\frac{2.2}{2.2}$

= 2.27 : 2.0 : 1.0

= 2.27 × 4 : 2 × 4 : 1 × 4

= 9 : 8 : 4

= $C_9H_8O_4$

606. If 0.765g of an acid gives 0.535g of CO$_2$ and 0.138g of H$_2$O then ratio percentage of C and H is ——

(a) 19 : 2 (b) 18 : 12

(c) 20 : 17 (d) 1 : 7

AP EAPCET 25.08.2021, Shift-II

Ans. (a) : Given –

Mass of acid = 0.765 gm

Mass of CO_2 = 0.535 gm

Mass of H_2O = 0.138 gm

$\therefore$ Acid × CO_2 + H_2O

$$\%\,C=\frac{12}{44}\times\frac{\text{mass of }CO_2}{\text{mass of acid (compound)}}\times100$$

$$\%\,C=\frac{12}{44}\times\frac{0.535}{0.765}\times100=19.07\%$$

@apna_pdf

$$\% H = \frac{2}{18} \times \frac{\text{mass of } H_2O}{\text{mass of compound}} \times 100$$

$$\% H = \frac{2}{18} \times \frac{0.13}{0.765} \times 100 = 2\%$$

So, the ratio of percentage of C and H is 19 : 2.

607. Using Duma's method for estimating nitrogen. 1 g of an organic compound 'X' gave 82 ml of nitrogen, collected at 27ºC and 750 mm Hg pressure. If the aqueous tension at 27ºC is 30 mm Hg pressure, then the percentage of nitrogen in the given compound X is ———

(a) 22.09% (b) 88.36%
(c) 44.18% (d) 70.69%

AP EAPCET 25.08.2021, Shift-II

Ans. (b) : Given, P = 750 mmHg,
T = 300K
Volume (v) = 82 ml.
∴ Actual pressure = 750 – 30 = 720 mmHg

$$\text{Volume of } N_2 \text{ at STP} = \frac{273 \times 720 \times 80}{300 \times 760\ (\text{mmHg})}$$

$$= 70.7 \text{ ml}$$

∴ 22400 ml of N_2 of at STP weight = 28 gm

$$70.7 \text{ ml of } N_2 \text{ weight} = \frac{28 \times 70.7}{22400}$$

$$\% \text{ of } N_2 = \frac{28 \times 70.7 \times 100}{22400 \times 0.1}$$

$$= 88.36\ \%$$

608. In Duma's method of estimation of nitrogen, 0.1840 g of an organic compound gave 30 mL of nitrogen collected at 287 K and 758 mm of Hg pressure. The percentage composition of nitrogen in the compound is ----------. (Round off to the Nearest Integer).

[Given: Aqueous tension at 287 K = 14 mm of Hg]

JEE Main 16.03.2021, Shift-II

Ans. (19%) : Given:-
Aqueous tension at 287K = 14mm of Hg
∴ Actual pressure = (758–14) = 744 mm of Hg

$$\text{volume of nitrogen at STP (V)} = \frac{273 \times 744 \times 30}{287 \times 760}$$

$$V = 27.935 \text{ mL}$$

∴ 22400 mL of N_2 at STP weights = 28g
∴27.94 mL of N_2 at STP weights

$$= \left(\frac{28}{22400} \times 27.94\right) g$$

$$= 0.034 g$$

$$\text{Hence\% of nitrogen} = \left(\frac{0.034}{0.1840} \times 100\right)$$

$$= 18.97\%$$

$$\approx 19\%$$

609. Using Kjeldahl's method over 1g of a soil sample, the ammonia evolved could neutralize 25 ml of 1 M H_2SO_4. Then, the percentage of nitrogen present in the sample is —

(a) 100% (b) 60%
(c) 70% (d) 25%

AP EAPCET 20.08.2021 Shift-I

Ans. (c) : Given that,
Mass of soil sample = 1 gm
Volume of 1M H_2SO_4 = 25 ml
∴ 25 ml of H_2SO_4 = 50 ml of NH_3
Since, 1 M NH_3 contain at 1000 ml is 14g Nitrogen.

$$\therefore \text{Parentage of } N = \frac{14 \times 50}{1000} \times \frac{100}{1} = 70\%$$

610. In each molecule of carbon tetrachloride. the mass percent of carbon and chlorine respectively are _____ and _____.

(a) 76.86 & 23.14 (b) 7.84 & 92.80
(c) 23.14 & 76.86 (d) 78.41 & 9.25

AP EAPCET 24.08.2021, Shift-I

Ans. (b) : Given,
Molar mass of CCl_4 = 153.82 g/mol
Formula –
Mass% of an element

$$= \frac{\text{mass of that element in compound}}{\text{molar mass of the compound}} \times 100$$

$$\text{Mass percent of carbon} = \frac{12}{153.82} \times 100 = 7.80$$

$$\text{Mass percent of Cl} = \frac{4 \times 35.45}{153.82} \times 100 = 92.18$$

611. 7.8 of a compound having molecular formula C_6H_6, on reacting with $CH_3COCl/AlCl_3$ gives 8.4 g of a product which has molecular formula C_8H_8O. Calculate the percentage yield of the product C_8H_8O. (Given atomic weights of H, C and O respectively are 1.12 and 16)

(a) 70% (b) 60%
(c) 80% (d) 75%

AP EAPCET 20.08.2021 Shift-II

Ans. (a):

612. 0.4g mixture of NaOH, Na_2CO_3 and some inert impurities was first titrated with $\frac{N}{10}$ HCl using phenolphthalein as an indicator, 17.5 mL of HCl was required at the end point. After this methyl orange was added and titrated. 1.5 mL of same HCl was required for the next end point. The weight percentage of Na_2CO_3 in the mixture is ______. (Rounded – off to the nearest integer)

JEE Main 25-02-2021, Shift-I

Ans. (4%) : Let, m moles of NaOH = x
m moles of Na_2CO_3 = y
So, First end point reaction is–

$$NaOH + HCl \rightarrow NaCl + H_2O$$

Second end point reaction is–

$$Na_2CO_3 + HCl \rightarrow NaHCO_3 + NaCl$$

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$$x + y = \frac{1}{10} \times 17.5 \qquad .....(i)$$

$NaHCO_3 + HCl \rightarrow NaCl + H_2O$

$$y = \frac{1}{10} \times 1.5 \qquad .....(ii)$$

So, $x = 1.60,\ y = 0.15$

∴ Weight of $Na_2CO_3 = 0.15 \times 10^{-3} \times 106$

$= 1.59 \times 10^{-2}$ g

$$\%\ \text{Weight of } Na_2CO_3 = \frac{1.59 \times 10^{-2}}{0.4} \times 100$$

$= 3.975\%$

$\approx 4\%$

613. Complete combustion of 1.80 g of an oxygen containing compound ($C_xH_yO_z$) gave 2.64 g of CO_2 and 1.08 g of H_2O. The percentage of oxygen in the organic compound is:

(a) 63.53 (b) 53.33

(c) 51.63 (d) 50.33

JEE Main 25-02-2021, Shift-I

Ans. (b) : Liebig's method for % of C,H,O

$$\text{(i) } H_2 = \frac{2}{18} \times \frac{\text{Mass of } H_2O \text{ formed}}{\text{Mass of organic compound}} \times 100$$

$$= \frac{2}{18} \times \frac{1.08}{1.80} \times 100$$

$$= \frac{2.16}{32.4} \times 100 = 6.66\%$$

$$\text{(ii) } CO_2 = \frac{12}{44} \times \frac{\text{Mass of } CO_2 \text{ formed}}{\text{Mass of organic compound}} \times 100$$

$$= \frac{12}{44} \times \frac{2.64}{1.80} \times 100$$

$$= \frac{31.68}{79.2} \times 100 = 40\%$$

(iii) For O_2 percentage = 100 – (% of H_2 + % of CO_2)

= 100 – (6.66% + 40%)

= 53.34%

614. When benzyl alcohol is reacted with concentrated HBr produces the product 'P'. The product 'P' on reaction with KCN gives "Q". The product "Q" on heating with H_3O^+ generates "R" The molecular formula of "R" is

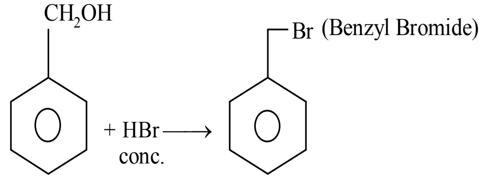
(a) $C_8H_8O_2$ (b) $C_7H_6O_2$

(c) $C_8H_9NO_2$ (d) C_8H_7N

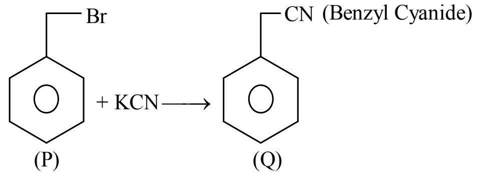
TS-EAMCET 09.08.2021, Shift-I

Ans. (a) :

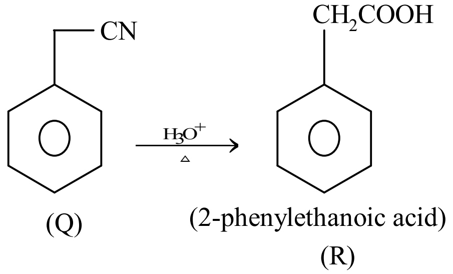
(1) $\text{Benzyl alcohol} + HBr \longrightarrow P$



(2) $\text{P(Benzyl Bromide)} + KCN \longrightarrow Q$



(3) $\text{Q(Benzyl Cyanide)} + H_3O^+ \xrightarrow[\Delta]{} R$



The molecular formula of product R is $C_8H_8O_2$.

615. Complete combustion of 750 g of an organic compound provides 420 g of CO_2 and 210 g of H_2O. The percentage composition of carbon and hydrogen in organic compound is 15.3 and _______ respectively. (Round off to the Nearest Integer).

JEE Main 16.03.2021, Shift-I

Ans. (3%) : Given, mass of H_2O = 210,

Mass of compound = 750

By Liebig method–

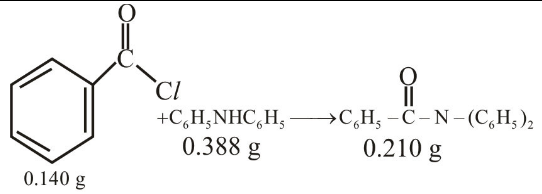
$$\%\ \text{of H-element} = \frac{2}{18} \times \frac{\text{Mass of } H_2O}{\text{Mass of compound}} \times 100$$

$$= \frac{2}{18} \times \frac{210}{750} \times 100$$

$$= \frac{1}{3} \times \frac{7}{75} \times 100$$

$$= \frac{7}{225} \times 100 = 3.11\% \approx 3\%$$

616.

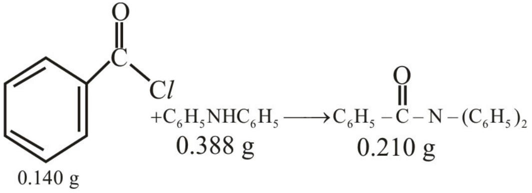


Consider the above reaction. The percentage yield of amide product is ____ (Round off to the Nearest Integer).

(Given : Atomic mass : C : 12.0 u, H: 1.0 u, N: 14.0 u, O: 16.0 u, Cl: 35.5 u

JEE Main 17.03.2021, Shift-II

Ans. (77)



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Number of mole of Ph–CO–Cl $= \frac{0.140}{140} = 10^{-3}$ mol

Theoritical mass of product = $10^{-3} \times 273 = 273 \times 10^{-3}$ g

Observed mass of product= 210×10^{-3} g

$$\therefore \% \text{ yield of product} = \frac{210 \times 10^{-3}}{273 \times 10^{-3}} \times 100 = 76.9\% \approx 77\%$$

617. Methylation of 10 g of benzene gave 9.2 g of toluene. Calculate the percentage yield of toluene .... (Nearest integer).

[JEE Main 2021, 22 July Shift-II]

Ans. (78%) : $C_6H_6 + CH_3Cl \rightarrow C_6H_5CH_3 + HCl$

10 gm of C_6H_6 $= \frac{10}{78}$ mole

Moles of methylbenzene should be obtained =

$= \frac{10}{78}$ mole

$= \left(\frac{10}{78} \times 92\right)$ gm

$$\therefore \quad \frac{A_y}{T_y} = \% \text{ yield} = \frac{9.2}{920} \times 78 \times 100 \Rightarrow 78\%$$

618. When 0.15 g of an organic compound was analysed using Carius method for estimation of bromine, 0.2397 g of AgBr was obtained. The percentage of bromine in the organic compound is .... (Nearest integer)
[Atomic mass : Silver = 108,
bromine = 80]

[JEE Main 20/08 /2021 Shift-II]
[JEE Main 16/03/2021 Shift-II]

Ans. (68%) : Given,

Mass of Bromine = 80u

Mass of AgBr = 188u

Weight of AgBr = 0.2397g

Weight of organic compound = 0.15g

$$\text{Percentage of Bromine} = \frac{\text{Molar mass of bromine}}{\text{Molar mass of AgBr}} \times \frac{\text{Weight of AgBr}}{\text{Weight of organic}} \times 100$$

$$\text{Percentage of Bromine} = \frac{80}{188} \times \frac{0.2397}{0.15} \times 100 = 68\%$$

619. .... grams of 3-hydroxy propanal (MW = 74) must be dehydrated to produce 7.8 g of acrolein (MW = 56) (C_3H_4O), if the percentage yield is 64 (Round off to the nearest integer). [Given : Atomic masses : C = 12.0 u, H = 1.0 u, O = 16.0 u]

[JEE Main 2021, 18 March Shift-I]

Ans. (16.11g) : 3-hydroxy propanol → Acrolein

$\frac{x}{74}$ mol $\qquad \frac{x}{74} \times \frac{64}{100} = \frac{7.8}{56}$

∴ Mass of acrolein–

$$\Rightarrow \quad \frac{x}{74} \times 0.64 = \frac{7.8}{56}$$

$$x = \frac{7.8 \times 74}{56 \times 0.64} = \frac{577.2}{35.84} = 16.10 = 16\text{g}$$

620. In the sulphur estimation, 0.471 g of an organic compound gave 1.44 g of barium sulphate. The percentage of sulphur in the compound is .... %
(Nearest integer)
(Atomic mass of Ba = 137 u)

[JEE Main 2021, 26 Aug Shift-II]

Ans. (42%): Given,

Mass of organic compound = 0.471 g

Mass of barium sulphate = 0.4813 g

Molecular mass of $BaSO_4$ = 137 + 32 + 64 = 233g

∵ 233 $BaSO_4$ contain → 32 g sulphur

∴ 1.44g $BaSO_4$ contain → $\frac{32}{233} \times 1.44$g sulphur

Given 0.471 g of organic compound

$$\% \text{ of S} = \frac{32 \times 1.44}{233 \times 0.471} \times 100 = 41.98\% \approx 42\%$$

621. The formula of a gaseous hydrocarbon, which requires 6 times of its own volume of O_2 for complete oxidation and produces 4 times its own volume of CO_2 is C_xH_y. The value of y is .....

[JEE Main 2021, 24 Feb Shift-II]

Ans. (8) :

$C_xH_y + 6O_24CO_2 + y/2H_2O$

Applying POAC on 'O' atoms

$6 \times 2 = 4 \times 2 + y/2 \times 1$

$y/2 = 4$

$y = 8$

622. A pure compound contains 2.4g of C, 1.2×10^{23} atoms. Its empirical formula is

(a) C_2HO (b) $C_2H_2O_2$
(c) CH_2O (d) CHO

Karnataka-CET-2021

Ans. (d) : Number of moles of C = $\frac{2.4}{12} = 0.2$

Number of moles of H = $\frac{1.2 \times 10}{6.0 \times 10} = 0.2$

Number of moles of O = 0.2 mol

Empirical formula is CHO

623. An organic compound contains 78% (by wt) carbon and remaining percentage of hydrogen. The right option for the empirical formula of this compound is [Atomic wt. of C is 12, h is 1]

(a) CH_4 (b) CH
(c) CH_2 (d) CH_3

NEET-2021

Ans. (d) :

Element	Mass %	At. weight	$\frac{\%}{\text{At. Weight}}$	Simplest ratio.
C	78	12	78/12 = 6.5	65/6.5 = 1
H	22	1	22/1 = 22	22/6.5 = 3

Empirical formula of this compound is CH_3.

@apna_pdf

624. 0.12 g of an organic compound 'X' containing phosphorus on reacting with magnesia mixture gave 0.22 g of magnesium pyrophosphate ($Mg_2P_2O_7$). The percentage of phosphorus in the compound 'X' is ....

(a) 45.30% (b) 28.70%
(c) 64.25% (d) 51.20%

AP EAMCET (Engg.) 18.09.2020, Shift-I

Ans. (d) : Estimation of phosphorus in organic compound is done by using magnesia mixture. It uses the working formula.

Given, w = 0.22g , W = 0.12 g

$$P\% = \frac{62}{222}\times\frac{w_1}{W}\times 100 = \frac{62}{222}\times\frac{0.22}{0.12}\times 100 = 51.20\%$$

625. In Kjeldahl's method, ammonia from 5 g of food neutralizes 30 cm^3 of 0.1 N acid. The percentage of nitrogen in the food is

(a) 0.84 (b) 8.4
(c) 16.8 (d) 1.68

COMEDK-2020

Ans. (a) : Given that

N = 0.1

V = 30

Percentage of nitrogen in the food is–

$$= \frac{1.4\times N\times V}{\text{Mass of given compond}}$$

$$= \frac{1.4\times 0.1\times 30}{5} = 0.84\%$$

626. If 0.2 gram of an organic compound containing carbon, hydrogen and oxygen on combustion, yielded 0.147 gram carbon dioxide and 0.12 gram water. What will be the content of oxygen in the substance?

(a) 73.29 (b) 78.45%
(c) 83.23% (d) 89.50%

[BITSAT-2020]

Ans. (a) : $\underset{0.2g}{\text{Organic compound}} + O_2 \rightarrow \underset{0.02g}{H_2O} + \underset{0.147g}{CO_2} + \text{Heat}$

$$\text{Percentage of C} = \frac{12}{44}\times\frac{\text{Mass of } CO_2}{\text{Mass of compound}}\times 100$$

$$= \frac{12}{44}\times\frac{0.147}{0.2}\times 100 \Rightarrow C = 20.04\%$$

$$\text{Percentage of H} = \frac{2}{18}\times\frac{\text{Mass of } H_2O}{\text{Mass of compound}}\times 100$$

$$= \frac{2}{18}\times\frac{0.12}{0.2}\times 100$$

$$H = 6.66\%$$

$$\text{Percentage of O} = 100-(\%C+\%H)$$

$$= 100-(20.04+6.66)$$

$$= 100-26.70$$

$$\text{Percentage of O} = 73.29\%$$

627. On electrolysis of aqueous solution of a halide of a metal 'M' by passing 1.5 ampere current for 10 minutes deposits 0.2938 g of metal. If the atomic mass of the metal is 63 gm/ mole, then what will be the formula of the metal halide?

(a) MCl_2 (b) MCl_3
(c) MCl (d) MCl_4

GUJCET-2020

Ans. (a) :

From Faraday's 1st law of electrolysis, m=Zit

$$0.2938 = \frac{63}{n\times 96500}\times 1.5\times 10\times 60$$

$$n = \frac{63\times 1.5\times 600}{96500\times 0.2938}$$

$$n = 2$$

$\therefore$ Formula = MCl_2

628. in an estimation of bromine by Carius method, 1.6 g of an organic compound gave 1.88 g of AgBr. The mass percentage of bromine in the compound is .... (Atomic mass, Ag = 108, Br = 80g mol^{-1})

[JEE Main 2020, 6 Sep Shift-I]

Ans. (50%) Given that,

Mass of organic compound = 1.6 gm

Mass of AgBr = 1.88 gm

Moles of Br = moles of AgBr = $\frac{1.88}{188} = 0.01$

Mass of Br = 0.01 × 80 = 0.80 gm

Percentage of Br = $\frac{0.80\times 100}{1.60} = 50\%$

629. The strengths of 5.6 volume hydrogen peroxide (of density 1 g/mL) in terms of mass percentage and morality (M), respectively, are (Take molar mass of hydrogen peroxide as 34 g/mol)

[JEE Main 2020, 3 Sep Shift-II]

Ans. (1.7%): Given that,

Volume strength = 5.6V

Morality = $\frac{5.6}{11.2} = 0.5$ (assuming 1 liter solution)

Mass of solution = 1000 ml × 1g/ml = 1000 g

Mass of solute = Moles × Molar mass

= 0.5 mol × 34g/mol

= 17 gm.

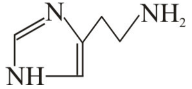
$$\therefore \quad \text{Mass }\% = \frac{\text{Mass of solute}}{\text{Mass of solution}}\times 100$$

$$= \frac{17}{1000}\times 100 = 1.7\%$$

630. The mass percentage of nitrogen in histamine is...... .

[JEE Main 2020, 9 Jan Shift-I]

Ans. (37.84): Structure of Histamine is



Molecular formula of Histamine = $C_5H_9N_3$

Molecular mass of Histamine = 111

Percentage nitrogen by mass in Histamine =

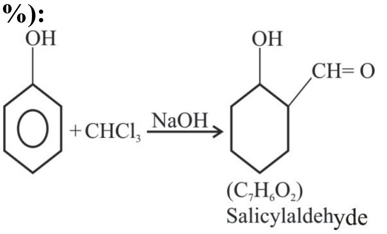
$$\frac{42}{111}\times 100 = 37.84$$

@apna_pdf

631. A solution of phenol in chloroform when treated with aqueous NaOH given compound P as a major product. The mass percentage of carbon in P is……. .
(to the nearest integer)
(Atomic mass: C=12; H=1; O=16)

[JEE Main 2020, 6 Sep Shift-II]

Ans. (69%):



Mass of Salicylaldehyde = 12 × 7 + 6 × 1 + 16 × 2
= 122

Mass of carbon = 12 × 7 = 84

$\therefore$ Mass % of C in P $= \frac{84}{122} \times 100 = 68.85\% \simeq 69\%$

632. A gas mixture contains 25% He and 75% CH_4 by volume at a given temperature and pressure. The percentage by mass of methane in the mixture is approximately –
(a) 75%
(b) 25%
(c) 92%
(d) 8%

Karnataka-CET-2020

Ans. (c): Given that,
Volume % of gas = mole % of gas [At STP]
Volume ratio = molar ratio

$$\frac{\text{Volume \% of He}}{\text{Volume \% of } CH_4} = \frac{25}{75} = \frac{1}{3}$$

Molar ratio = $\frac{1}{3}$

1 mole for (He) means

Mole = $\frac{\text{Weight}}{\text{At.weight}}$ [At. weight of (He) is 4]

$1 = \frac{\text{weight}}{4} = 4\text{g} = \text{weight of (He)}$

Then 3 mole of CH_4
Weight = 16 × 3 = 48 gm

Mass % of CH_4 = $\frac{\text{weight of } CH_4}{\text{total weight}} \times 100$

$\frac{48}{48+4} \times 100 \quad \Rightarrow \frac{48}{52} \times 100 \quad \Rightarrow 92.3\%$

Hence, the mass percentage of CH_4 = 92.3%

633. The formula of dichlorobis (urea) copper (II) is
(a) $[Cu\{O{=}C(NH_2)_2\}Cl]Cl$
(b) $[CuCl_2]\ \{O{=}C(NH_2)_2\}$
(c) $[Cu\{O{=}C(NH_2)_2\}]Cl_2$
(d) $[CuCl_2\{O{=}C(NH_2)_2\}_2]$

COMEDK-2019

Ans. (d) : The formula of dichlorobis (Urea) copper (II) is $\left[CuCl_2\{CO(NH_2)_2\}_2\right]$. The complex contains the two chloride and urea legend and shows the +2 oxidation state. This is the heteroleptic complex.

634. An organic compound is found to contain C= 54.5% , O=36.4% and H=9.1% by mass. Its empirical formula is
(a) C_2H_4O
(b) CH_2O
(c) C_3H_4O
(d) CHO_2

COMEDK-2019

Ans. (a) :
% age of carbon = 54.5%
% age of Hydrogen = 9.1%
% age of Oxygen = 100 – (54.5+9.1) = 36.4 %

Element	% age of mass	molar mass	n	ratio
O	36.4	16	$\frac{36.4}{16} = 2.27$	$\frac{2.27}{2.27} = 1$
C	54.5	12	$\frac{54.5}{12} = 4.54$	$\frac{4.54}{2.27} = 2$
H	9.1	1	$\frac{9.1}{1} = 9.1$	$\frac{9.1}{2.27} = 4$

Formula = C_2H_4O

635. The empirical formula of the compound if M = 68% (atomic mass = 34) and remaining 32% oxygen is?
(a) MO
(b) M_2O
(c) MO_2
(d) M_2O_3

AIIMS 25 May 2019 (Morning)

Ans. (a): We know that,

$$\text{No. of moles} = \frac{\text{Percentage of element}}{\text{At. mass}}$$

$$\text{No. of moles of element (M)} = \frac{68}{34} = 2$$

$$\text{No. of moles of oxygen} = \frac{100-68}{16} = 2$$

$$\text{Empirical formula of compound} = M_2O_2 = MO$$

636. An organic compound is estimated through Dumas method and was found to evolved 6 moles of CO_2, 4 moles of H_2O and 1 mole of nitrogen gas. The formula of the compound is
(a) C_6H_8N
(b) $C_{12}H_8N$
(c) $C_{12}H_8N_2$
(d) $C_6H_8N_2$

[JEE Main 2019, 11 Jan Shift-I]

Ans. (d) : $[C_x\ H_y\ N_z] \xrightarrow[\text{Method}]{\text{Duma}} 6CO_2 + 4H_2O + N_2$

$C \rightarrow 6$
$H \rightarrow 8$
$N \rightarrow 2$

Hence, $C_6H_8N_2$
$\therefore$ Molecular formula of the compound is $C_6H_8N_2$.

637. At 300 K and 1 atmospheric pressure, 10 mL of a hydrocarbon required 55 mL of O_2 for complete combustion and 40 mL of CO_2 is formed. The formula of the hydrocarbon is
(a) C_4H_7Cl
(b) C_4H_6
(c) C_4H_{10}
(d) C_4H_8

[JEE Main 2019, 10 April Shift-I]

@apna_pdf

Ans. (b) :

$$\underset{10\text{ml}}{C_xH_y(g)}+\underset{10\text{ml}\left(x+\frac{y}{4}\right)}{\left(x+\frac{y}{4}\right)O_2}\longrightarrow \underset{10x}{xCO_2(g)}+\frac{y}{2}H_2O$$

We have, formed of CO_2 = 40 mL

$$10x = 40$$

$$x = 4$$

For complete combustion required O_2 = 55 mL

$$10\left(x+\frac{y}{4}\right)=55$$

$$10\left(4+\frac{y}{4}\right)=55$$

$$10\left(\frac{16+y}{4}\right)=55$$

$$16+y=\frac{55\times 4}{10}$$

$$16 + y = 22$$

$$y = 22 - 16 = 6$$

So, the formula of hydrocarbon is = C_4H_6.

638. A 10 mg effervescent tablet containing sodium bicarbonate and oxalic acid releases 0.25 mL of CO_2 at T = 298.15 K and p = 1 bar. If molar volume of CO_2 is 25.0 L under such condition, what is the percentage of sodium bicarbonate in each tablet? [molar mass of $NaHCO_3$ = 84 g mol^{-1}]

(a) 8.4 (b) 0.84

(c) 16.8 (d) 33.6

[JEE Main 2019, 11 Jan Shift-I]

Ans. (a):

$2NaHCO_3 + H_2C_2O_4 \rightarrow 2CO_2 + Na_2C_2O_4 + 2H_2O$

Number of moles of CO_2 produced

$$n=\frac{pV}{RT}=\frac{1\,\text{bar}\times 0.25\times 10^{-3}\,\text{L}}{0.82\,\text{L atm K}^{-1}\text{mol}^{-1}\times 298.15\text{K}}$$

$$=1.02\times 10^{-5}\ \text{mol}$$

$$\text{Number of mole of NaHCO}_3=\frac{\text{Weight of NaHCO}_3}{\text{Molecular mass of NaHCO}_3}$$

$$\therefore\ W_{NaHCO_3}=1.02\times 10^{-5}\times 84\times 10^3\,\text{mg}$$

$$NaHCO_3\,\%=\frac{0.85\text{mg}}{10}=8.56\%$$

639. Which of the following is an example of Law of Multiple proportion?

(a) H_2O, H_2O_2 (b) CH_4, CO_2

(c) H_2O, CO_2 (d) SO_2, CS_2

J & K CET-(2019)

Ans. (a): According to Law of Multiple proportions when two elements combine to form more than one compound, the fixed amount of one element combining with other element have simple whole number ratio.

- H_2O and H_2O_2 here 2 part of hydrogen react with 16 and 32 part of oxygen 16 : 32 = 1:2 which is simple whole number ratio. It follows Law of Multiple proportions.
- CH_4 and CO_2 are not example of Law of Multiple proportions because elements are different.
- H_2O and CO_2 are not example of Law of Multiple proportions because elements are different.
- SO_2 and CS_2 are not example of Law of Multiple proportions because elements are different.

640. What is the percentage of carbon in urea? (Atomic mass C = 12, H = 1, N = 14, O = 16)

(a) 20% (b) 26.6%

(c) 6.67% (d) 46.0%

MHT CET-02.05.2019, SHIFT-III

Ans. (a) : Given that,

Molar mass of urea (NH_2CONH_2) = 60g

Mass % of an element

$$=\frac{\text{Mass of that element in compound}}{\text{Molar mass of the compound}}$$

$$\text{Percentage of C}=\frac{1\times 12}{60}\times 100=20\%$$

641. A compound contains 26% nitrogen and 74% oxygen. Its molecular formula will be

(a) N_2O (b) NO

(c) NO_2 (d) N_2O_5

Tripura JEE-2019

Ans. (d) : Percentage of N in compound = 26%

Percentage of O in compound = 74%

$$\text{Mass of nitrogen in 1 mole}=\frac{26}{100}\times 108\approx 28\text{g}$$

$$\text{Mass of oxygen in 1 mole}=\frac{74}{100}\times 108\approx 80\text{g}$$

$$\text{No. of moles of nitrogen}=\frac{28}{14}=2\,\text{moles}$$

$$\text{No. of moles of nitrogen}=\frac{80}{16}=5\ \text{moles}$$

So, the molecular formula is N_2O_5.

642. In the crystalline solid MSO_4. nH_2O of molar mass 250 g mol^{-1}, the percentage of anhydrous salt is 64 by weight.

The value of n is

(a) 2 (b) 3

(c) 5 (d) 7

WB-JEE-2019

Ans. (c) : MSO_4, $nH_2O \Rightarrow$ Molecular mass = 250 g or molar mass = 250 gm/mol.

We have to calculate molar mass of MSO_4, then we have to calculate the value of 'n'.

$$\frac{\text{Molar mass of MSO}_4\text{ (anhydrous salt)}}{\text{Total molar mass}}\times 100=$$

Percentage weight of anhydrous salt.

$$\frac{\text{Molar mass of MSO}_4}{250\,\text{gm. mol}^{-1}}\times 100=64$$

$$\text{Molar mass of MSO}_4=\frac{250\times 64}{100}\,\text{gm/mol}$$

$$=160\ \text{gm mol}^{-1}$$

@apna_pdf

nH_2O = Molar mass

$= (250 - 160)\ \text{gm. mol}^{-1}$

$= 90\ \text{gm. mol}^{-1}$ $\quad \because H_2O \rightarrow 2 \times 1 + 16$

$= 18\ \text{gm mol}^{-1}$

$$n = \frac{90\,\text{gm.mal}^{-1}}{18\,\text{gm.mol}^{-1}}$$

$n = 5$

643. A binary mixture of bivalent metals having mass 2 g, molecular mass of A and B are 15 and 30 respectively, is dissolved in HCl, it evolves 2.24L H_2 at STP, what is the mass of A present in mixture? (Atomic mass of A = 15μ, B = 30μ)

(a) 1 g (b) 1.5 g

(c) 0.5 g (d) 0.75 g

AIIMS-26 May, 2018 (E)

Ans. (a): For metal A let the mass of metal is x

No. of moles = x/15

$$A + 2HCl \rightarrow ACl_2 + H_2$$

one mole of metal gives one mole of H_2 gas

Mole : $\frac{x}{15}$ $\qquad \frac{x}{15}$

$$B + 2HCl \rightarrow BCl_2 + H_2$$

Mole $\frac{2-x}{30}$ $\qquad \frac{2-x}{30}$

Total moles of $H_2 = \frac{x}{15} + \frac{2-x}{30} = \frac{2.24}{22.4} = \frac{1}{10}$

$$\frac{2+x}{30} = \frac{1}{10}$$

$20 + 10x = 30$

$10 = 10x$

$x = 1g$

644. The formulas of the following compounds respectively are Bleaching powder; Quicklime; Plaster of Paris; Slaked lime

(a) $CaO, Ca(OH)_2, Ca(OCl)_2, CaSO_4\frac{1}{2}H_2O$

(b) $Ca(OCl)_2, CaO, CaSO_4\frac{1}{2}H_2O, Ca(OH)_2$

(c) $Ca(OCl)_2, Ca(OH)_2, CaSO_4\frac{1}{2}H_2O, CaO$

(d) $Ca(OH)_2, CaO, Ca(OCl)_2, CaSO_4\frac{1}{2}H_2O$

Assam CEE-2018

Ans. (b) : Bleaching powder = $Ca(OCl)_2$

Quicklime = CaO

Plaster of Paris = $CaSO_4.\frac{1}{2}H_2O$

Slaked lime = $Ca(OH)_2$

So, correct answer is $Ca(OCl)_2$, CaO, $CaSO_4\frac{1}{2}H_2O$, $Ca(OH)_2$.

645. The ratio of mass per cent of C and H of an organic compound ($C_xH_yO_z$) is 6 : 1. If one molecule of the above compound ($C_xH_yO_z$) contains half as much oxygen as required to burn one molecule of compound C_xH_y completely to CO_2 and H_2O. The empirical formula of compound $C_xH_yO_z$ is

(a) $C_3H_6O_3$ (b) C_2H_4O

(c) $C_3H_4O_2$ (d) $C_2H_4O_3$

[JEE Main 2018]

Ans. (d):

Element	Relative mass	Relative mole	Simplest no.ratio
C	6	$\frac{6}{12} = 0.5$	1
H	1	$\frac{1}{1} = 1$	1

So, $\quad x = 1, y = 2$

Now, $\quad C_xH_y + \left(x + \frac{y}{4}\right)O_2 \rightarrow xCO_2 + \frac{y}{2}H_2O$

O_2 atoms required $= 2\left(x + \frac{y}{4}\right)$

According to question–

$$2\left(x + \frac{y}{4}\right) = 2z$$

$$\left(1 + \frac{2}{4}\right) = z \qquad (\because x = 1, y = 2)$$

$z = 1.5$

Molecule can be written as–

$$C_xH_yO_z = C_1H_2O_{3/2} = C_2H_4O_3$$

646. What will be the percentage of dimerization of 61 g of benzoic acid in 1000 g of a solvent and producing a depression in freezing point of 2 °C? Consider K_f to be 6.

(a) 72% (b) 67%

(c) 43% (d) 28%

J & K CET-(2018)

Ans. (b): Given,

$W_{\text{benzoic acid}} = 61g;$

$W_{\text{solvent}} = 1000g$

$\Delta T_f = 2°C; K_f = 6$

We know that-

$$\Delta T_f = i K_f m$$

$$m = \frac{61/122}{1000} \times 1000 = 0.5;$$

$$i = \frac{\Delta T_f}{k_{f_m}} = \frac{2}{6 \times 0.5} = 0.67$$

Now from the equation

$$\alpha = \frac{1-i}{1-1/n} \qquad [\therefore n = 2\,\text{for benzoic acid}]$$

$$\alpha = \frac{1-0.67}{1-0.5} = 0.66 = 66\%$$

@apna_pdf

647. A compound, containing only carbon, hydrogen and oxygen has a molecular weight of 44. On complete oxidation, it is converted into a compound of molecular weight is 60.
The original compound is

(a) Alcohol	(b) Acid
(c) Aldehyde	(d) Ether

JIPMER-2018, MPPET-2013

Ans. (c) : As the compound is containing (C, H, O) the expected compound is an aldehyde, alcohol or ether.
On complete oxidation the obtained compound shows increment in molecular weight of only 16. It means only one oxygen atom is added here. This condition is fulfilled by only aldehyde which on oxidation gives acid.

$$RCHO \xrightarrow{[O]} RCOOH$$

Hence, original compound will be aldehyde

$$\underset{\text{mol. wt. 44}}{CH_3CHO} \xrightarrow{[O]} \underset{\text{mol. wt. 60}}{CH_3COOH}$$

648. If a mixture of FeO and Fe_3O_4 contains 75% Fe, what will be the percentage amount of each oxide in the mixture?
(a) 64.10% FeO and 35.90% Fe_2O_3
(b) 50% FeO and 50% Fe_2O_3
(c) 75% FeO and 25% Fe_2O_4
(d) 35.90% FeO and 64.10% Fe_2O_3

UPTU/UPSEE-2018

Ans. (a) : The percentage of Fe in FeO

$$= \frac{\text{Atomic weight of Fe}}{\text{Formula weight of FeO}} \times 100$$

$$= \frac{56}{72} \times 100 = 77.78\%$$

The percentage of Fe in Fe_2O_3

$$= \frac{(\text{Atomic weight of Fe}) \times 2}{\text{Formula weight of } Fe_2O_3} \times 100$$

$$= \frac{112}{160} \times 100 = 70.00\%$$

Suppose, 'x' g of FeO (in total) and 'y' g of Fe_2O_3 form the mixture that contains 75% Fe.
77.78% of x + 70.00% y = 75.00 of x + 75.00% of y
(77.78 – 75.00%) of x = (75.00 – 70.00)% of y
2.77% of x = 5.00% of y

$$\frac{x}{y} = \frac{5.00}{2.78}\% = \frac{500}{278} = \frac{250}{139}$$

$\Rightarrow$ x : y = 250 : 139
Now percent amount of FeO in mixture (x)

$$= \frac{250}{(250+139)} \times 100 = \frac{25000}{389}\% = 64.3\%$$

Hence, percent amount of Fe_2O_3 in mixture (y)
= (100 – 64.3)% = 35.7%

649. A metal M (specific heat 0.16) forms a metal chloride with 65% chlorine present in it. The formula of the metal chloride will be

(a) MCl	(b) MCl_2
(c) MCl_3	(d) MCl_4

WB-JEE-2018

Ans. (b): Given, specific heat = 0.16
According to Dulong Petit's law
Let MCl_x be the metal chloride.

$$\frac{6.4}{\text{Specific heat}} = \text{Atomic weight of metal}$$

$$\frac{6.4}{0.16} = \text{Atomic weight of metal}$$

Atomic weight = 40
40 is the atomic weight of Calcium, According to question, metal chloride (MCl_x) have ≈ 65% chlorine present in it.

$$\frac{x \times \text{Atomic weight of Chlorine}}{(40+x) \times \text{Atomic weight of Chlorine}} \times 100 = 65$$

$$\frac{x \times 35.5}{40 + x \times 355} \times 100 = 65$$

x = 2 (approx)
So, the formula of metal chloride will be MCl_2.

650. Two oxides of an non-metal X contain 50% and 40% of non-metal respectively. If the formula of the first oxide is XO_2, Then the formula of second oxide is

(a) X_2O_3	(b) X_2O_5
(c) XO_3	(d) X_2O

AP EAMCET-2017

Ans. (c) : Given that, the formula of first oxide is XO_2
For, second oxide 40% of (X) we have 60% of oxygen.
∴ For 100% of (X) (i.e. one mole) we get

$$\therefore \text{ Moles of oxygen} = \frac{2 \times 60}{40} = 3$$

Hence the formula of second oxide is XO_3.

651. An alkane has a C/H ratio (by mass) of 5.1428. Its molecular formula is

(a) C_8H_{18}	(b) C_5H_{12}
(c) C_7H_{10}	(d) C_6H_{14}

COMEDK-2017

Ans. (d) : Given that,
Carbon and hydrogen ratio (C/H) = 5.1428.
Atomic mass of C = 12
Atomic mass of H = 1
So,

$$\text{(a) } C_8H_{18} = \frac{C}{H} = \frac{12\times8}{1\times18} = \frac{96}{18} = 5.33$$

$$\text{(b) } C_5H_{12} = \frac{C}{H} = \frac{12\times5}{1\times12} = \frac{60}{12} = 5$$

$$\text{(c) } C_7H_{10} = \frac{C}{H} = \frac{12\times7}{1\times10} = \frac{84}{10} = 8.4$$

$$\text{(d) } C_6H_{14} = \frac{C}{H} = \frac{12\times6}{1\times14} = \frac{72}{14} = 5.1428$$

Thus, molecular formula of alkane having C/H ratio by mass 5.1428 is C_6H_{14}.

652. 0.0833 mole of a carbohydrate of empirical formula CH_2O contains 1.00 g of hydrogen. The molecular formula of the carbohydrate is

(a) $C_5H_{10}O_5$	(b) $C_3H_4O_3$
(c) $C_{12}H_{22}O_{11}$	(d) $C_6H_{12}O_6$

CG PET -2017

@apna_pdf

Ans. (d): Given, Empirical formula = CH_2O
Mole ratio of C, H and O = 1:2:1
Also 0.0833 moles contains 1g of hydrogen
$\therefore$ 0.0833 × n=1g of hydrogen
Where n = Number of moles of hydrogen
(a) For $C_5H_{10}O_5 (n = 10)$
$\therefore \quad 0.0833 \times 10 = 0.833 \neq 1$
(b) For $C_3H_4O_3 (n = 4)$
$\therefore \quad 0.0833 \times 4 = 0.333 \neq 1$
(c) For $C_{12}H_{22}O_{11} (n = 22)$
$\therefore \quad 0.0833 \times 22 = 1.8326 \neq 1$
(d) For $C_6H_{12}O_6 (n = 12)$
$\therefore \quad 0.0833 \times 12 = 0.9996 \approx 1$
The molecular formula of the carbohydrate is $C_6H_{12}O_6$.

653. 10g of $MgCO_3$ decomposes on heating to 0.1 mole CO_2 and 4g MgO. The percent purity of $MgCO_3$ is
(a) 24% (b) 44%
(c) 54% (d) 74%
(e) 84%

Kerala-CEE-2017

Ans. (e): Mole ratio = 1 : 1 : 1
Mass ratio = 84 : 40 : 44
Since, $MgCO_3 \xrightarrow{\Delta} MgO + CO_2$
(i) 84 gm of $MgCO_3$ give MgO = 40gm
10 gm of $MgCO_3$ give MgO = $\frac{40 \times 10}{84} = 4.76$ gm
MgO obtained is less by = 4.76 × 4.0 = 0.76gm

(ii) 84 gm of $MgCO_3$ give CO_2 = 44gm
10 gm of $MgCO_3$ give CO_2 = $\frac{44 \times 10}{84} = 5.23$ gm
Thus, CO_2 obtained is less by 5.23 – 4.4 = 0.83gm
Total short = 0.76 + 0.84 = 1.59 ≅ 1.60
∵ 10 gm of $MgCO_3$ give less products by = 1.60 gm
∴ 100 gm of $MgCO_3$ give less products by = 1.600 gm
$MgCO_3$ = 100 –16 = 84%

654. A 6% solution of sucrose $C_{22}H_{22}O_{11}$ is isotonic with 3% solution of an unknown organic substance. The molecular weight of unknown organic substance will be
(a) 684 (b) 171
(c) 100 (d) 342

UPTU/UPSEE-2017

Ans. (b) : Both the solution are isotonic they have same concentration in mole/litre.
Sucrose solution concentration = 6g/100 cm^3
= 60g/litre
Molar mass of sucrose $C_{12}H_{22}O_{11}$ =342
Therefore, we got = $\frac{60}{342}$ moles/litre
For unknown substance let N be the molecular mass then concentration
= 3g/100 cm^3
= 30g/litre
= 30/N moles/litre
Comparing the both equation
$$\frac{30}{N} = \frac{60}{342}$$
$$N = \frac{30 \times 342}{60} = 171$$
N = 171.
Hence the molecular weight of unknown organic substance is 171.

655. Blister copper contains ____ percentage of copper.
(a) 2 (b) 98
(c) 50 (d) 0

SRMJEEE-2016

Ans. (b): Blister copper contains 98% of copper. Blister copper is a metallic copper which has a black blistered surface. The other percentage consists of impurities are oxygen etc.
$2\,Cu_2O + Cu_2S \rightarrow 6Cu\downarrow + SO_2$

656. In Dumas method, 0.3 g of an organic compound gave 45 mL of nitrogen at STP. The percentage of nitrogen is
(a) 16.9 (b) 18.7
(c) 23.2 (d) 29.6

BITSAT-2016
AP-EAMCET – 2016

Ans. (b) : Dumas method is a method for quantitative determination of nitrogen in the chemical substances.
We have weight of organic compound = 0.3g
And, volume (V) = 45mL
∴The volume of N_2 at STP, the percentage of nitrogen is calculated as –
$$\text{Percentage of nitrogen} = \frac{28V \times 100}{22400 \times W}$$
$$= \frac{V}{8W}$$
$$= \frac{45}{8 \times 0.3}$$
$$= 18.75$$
Hence, the required percentage of nitrogen is 18.75.

657. 1 g of an impure sample of calcium carbonate (containing no complete thermally decomposition impurities) on complete thermal decomposition gave 0.33 g of carbon dioxide gas. The percentage of impurity in this sample is (Atomic masses of C, O and Ca are respectively 12, 16 and 40 g mol^{-1})
(a) 25 (b) 20
(c) 30 (d) 33

J & K CET-(2016)

Ans. (a): Given, the amount of $CaCO_3$ = 1g
amount of CO_2 = 0.33g
$CaCO_3 \xrightarrow{\Delta} CaO + CO_2$
44g of CO_2 is obtained from 100g of $CaCO_3$
0.33 g of CO_2 is obtained from $\frac{100}{44} \times 0.33$ = 0.75 g of $CaCO_3$

@apna_pdf

percentage of impurity in the sample of $CaCO_3$ is = $100\% - \frac{0.75}{100}\%$ = 100% – 75% = 25%.

Hence, 25% of impurity present in the given sample.

658. A compound contain three elements X, Y and Z. The oxidation number. Of X, Y and Z are +3, +5 and –2 respectively. The possible formula of the compound is –

(a) X_2YZ (b) XYZ_3

(c) $X_3(YZ_4)_3$ (d) X_2Y_2Z

BCECE-2016

Ans. (c) : The sum of all oxidation values must be equal to zero.

Let, number of atoms of X, Y and Z are respectively a, b and c.

Then, (+3)a + (+5)b + (–2c) = 0 or 3a + 5b – 2c = 0

Now, putting values of a, b and c for all the given options, which will give sum equal to zero, will be our formula.

(a) For, X_2YZ

$a = 2, b = 1, c = 1$

$3a + 5b - 2c = 0 \Rightarrow 3 \times 2 + 5 - 2 = 9 \neq 0$

(b) For, XYZ_3

$a = 1, b = 1, c = 3$

$3a + 5b - 2c = 0$

$3 + 5 - 6 = 2 \neq 0$

(c) For, $X_3(YZ_4)_3$

$a = 3, b = 3, c = 12$

$3a+5b-2c = 0 \Rightarrow (3 \times 3 + 5 \times 3) - (2 \times 12) = 0$

$9 + 15 - 24 = 0$

(d) For, X_2Y_2Z

$a = 2, b = 3, c = 1$

$3a+5b-2c = 0 \Rightarrow (3 \times 2) + (5 \times 2) - (2 \times 1) = 0$

$6 + 15 - 2 = 19 \neq 0$

The possible formula of compound is $X_3(YZ_4)_3$.

659. 1.25 g of a sample of Na_2CO_3 and $NaSO_4$ is dissolved in 250 mL solution. 25 mL of this solution neutralizes 20 mL of 0.1 N H_2SO_4. The % of Na_2CO_3 in this sample is

(a) 84.8% (b) 8.48%

(c) 15.2% (d) 42.4%

BITSAT 2016

Ans. (a) : Let the amount of Na_2CO_3 present in the mixture be x g. Na_2SO_4 will not react with H_2SO_4. Then

$$\frac{x}{53} = \frac{20 \times 0.1 \times 10}{1000} \quad \therefore x = 1.06\text{g}$$

∴ Percentage of Na_2CO_3

$$= \frac{1.06 \times 100}{1.25} = 84.8\%$$

Hence, 84.8% of Na_2CO_3 present in this sample.

660. The percentage of oxygen in CH_2O is

(a) 40% (b) 6.6%

(c) 53.33% (d) 49%

JCECE - 2016

Ans. (c) : As per molecular formula

$CH_2O = 12 + 2 + 16 = 30$

Molecular mass of O = 16

$$\text{Percentage of oxygen} = \frac{16}{30} \times 100$$

$$\text{Percentage of oxygen} = 53.33\%.$$

661. An organic compound contains C = 40%, H = 13.33% and N = 46.67%. Its empirical formula is

(a) C_2H_2N (b) C_3H_7N

(c) CH_4N (d) CHN

Karnataka-CET-2016

Ans. (c) : Given, amount of C = 40%

Amount of H = 13.33%

Amount of N = 46.67%

Convert percentile to weight in grams.

Then, convert wt. in grams to moles.

$$\text{Moles of C} = \frac{40}{12} = 3.33$$

$$\text{Moles of H} = \frac{13.33}{1} = 13.33$$

$$\text{Moles of N} = \frac{46.6}{14} = 3.33$$

Now, divide each mole value by lowest value of n as;

C = 3.33/ 3.33 = 1

H = 13.33/ 3.33 = 4.00

N = 3.33/ 3.33 = 1

Hence, the required empirical formula is CH_4N

662. A gaseous compounds having carbon, hydrogen and oxygen was burnt in the presence of oxygen. After combustion, 1 volume of the gaseous compound produces 2 volumes of CO_2 and 2 volumes of steam. Determines the molecular formula of the compound, it all the volumes were measured under the same conditions of pressure and temperature.

(a) $C_2H_4O_2$ (b) $C_3H_6O_3$

(c) $C_4H_8O_2$ (d) $C_5H_{10}O_3$

Manipal-2016

Ans. (a): Let the chemical formula of the compound is $C_XH_YO_Z$

$$C_x H_y O_z + mO_2 \longrightarrow xCO_z + \frac{y}{2}H_2O(\text{steam})$$

1Vol 2 Vol 2 Vol 2 Vol

For, gaseous reactants and products that are at same temperature and pressure, the molar ratio is equal to the volume ratio.

2 moles of CO_2 have atoms of carbon and this carbon must have come from the compound.

X = 2

2 moles of steam contain 4 atoms of hydrogen and they have come from the compound.

Y = 4

Molecular formula of compound = $C_2H_4O_2$

663. The percentage of pyridine (C_5H_5N) that forms pyridinium ion (C_5H_5NH) in a 0.10 M aqueous pyridine solution (K_b for $C_5H_5N = 1.7 \times 10^{-9}$) is

(a) 0.0060% (b) 0.013%

(c) 0.77% (d) 1.6%

NEET-II 2016

@apna_pdf

Ans. (b): Given, K_b for $C_5H_5N = 1.7 \times 10^{-9}$
Pyridine solution concentration is 0.01M
Therefore, keeping the value in reaction
$C_5H_5N + H_2O \rightleftharpoons C_5H_5N^+H + OH^-$
We know that,
$K_b = C\alpha^2$

$$\alpha = \sqrt{\frac{K_b}{C}}$$

$$= \sqrt{\frac{1.7 \times 10^{-9}}{0.10}}$$

$$= \sqrt{1.7 \times 10^{-8}}$$

$= 1.30 \times 10^{-4}$
Where,
α = Constant dissociation
C = Concentration
K_b = base ionization constant
Hence, percentage of pyridine that forms pyridinium ion $= \alpha \times 100\%$
$= 1.30 \times 10^{-4} \times 100$
$= 0.013\%$
So, the percentage of pyridine is 0.013%

664. 0.222 g of iron ore was brought into solution. Fe^{3+} is reduced to Fe^{2+} with $SnCl_2$. The reduced solution required 20 ml of 0.1N $KMnO_4$ solution. The percentage of iron present in the ore is (equivalent weight of iron is 55.5)

(a) 55.5% (b) 45.0%
(c) 50.0 % (d) 40.0%

SCRA-2015

Ans. (c): Given that, V = 20 ml
Equivalent weight of iron = 55.5
∴ Number of equivalent of Fe = Number of equivalent of $KMnO_4$

$$\text{Number of equivalent of Fe} = \frac{0.1 \times 20}{1000} = 0.002 = NV/100$$

Mass of iron (pure) = 0.002 × 55.5 = 0.111gm

$$\text{Percentage of iron present in ore} = \frac{\text{Mass of pure iron}}{\text{Mass of iron ore}} \times 100$$

$$= \frac{0.111}{0.222} \times 100$$

$$= 50\%$$

Hence, 50% of iron present in ore.

665. Beryllium given a compound X with the following percentage composition : Be-6.1%, N-37.8%, Cl-48%, H-8.1%. Molecular weight of X is 148g mol^{-1} and that of Be is 9g mol^{-1}. The molecular formula of the compound is:

(a) $BeN_4Cl_2H_{12}$ (b) BeN_4ClH_6
(c) $BeN_4Cl_2H_6$ (d) BeN_4ClH_8

BCECE-2015

Ans. (a):

$$\text{Mass composition\%} = \frac{\text{Total mass of element}}{\text{Molar mass of compound}}$$

Therefore, total mass of element = Mass % of each element one by one.

For, Be

$$\text{Total mass of Be } = \frac{6.1}{100} \times 148 \simeq 9$$

Similarily,
$N \simeq 56$
$Cl \simeq 71$
$H \simeq 12$

$$\text{Now, Moles of element} = \frac{\text{Total mass of element}}{\text{Atomic mass of element}}$$

For, Be

$$\text{Moles of Be} = \frac{9}{9} = 1$$

$$N = \frac{56}{14} = 4$$

$$Cl = \frac{71}{35.5} = 2$$

$$H = \frac{12}{1} = 12$$

For calculating Molecular formula,

Atom	Atomic Weight (A)	%	%A	Simple ratio
Be	9	6.1	0.68	1
N	14	37.8	2.70	4
Cl	35.5	48.0	1.35	2
H	1	8.1	8.10	12

Thus, we can deduce the empirical formula to be $BeN_4Cl_2H_{12}$
Therefore, $BeN_4Cl_2H_{12}$ is the molecular formula.

666. The empirical formula of a compound is CH_2.One mole of this compound has a mass 42g. Its molecular formula is

(a) C_3H_6 (b) C_2H_6
(c) CH_2 (d) C_2H_2

CG PET- 2015

Ans. (a) : Given, Empirical formula of a compound is CH_2
Then the empirical weight is = 14
Molecular weight = 42gm
We know that,

$$\therefore \quad n = \frac{\text{molecular weight}}{\text{Emprical weight}} = \frac{42}{14} = 3$$

Molecular formula = (Empirical formula) n
Molecular formula = $(CH_2)_3$
$= C_3H_6$
Hence, the molecular formula of compound is C_3H_6.

667. In Carius method of estimation of halogens, 250 mg of an organic compound gave 141 mg of AgBr. The percentage of bromine in the compound is (at, mass Ag = 108, Br = 80)

(a) 24 (b) 36
(c) 48 (d) 60

JEE Main-2015

@apna_pdf

Ans. (a) : Given that,
Weight of AgBr = 141 mg
Weight of organic compound = 250 g
According to carious methods

$$\text{Percentage of Br} = \frac{\text{At. wt. of Br}}{\text{Molecular wt. of AgBr}} \times \frac{\text{Wt. of AgBr}}{\text{Wt. of organic compound}} \times 100$$

$$= \frac{80}{188} \times \frac{141}{250} \times 100$$

$$= \frac{112800}{47000}$$

$$= 24\%$$

668. The molecular formula of a commercial resin used for exchanging ions in water softening is $C_8H_7SO_3$ Na (mol. wt. = 206). What would be the maximum uptake of Ca^{2+} ions by the resin when expressed in mole per gram resin?

(a) $\frac{1}{103}$ (b) $\frac{1}{206}$

(c) $\frac{2}{309}$ (d) $\frac{1}{412}$

[JEE Main-2015]

Ans. (d) : The molecular weight of resin is 206 g/mol.

1g of resin corresponds to $\frac{1}{206}$ moles.

$C_8H_7SO_3Na + Ca^{2+} \rightarrow (C_8H_2SO_3)_2Ca + 2Na^+$
2 mole 1mole

1 mole of calcium ions will displace 2 moles of sodium ions from resin.

1 mole of resin contains 1 mole of sodium ions and can uptake upto 0.5 moles of calcium ions.

Hence, 1g of resin will uptake $\frac{1}{206} \times 0.5 = \frac{1}{412}$ moles of calcium ions.

669. The molal freezing point depression constant for benzene (C_6H_6) is 4.90 K Kg mol^{-1}. Selenium exists as a polymer of the type Se_x. When 3.26 g of selenium is dissolved in 226g of benzene, the observed freezing point is 0.112°C lower than that of pure benzene. The molecular formula of selenium is
(Atomic mass of Se = 78.8 g mol^{-1})

(a) Se_8 (b) Se_6

(c) Se_4 (d) Se_2

JIPMER-2015

Ans. (a): Given that,
Depression in freezing point (ΔT_f) = 0.112°C
Mass of Selenium (W_A) = 226 gm =0.226 kg
Mass of Selenium (W_B) = 3. 26 gm
Molar depression constant (K_f) = 4.9K kg mol
Molar mass of selenium which can be furthur calculated by the formula–

$$M_B = \frac{K_f \times W_B}{\Delta T_f \times W_A}$$

$$= \frac{4.9 \times 3.26}{0.112 \times 0.226} = 631.08 \text{g mol}^{-1}$$

And, given that atomic mass of Se_x = 78.8 g mol^{-1}

So, the value of x can be calculated as–

$$\frac{631.08}{78.8} = 8$$

Thus, molecular formula of selenium = Se_8.

670. 0.30 g of an organic compound containing C, H and oxygen on combustion yields 0.44 g of CO_2 and 0.18 g of H_2O. If one mole of compound weighs 60, then molecular formula of the compound is

(a) CH_2O (b) C_3H_8O

(c) C_4H_6O (d) $C_2H_4O_2$

Karnataka-CET-2015

Ans. (d): Given that, weight of CO_2 = 0.44g
Weight of H_2O = 0.18g

$$\% \text{ of C} = \frac{12}{44} \times \frac{\text{Weight of CO}_2 \text{ formed}}{\text{Weight of organic compound}} \times 100$$

$$= \frac{12}{44} \times \frac{0.44}{0.30} \times 100 = 40$$

$$\% \text{ of H} = \frac{2}{18} \times \frac{\text{Weight of H}_2\text{O formed}}{\text{Weight of organic compound}} \times 100$$

$$= \frac{2}{18} \times \frac{0.18}{0.30} \times 100 = 6.66$$

% of O = 100 – (% of C + % of H)
= 100 – (40 + 6.66) = 53.34

For empirical formula

Element	Mass	Relative no. of moles	ratio
C	12	$\frac{40}{12} = 3.33$	1
H	1	$\frac{6.66}{1} = 6.66$	2
O	16	$\frac{53.34}{16} = 3.33$	1

Empirical formula CH_2O
Molecular formula = n × EF

$$n = \frac{MF_{mass}}{EF_{mass}} = \frac{60}{30} = 2$$

MF is $(CH_2O)_2 = C_2H_4O_2$
Hence, molecular formula of the compound is $C_2H_4O_2$.

671. An organic compound contains 90% carbon and 10% hydrogen by mass. Its empirical formula is

(a) C_2H_4 (b) C_3H_6

(c) C_3H_8 (d) C_3H_4

(e) C_2C_6

Kerala-CEE-2015

Ans. (d): Given,
percent of carbon = 90%
percent of hydrogen = 10%

$$\therefore \text{Empirical formula} = C_{\frac{90}{12}\times100} H_{\frac{10}{1}\times100}$$

$$= C_{750}H_{1000}$$

$$= C_3H_4$$

@apna_pdf

672. In Duma's method for estimation of nitrogen, 0.25 g of an organic compound gave 40 mL of nitrogen collected at 300 K temperature and 725 mm pressure. If the aqueous tension at 300 K is 25 mm, the percentage of nitrogen in the compound is

(a) 16.76 (b) 15.76
(c) 17.36 (d) 18.20

NEET-2015, cancelled

Ans. (a): According to the question,

m = 0.25g
v_1 = 40 mL
v_2 = ?
T_1 = 300K
T_2 = 273
P_1 = 725 – 25 = 700 mm
P_2 760 mm

from combined gas law,

$$\frac{700\times 40}{300}=\frac{760\times v_2}{273}$$

v_2 = 33.52 mL

Now finding the mass of nitrogen which corresponds to 33.53 ml-

22400 mL of N_2 at STP weights = 28g

Therefore, 33.52 mL of N_2 at STP will weigh

$$=\frac{28\times 33.52}{22400}=0.0419\text{g}$$

for percentage of nitrogen.

$$\%\text{ of nitrogen}=\frac{0.419}{0.25}\times 100=16.76\%$$

673. The formula for sodium trioxalatoaluminate (III) is

(a) $Na_4[Al(C_2O_4)_3]$ (b) $Na_3[Al(C_2O_4)]_3$
(c) $Na_3[Al(C_2O_4)_3]$ (d) $Na_2[Al(C_2O_4)_3]$

COMEDK-2015

Ans. (c) : The formula for sodium trioxalatoaluminate (III) is $Na_3[Al(C_2O_4)_3]$. The aluminum shows the +3 oxidation state and this is the homoleptic complex compound.

674. An organic compound weighing 0.15g gave on Carius estimation, 0.12 g of AgBr. The percentage of Br in the compound will be close to (At. Mass of Ag = 108, Br = 80)

(a) 46% (b) 34.1%
(c) 3.41% (d) 4.6%

COMEDK-2015

Ans. (b) : The Percentage of bromine in the compound

$$=\frac{80}{188}\times\frac{\text{Mass of AgBr formed}}{\text{Mass of substance taken}}\times 100$$

$$=\frac{80}{188}\times\frac{0.12}{0.15}\times 100=34.04\%$$

675. 2 g of benzoic acid (C_6H_6COOH) is dissolved in 25 g of benzene. The observed molar mass of benzoic acid is found to be 241.98. What is the percentage association of acid if it forms dimer in solution?

(a) 85.2% (b) 89.2%
(c) 95.2% (d) 99.2%

AMU-2015

Ans. (d) : Given, $(W_A)_{\text{benzoic acid}}$ = 2g
$(W_B)_{\text{benzen}}$ = 25g
K_f = 4.9 Kg mol^{-1}
T_f = 1.62K
M_B = 241.98

Normal molecular mass of C_6H_5COOH = [12(6) + 1(5) + 12(1) + 16(2) + 1(1)]
= 122 g mol^{-1}

Observed molecular mass of C_6H_5COOH=241.98gmol^{-1}

So, Van't Hoff factor,

$$i=\frac{\text{Normal molecular mass}}{\text{Observed molecular mass}}$$

$$i=\frac{122}{241.98}=0.504 \qquad .....(i)$$

Now, $\alpha_{\text{association}}=(1-i)\dfrac{n}{n-1}$

$\Rightarrow$ $\alpha=(1-0.504)\dfrac{2}{2-1}$ [n = 2 as it forms a dimer]

α = 0.496 × 2
α = 0.992

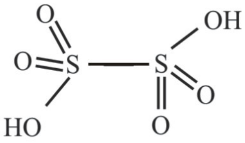
% of α = 0.992 × 100 = 99.2%

676. The molecular formula of Dithionic acid is

(a) $H_2S_2O_4$ (b) $H_2S_2O_6$
(c) $H_2S_2O_5$ (d) $H_2S_2O_7$

SRMJEEE – 2014

Ans. (b) : $H_2S_2O_6$ is Dithionic acid



Dithionic acid

677. A 5.82 g silver coin is dissolved in nitric acid. When sodium chloride is added to the solution, all the silver is precipitated as AgCl. The AgCl precipitate weighs 7.20 g. The percentage of silver in the coin is

(a) 60.3% (b) 80%
(c) 93.1% (d) 70%

AMU-2014

Ans. (c) : Fraction of Ag in AgCl $=\dfrac{107.9}{143.3}=0.753$

Weight of Ag in AgCl = 0.753 × 7.20
= 5.42 g

Hence, 5.82g coin contains 5.42 g of Ag

Now, fraction of Ag in coin $=\dfrac{5.42}{5.82}=0.931\text{g}$

% of Ag in the coin = 93.1%

678. Two oxides of a metal contain 50% and 40% metal (M) respectively. If the formula of first oxide is MO_2, the formula of second oxide will be

(a) MO_2 (b) MO_3
(c) M_2O (d) M_2O_5

Assam CEE-2014

@apna_pdf

Ans. (b) : Formula of 1st oxide is MO_2
Which contains 50% of metal.
So, remaining is O_2
Amount of metal = Amount of O_2
$= 32$ gm
When 40% of M is the second oxide
So, $0.4(MO_x) = 32$

$$(MO_x) = \frac{32}{0.4} = \frac{320}{4} = 80$$

Where, (MO_x) is the oxide–
So, mass of O = 80 – 32 = 48
$\therefore \quad x \times 16 = 48$
$x = 3$
$\therefore$ Formula is MO_3.

679. For the estimation of nitrogen 1.4 g of an organic compound was digested by Kjeldahl's method and the evolved ammonia was absorbed in 60 mL of M/10 sulphuric acid. The unreacted acid required 20 mL of M/10 sodium hydroxide for the complete neutralization. The percentage of nitrogen in the compound is

(a) 6% (b) 10%
(c) 3% (d) 5%

JEE Main 2014

Ans. (b) : Given that,
Weight of $N_2 = 1.4$ g

$$\% \text{ of N} = \frac{1.4 \times \text{meq. of acid}}{\text{Mass of organic compound}}$$

$$\text{meq. of } H_2SO_4 = 60 \times \frac{1}{10} \times 2 = 12$$

$$\text{meq. of NaOH} = 20 \times \frac{1}{10} = 2$$

$\therefore$ meq. of acid consumed = 12 – 2 = 10

$$\% \text{ of N} = \frac{1.4 \times 10}{1.4} = 10\%$$

680. The percentage of water of crystallisation of a sample of blue vitriol is

(a) 34.07% (b) 35.07%
(c) 36.07% (d) 37.07%

JCECE - 2014

Ans. (c) : Blue vitriol is $CuSO_4 \cdot 5H_2O$
Molecular weight of $CuSO_4 \cdot 5H_2O = 249.5$

$$\% \text{ of water of crystallisation} = \frac{5 \times 18}{249.5} \times 100 = 36.07\%$$

681. 10 g of a mixture of BaO and CaO requires 100 cm^3 of 2.5 M HCl to react completely. The percentage of calcium oxide in the mixture is approximately (Given: molar mass of BaO = 153)

(a) 52.6 (b) 55.1
(c) 44.9 (d) 47.4

Karnataka-CET-2014

Ans. (a) : Let mass of CaO = x g
$\therefore$ Mass of BaO = (10 – x)g

$$\because \text{ equivalent mass of BaO} = \frac{\text{Molar mass}}{2} = \frac{153}{2} = 76.5$$

$$\text{Number of moles of BaO} = \frac{10 - x}{76.5}$$

$$\text{equivalent mass of CaO} = \frac{56}{2} = 28$$

$$\text{Number of moles of CaO} = \frac{x}{28}$$

We know that,

$$\text{Molarity} = \frac{\text{moles of solute}}{\text{Volume of solution (in L)}}$$

$$2.5 = \frac{\text{moles of solute}}{\frac{100}{1000}}$$

$$\therefore \text{ Moles of solute} = \frac{2.5 \times 100}{1000}$$

$$\text{or } \frac{x}{28} + \frac{10 - x}{76.5} = 0.25$$

$76.5x + 28(10 - x) = 0.25 \times 28 \times 76.5$

$$48.5x = 255.5 = x = \frac{255.5}{48.5} = 5.26$$

$$\therefore \% \text{ of CaO} = \frac{5.26}{10} \times 100 = 52.6\%$$

Hence, 52.6% of CaO present in the mixture.

682. In the Kjeldahl's method for estimation of nitrogen present in a soil sample, ammonia evolved from 0.75 g of sample neutralized 10 mL of 1 M H_2SO_4. The percentage of nitrogen in the soil is

(a) 37.33 (b) 45.33
(c) 35.33 (d) 43.33

NEET-2014

Ans. (a): In the Kjeldahl's method, percentage of N

$$(\% \text{ N}) = \frac{1.4 \times \text{Normality of acid} \times \text{Volume of acid}}{\text{Weight of compound}}$$

$1M \ H_2SO_4 = 2N \ H_2SO_4$

$$\% \text{ N} = \frac{1.4 \times 2 \times 1}{0.75} = 37.33\%$$

It will neutralize 20M of NH_3.

683. A compound contains 38.8% C, 16% H, 42.5% N. The formula of compound will be :

(a) CH_3NH_2 (b) CH_3CN
(c) C_2H_5CN (d) $CH_2(NH_2)_2$

MPPET-2013

Ans. (a) : Given that,
Percentage of C in a compound = 38.8%
Percentage of H in a compound = 16%
Percentage of N in a compound = 42.5%

@apna_pdf

Element	%	Ratio%/ at wt.	Simple ratio
C	38.8	$\frac{38.8}{12}=3.2$	1
H	16.0	$\frac{16}{1}=16$	5
N	42.5	$\frac{42.5}{14}=3.2$	1

Hence, the formula of compound will be CNH_5 or CH_3NH_2.

684. For which of the following, both the empirical formula and molecular formula are the same?

(a) Naphthalene (b) Sucrose
(c) Glucose (d) 1-Butene

SRMJEEE-2013

Ans. (b) : Molecular formula - Indicates exact no. of all the atoms in a molecules.

Emprical formula - Indicated simplest ratio of the atoms in a molecules.

Both the empirical formula and molecular formula are same for Sucrose ($C_{12}H_{22}O_{11}$).

685. The arsenic content of an agricultural insecticide was reported as 28% As_2O_5. What is percentage of arsenic in this preparation?

(a) 16% (b) 18%
(c) 15% (d) 20%

AMU-2013

Ans. (b) :

Molar mass of $As_2O_5 = (2 \times 75) + (5 \times 16) = 230g$

230g As_2O_5 contains = 150g As

28g As_2O_5 contain = $\frac{150 \times 28}{230}$ = 18.26g As

18.26g As is present in 100g insecticide so it is 18.26% ≈ 18%

686. Analysis shows that a binary compound of X (atomic mass = 10) and Y (atomic mass = 20) contains 50% X. The formula of the compound is

(a) XY (b) X_2Y
(c) XY_2 (d) X_2Y_3

AMU-2013

Ans. (c): Assume total mass = 100g

Percentage = grams per 100 grams

We have 50g of X atomic mass 10

And, 50 g of Y atomic mass 20.

Atomic Mass of X < Atomic Mass of Y

$\boxed{Y = 2X}$ .....(i)

Empirical formula, $X = \frac{50\%}{10} = 5$

X = 5

y = 10 (from (i) eq^n.)

The formula for compound = X_5Y_{10}

$= XY_2$

687. Empirical formula of a compound is CH_2O and its molecular mass is 90, the molecular formula of the compound is

(a) $C_3H_6O_3$ (b) $C_2H_4O_2$
(c) $C_6H_{12}O_6$ (d) CH_2O

Karnataka-CET-2013

Ans. (a): Given that, Empirical formula = CH_2O

We know that,

Molecular formula = n × empirical formula

$$n = \frac{\text{molecular formula weight}}{\text{emperical formula weight}}$$

Empirical formula weight of CH_2O is 30(12 + 2 + 16)

Molecular formula weight is 90

$$n = \frac{90}{3} = 3$$

Molecular formula = 3 × CH_2O

Molecular formula is $C_3H_6O_3$

688. In an experiment it showed that 10 ml of 0.05 M solution of chloride required 10 mL of 0.1 M solution of $AgNO_3$, which of the following will be the formula of the chloride (X stands for the symbol of the element other than chlorine)?

(a) X_2CL_2 (b) XCL_2
(c) XCL_4 (d) X_2CL

Karnataka NEET-2013

Ans. (b): Given that,

Molarity of $AgNO_3$ = 0.1

Molarity = 0.05M

Volume of chloride = 10 ml

So, no. of moles of chloride

$$= \frac{10}{100} \times 0.05$$

$$= \frac{0.5}{1000}$$

& no. of moles of $AgNO_3$

$$= 0.1 \times \frac{10}{100}$$

$$= \frac{1}{1000}$$

Gram of chloride = gram equivalent of $AgNO_3$

$$\Rightarrow \frac{0.5n}{1000} = \frac{1}{1000} \quad \begin{pmatrix} \text{Where} \\ n = \text{no.of chlorides} \end{pmatrix}$$

∴ n = 2

So, formula in XCl_2

689. An organic compound contains 38.8% carbon, 16% hydrogen & 45.2% nitrogen. Its empirical formula is:

(a) CH_3CN (b) C_2H_5CN
(c) $CH_2(NH_2)_2$ (d) CH_3NH_2

MPPET - 2012

Ans. (d): For calculating in the empirical formula,

S. No.	Element	%	Atomic Wt.	Relative No. of moles	Simple ratio moles
1.	C	38.8	12	$\frac{38.8}{12}=3.23$	3.23/3.23 = 1
2.	H	16	1	$\frac{16}{1}=16.0$	16/3.23 = 5
3.	N	45.2	14	$\frac{45.2}{14}=3.23$	3.23/3.23 = 1

The Empirical Formula is– CH_5N (or) $\boxed{CH_3NH_2}$

@apna_pdf

690. In a hydrocarbon, mass ratio of hydrogen and carbon is 1:3, the empirical formula of hydrocarbon is

(a) CH_4 (b) CH_2

(c) C_2H (d) CH_3

AIIMS-2012

Ans. (a): Given, $\frac{C}{H}=\frac{1}{3}$

Atomic mass of H = 1

Atomic mass of C = 12

According to the option

In,

$$CH_2 \rightarrow \frac{C}{H}=\frac{2}{12}=1:6$$

$$C_2H\rightarrow \frac{C}{H}=\frac{1}{24}=1:24$$

$$CH_3 \rightarrow \frac{C}{H}=\frac{3}{12}=1:4$$

$$CH_4 \rightarrow \frac{C}{H}=\frac{4}{12}=1:3$$

691. The density of a 3 M sodium thiosulphate ($Na_2S_2O_3$) solution is 1.25 g/mL. Calculate the percent by weight of sodium thiosulphate.

(a) 12.64% (b) 37.92%

(c) 0.87% (d) 63.21%

AMU-2012

Ans. (b): Given that,

Molarity of $Na_2S_2O_3$ = 3mol/L

density of 3M of sodium thiosulphate = 1.25g/ml

Moles of $Na_2S_2O_3$ = 3

Weight of $Na_2S_2O_3$ = 3 × 158 = 474g

And, volume (V) of solution = 1L = 1000 mL

m = d × v = 1.25 g/mL × 1000 mL

m = 1250 g

$$\text{\% by weight of } Na_2S_2O_3=\frac{\text{Wt.of } Na_2S_2O_3}{\text{Wt.of solution}}\times 100$$

$$=\frac{474}{1250}\times 100 = 37.92\ \%$$

692. The formula of chloral is

(a) $CHCl_3$ (b) CH_2ClCHO

(c) CCl_3CHO (d) $CHCl_2CHO$

JCECE - 2012

Ans. (c) : The formula of chloral is CCl_3CHO.

693. In the estimation of sulphur by Carius method, 0.480 g of an organic compound gives 0.699 g of barium sulphate. The percentage of sulphur in this compound is (Atomic masses Ba = 137, S = 32, O = 16)

(a) 20% (b) 15%

(c) 35% (d) 30%

(e) 40%

Kerala-CEE-2012

Ans. (a): Given that,

Amount of $BaSO_4$ = 0.699g

weight of organic compound = 0.48g

$$\text{\% of S } = \frac{32}{233}\times\frac{\text{Wt.of } BaSO_4}{\text{Wt.of organic compound}}\times 100$$

$$=\frac{32}{233}\times\frac{0.699}{0.480}\times 100$$

= 20%

Hence, 20% sulphur present in this compound

694. 0.833 mol of a carbohydrate with empirical formula CH_2O, has 10g of hydrogen. Molecular formula of carbohydrate is

(a) $C_3H_5O_3$ (b) $C_6H_{12}O_6$

(c) $C_3H_{10}O_5$ (d) $C_3H_4O_3$

UP CPMT-2012

Ans. (b): Given that,

Weight of hydrogen = 10g

Moles of carbohydrate = 0.833

weight of hydrogen = 10g

0.833 moles of carbohydrate has hydrogen = 10g

1 mole of carbohydrate has hydrogen

$$=\frac{10\times 1}{0.833}=12\text{g}$$

Given, empirical formula of carbohydrate = CH_2O

CH_2O contains hydrogen = 2 g/mole

∴ Molecular formula should contain hydrogen

$$=\frac{12\times 2}{2}=12$$

Molecular formula = $C_6H_{12}O_6$

695. 0.16g of an organic compound containing sulphur produces 0.233 g of $BaSO_4$. Percentage of sulphur in the compound is

(a) 20 (b) 80

(c) 50 (d) 10

AP-EAMCET- (Engg.)-2011

Ans. (a) : Given that, weight of $BaSO_4$ = 0.233g

weight of compound = 0.16

$$\text{percentage of sulphur} = \frac{32\times \text{weight of } BaSO_4 \times 100}{233\times \text{weight of compound}}$$

$$=\frac{32\times 0.233\times 100}{233\times 0.16}$$

$$=\frac{7.45\times 100}{37.28}$$

$$= 19.98 \approx 20$$

Hence, 20% of sulphur present in the compound.

696. The empirical formula of a non-electrolyte is CH_2O. A solution containing 3g of the compound exerts the same osmotic pressure as that of 0.05 M glucose solution. The molecular formula of the compound is

(a) CH_2O (b) $C_2H_4O_2$

(c) $C_4H_8O_4$ (d) $C_3H_6O_3$

Karnataka-CET-2011

Ans. (b) : For isotonic solution (solution with same osmotic pressure)

$$\frac{W_1}{m_1V_1}=\frac{W_2}{m_2V_2}$$

@apna_pdf

Where, W_1 = Mass of glucose = 0.05 × 180 g = 9 g

m_1 = Molecular mass of glucose = 180 g

Assuming $V_1 = V_2 = 1L$

W_2 = Mass of compound = 3 g

m_2 = ?

$$\therefore \quad \frac{9}{180} = \frac{3}{x}$$

$$x = \frac{3\times180}{9}$$

x = 60 g

Molecular formula = n × empirical formula

Empirical formula = CH_2O

Empirical formula mass = 12 + 2 + 16 = 30

$$n = \frac{\text{molecular mass}}{\text{empirical formula mass}}$$

$$= \frac{60}{30} = 2$$

Molecular formula = 2 × CH_2O = $C_2H_4O_2$

697. The percentage composition by weight of an aqueous solution of solute (molar mass 150) which boils at 373.26K(k_b=0.52) is

(a) 7
(b) 6
(c) 9
(d) 15

CG PET- 2011

Ans. (a): Given,

$\Delta T_b = (B.P)_{soln.} - (B.P)_{solvent} = 373.26 - 373 = 0.26$ K

$\Delta T_b = 0.26$,

$K_b = 0.52$

We know that,

$\Delta T_b = K_b \times m$,

$$m = \frac{\Delta T_b}{K_b} = \frac{0.26}{0.52} = 0.5$$

0.5 × 150 = 75g of solute in 1000g of the water

$$\Delta T_b = \frac{K_b \times W_2 \times 1000}{W_1 M_1}$$

$$0.26 = \frac{0.52 \times W_2 \times 1000}{1000 \times 150}$$

$W_2 = 75$

$$\text{Percentage composition} = \frac{75\times100}{1000} = 7.5\%$$

698. 1 g of silver gets distributed between 10 cm^3 molten zinc and 100 cm^3 of molten lead at 800°C. The percentage of silver still left in the lead layer is approximately

(a) 2
(b) 5
(c) 3
(d) 1

Karnataka-CET-2011

Ans. (c) : Partition coefficient

$$= \frac{\text{Conc. of Ag in molten Zn}}{\text{Conc. of Ag in molten Pb}}$$

Mass of Ag in lead at equilibrium = 1 – x

Mass of Ag in Zn at equilibrium = x

$$300 = \frac{x/10}{1-x/100} = \frac{10x}{1-x}$$

10 x = 300 – 300 x

10 x = 300 – 300 x

310 x = 300

$$x = \frac{300}{310}$$

$$x = \frac{30}{31}$$

Amount of silver in molten lead

$$= 1 - x = 1 - \frac{30}{31} = \frac{31-30}{31} = \frac{1}{31}$$

$$\Rightarrow \quad \%\text{ of silver} = \frac{1}{31}\times100 \simeq 3\%$$

699. 1.2 g of organic compound of Kjeldahlization liberates ammonia which consumes 30 cm^3 of 1 N HCl. The percentage of nitrogen in the organic compound is

(a) 30
(b) 35
(c) 46.67
(d) 20.8

Karnataka-CET-2011

Ans. (b) : Given, Organic compound (w) = 1.2g

Ammonia consumes = 30 cm^3 = 30 ml

Normality of HCl = 1 N

Percentage of nitrogen =

$$\frac{1.4 \times \text{N of acid} \times \text{Vol. used with } NH_3}{\text{Weight of organic compound}}$$

$$= \frac{1.4\times1\times30}{1.2}$$

= 35%

Hence, 35% of nitrogen present in the organic compound.

700. Two organic compounds X and Y on analysis gave the same percentage composition namely C = (12/13) × 100% and H = (1/13) × 100% However, compound X decolourises bromine water while compound Y does not. The two compounds X and Y may be respectively

(a) acetylene and ethylene
(b) acetylene and benzene
(c) ethylene and benzene
(d) toluene and benzene
(e) benzene and styrene

Kerala-CEE-2011

Ans. (b) : Given that,

percentage composition of X and Y.

$$\frac{12}{13}\times100 \text{ percent} : \frac{1}{13}\times100 \text{ percent}$$

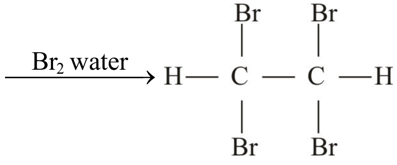
i.e. the ratio of masses of C and H in the organic compound

$$C \quad : \quad H$$

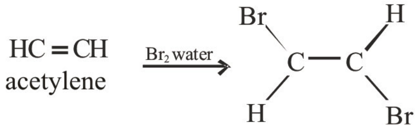
$$\frac{12}{13} \quad : \quad \frac{1}{13}$$

@apna_pdf

The empirical formula of the compound X and Y is CH and X decolorize bromine water while Y does not thus X and Y must be acetylene ($CH\equiv CH$) and benzene (C_6H_6) respectively.



1, 1, 2, 2- tetrabromoethane



trans –1, 2– dibromo ethene

701. An organic contains 49.3% carbon, 6.84% hydrogen and its vapour density is 73. Molecular formula of the compound is

(a) $C_3H_5O_2$ (b) $C_4H_{10}O_2$

(c) $C_6H_{10}O_4$ (d) $C_3H_{10}O_2$

BCECE-2010

Ans. (c): For calculating molecular formula,

Element	**%**	**Relative no.of atom**	**Simple ratio**
C	49.3	$\frac{49.3}{12}=4.10$	$\frac{4.10}{2.74}=1.5\times2=3$
H	6.84	$\frac{6.84}{1}=6.84$	$\frac{6.84}{2.74}=2.5\times2=5$
O	43.68	$\frac{43.68}{16}=2.74$	$\frac{2.74}{2.74}=1\times2=2$

∴ The empirical formula is $C_3H_5O_2$

Empirical formula weight = 12 × 3 + 1 × 5 + 16 × 2=73

Melecular weight of the compound = 2 × vapour density

= 2 × 73 = 146

$$n=\frac{\text{Molecular weight}}{\text{Empirical formula weight}}$$

$$=\frac{146}{73}=2$$

Molecular formula = Empirical formula × 2

$= 2(C_3H_5O_2) = C_6H_{10}O_4$

702. Molecular formula of Glauber's salt is

(a) $MgSO_4\cdot7H_2O$ (b) $CuSO_4\cdot5H_2O$

(c) $FeSO_4\cdot7H_2O$ (d) $Na_2SO_4\cdot10H_2O$

JCECE - 2010

Ans. (d) : Sodium sulphate decahydrate ($Na_2SO_4\cdot10H_2O$) is also known as Glauber's salt.

703. 0.765 g of an acid gives 0.535 g of CO_2 and 0.138 g of H_2O. Then, the ratio of the percentage of carbon and hydrogen is

(a) 19 : 2 (b) 18 : 11

(c) 20 : 17 (d) 1 : 7

JCECE - 2010

Ans. (a): Given, $W_{acid} = 0.765g$

$W_{CO_2} = 0.535g$ & $W_{H_2O} = 0.138g$

$$\text{Pecentage of C} = \frac{12}{44}\times\frac{\text{Mass of }CO_2}{\text{Mass of compund}}\times100$$

$$\text{Percentage of C} = \frac{12}{44}\times\frac{0.535}{0.765}\times100=19.07$$

$$\text{Percentage of H} = \frac{2}{18}\times\frac{\text{Mass of }H_2O}{\text{Mass of compund}}\times100$$

$$\text{Percentage of H} = \frac{2}{18}\times\frac{0.138}{0.765}\times100=2.004$$

Ratio of % of C : H = 19 : 2 (approx)

704. 1.5 g of $CdCl_2$ was found to contain 0.9 g of Cd. Calculate the atomic weight of Cd.

(a) 118 (b) 112

(c) 106.5 (d) 53.25

VITEEE- 2009

Ans. (c) : Mass percent of Cd in $CdCl_2$

$$=\frac{0.9}{1.5}\times100=60\%$$

∴ Mass percent of Cl_2 in $CdCl_2$

= 100 – 60 = 40%

∵40% part (Cl_2) has atomic weight

= 2 × 35.5 = 71.0

∴ 60% part (Cd) has atomic weight

$$=\frac{71.0\times60}{40}=106.5$$

Hence, the atomic weight of Cd is 106.5g.

705. In an organic compound, C =68.5% and H = 4.91%. Which empirical formula is correct for it?

(a) C_6H_{10} (b) $C_7H_6O_2$

(c) C_5H_8O (d) C_9H_3O

UP CPMT-2009

Ans. (b): For calculating Empirical formula,

Element	At.wt.	Percent composition	No.of moles	Simple molar ratio
C	12	68.5	$\frac{68.5}{12}=5.708$	$\frac{5.708}{1.67}=3.41\times2=7$
H	1	4.91	$\frac{4.91}{1}=4.91$	$\frac{4.91}{1.67}=2.95\times2=6$
O	16	$(100-68.5-4.91)$ $=26.59$	$\frac{26.59}{16}=1.67$	$\frac{1.67}{1.67}=1\times2=2$

Hence, the empirical formula of the compound is $C_7H_6O_2$.

706. The percentage (by weight) of sodium hydroxide in a 1.25 molal NaOH solution is

(a) 4.76% (b) 1.25%

(c) 5% (d) 40%

MHT CET-2009

Ans. (a): We know that,

$$\text{molality}=\frac{\text{moles of solute}}{\text{mass of solvent (kg)}}$$

$$1.25=\frac{n_A}{1\text{kg}}$$

@apna_pdf

n_A = moles of NaOH = 1 · 25 moles
weight of NaOH = moles × molar mass
$= 1\cdot 25 \times 40 = 50$ g
weight of solution = 1000 + 50 = 1050 g

$$\% \text{ (by weight) of NaOH} = \frac{50}{1050}\times 100$$
$$= 4.76\%$$

707. An organic compound made of C,H and N contains 20% nitrogen. Its molecular weight is

(a) 70
(b) 140
(c) 100
(d) 65

WB-JEE-2009

Ans. (a) : Atomic mass of nitrogen = 14

$$\% \text{ of N} = \frac{\text{Atomic mass of N}}{\text{Minimum mol mass of compund}}\times 100$$

$$20\% = \frac{14}{\text{Minimum mol mass}}\times 100$$

$$\text{Minimum mol mass} = \frac{14\times 100}{20} = 70$$

Therefore, Minimum molecular weight of the organic compound = 70.

708. A compound with molecular formula $C_4H_{10}O_3$ is converted by the action of acetyl chloride to a compound of molecular mass 190. The original compound ($C_4H_{10}O_3$) has

(a) two OH groups
(b) four OH groups
(c) one OH group
(d) three OH groups.

SRMJEEE-2008

Ans. (a) : Molecular mass of $C_4H_{10}O_3$
$= 4 \times 12 + 10 \times 1 + 3 \times 16$
$= 106$
Molecular mass of CH_3CO
$= 12 \times 2 + 3 \times 1 + 16 = 43$
Hence, the no. of – OH groups in the compound = M. mass of $C_4H_{10}O_3$ + 2 × M. mass of CH_3CO – 190
$= 106 + 2 \times 43 - 190$
$= 2$
Hence, the original compound $C_4H_{10}O_2$ has two – OH groups.

709. In a compound C, H and N are present in 9 : 1 : 3.5 by weight. If molecular weight of the compound is 108, then molecular formula of the compound is–

(a) $C_2H_6N_2$
(b) C_3H_4N
(c) $C_6H_8N_2$
(d) $C_9H_{12}N_3$

BCECE-2008

Ans. (c) : Molecular weight of compound = 108

	C	H	N
	9	1	3.5
Number of atom,	$\frac{9}{12} = 0.75$	$\frac{1}{1} = 1$	$\frac{3.5}{14} = 0.25$
simplest ratio,	$\frac{0.75}{0.25} = 3$	$\frac{1}{0.25} = 4$	$\frac{0.25}{0.25} = 1$

So, empirical formula = C_3H_4N

$$n = \frac{108}{54} = 2$$

Molecular formula = $(C_3H_4N)_2$
$= C_6H_8N_2$

710. 0.1 mole of a carbohydrate with empirical formula CH_2O contains 1 g of hydrogen. What is its molecular formula?

(a) $C_5H_{10}O_5$
(b) $C_6H_{12}O_6$
(c) $C_4H_8O_4$
(d) $C_3H_6O_3$
(e) $C_2H_4O_2$

Kerala-CEE-2008

Ans. (a): Assume molecular formula be $(CH_2O)n$
In one mol of carbohydrate, there is 2n g of hydrogen present.

∴ 0.1 mole of carbohydrate there is $\frac{2n}{1}\times 0.1$g of hydrogen which is equal to 1g

$$\frac{2n}{1}\times 0.1 = 1 \Rightarrow n = 5$$

Molecular formula = $C_5H_{10}O_5$
Hence, the required molecular formula is $C_5H_{10}O_5$

711. The percentage of an element M is 53 in its oxide of molecular formula M_2O_3. Its atomic mass is about

(a) 45
(b) 9
(c) 18
(d) 36
(e) 27

Kerala-CEE-2008

Ans. (e): Let atomic mass of M is x
Molecular weight of compound = 2x + 16 × 3
= 2x + 48

$$\% \text{ of weight of M} = \frac{2x\times 100}{2x+48} = 53 \text{ (given)}$$

Solve for x, $x \simeq 27.06$
x = 27
Hence, the atomic mass of M is 27.

712. An organic compound contains carbon, hydrogen and oxygen. Its element analysis gave C, 38.71% and H, 9.67%. The empirical formula of the compound would be

(a) CHO
(b) CH_4O
(c) CH_3O
(d) CH_2O

NEET-2008

@apna_pdf

Ans. (c): For calculating Empeirical formula,

Element	%	At. Wt.	Relative No. of atoms	Simplest ratio of atoms
C	38.71	12	3.23	3.23/3.23=1
H	9.67	1	9.67	9.67/3.23=3
O	51.62	16	3.23	3.23/3.23=1

Hence, empirical formula is CH_3O.

713. Composition of azurite mineral is

(a) $CuCO_3 \cdot CuO$

(b) $Cu(HCO_3)_2 \cdot Cu(OH)_2$

(c) $2CuCO_3 \cdot Cu(OH)_2$

(d) $CuCO_3 \cdot 2Cu(OH)_2$

WB-JEE-2008

Ans. (c) : Azurite is the ore of copper, its molecule or formula is $Cu(OH)_2.2CuCO_3$

- It is best known for its characteristic deep blue to violet blue color.

714. An unknown element forms an oxide. What will be the equivalent wt. of the element if the oxygen content is 20% by wt

(a) 16 (b) 32

(c) 8 (d) 64

WB-JEE-2008

Ans. (b): Given that,

Oxygen contents in element oxide is 20% by weight.

Element contents in element oxide is 8% by weight.

Then, equivalent weight of unknown element = $\frac{80}{20} \times 8$

∴ Equivalent weight of unknown element 32.

715. When 30 litres of H_2 and 30 litre of N_2 are reacted NH_3 is formed and the yield is only 50%. The composition of the gaseous mixture will be :

(a) 5L of N_2, 5L of H_2 and 5L of NH_3.

(b) 5L of N_2, 10L of H_2 and 10L of NH_3.

(c) 10L of N_2, 15L of H_2 and 5L of NH_3.

(d) 5L of N_2, 15L of H_2 and 10L of NH_3.

BITSAT-2007

Ans. (d) : $N_2(g) + 3H_2(g) \rightarrow 2NH_3(g)$;

H_2 is the limiting reagent in this reaction. 10L N_2 will react with 30L H_2 to produce 20L of NH_3. As only 50% of the expected product is formed, hence the composition of resultant mixture will be 5L of N_2, 15L of H_2 and 10L of NH_3.

716. A compound has the empirical formula CH_2 O. Its vapour density is 30. Its molecular formula is

(a) $C_2H_4O_2$ (b) C_2H_6O

(c) $C_2H_6O_2$ (d) C_2H_4O

CG PET -2007

Ans. (a) : We know that,

Molecular mass = 2 × vapour density

Empirical formula mass (CH_2O) = 12 + 2 + 16 = 30

$\Rightarrow \quad n = \frac{\text{Molecular weight}}{\text{Empirical mass}} = \frac{60}{30} = 2$

$\Rightarrow$ Molecular formula is $(CH_2O)_2 = C_2H_4O_2$

717. An aromatic hydrocarbon with empirical formula C_5H_4 on treatment with concentrated H_2SO_4 gave a monosulphonic acid. 0.104 g of the acid required 10 mL of $\frac{N}{20}$ NaOH for complete neutralization. The molecular formula of hydrocarbon is

(a) C_5H_4 (b) $C_{10}H_8$

(c) $C_{15}H_{12}$ (d) $C_{20}H_{16}$

(e) $C_{15}H_{20}$

Kerala-CEE-2007

Ans. (b) : The equivalent of acid = Equivalent of base

Basicity of acid × number of moles of acid = acidity of the base × number of mol of the base

$\Rightarrow \quad \frac{1 \times 0.104g}{M} = 1 \times \text{normality} \times \text{volume in litre}$

$\frac{0.104}{M} = \frac{10}{1000} 1 \times \frac{1}{20} N$

M = 0.104 × 2000 = 208g/mol

Molecular mass of acid is 208g/mol

Empirical formula of mono sulphonic acid = $R–SO_3H$

Molecular mass= Molecular mass of –R + (32 + 48 + 1)

$\Rightarrow$ 208g/ mol = x × (mass empirical formula of hydrocarbon, C_5H_4) + 80g/mol

$\Rightarrow$ 208 – 80 = x × (12 × 5 +4)

$\Rightarrow$ x = 2

∴ Molecular formula of Hydrocarbon = 2 (C_5H_4)

= $C_{10}H_8$

718. 5.6 g of an organic compound on burning with excess of oxygen gave 17.6 g of CO_2 and 7.2 g of H_2O. The organic compound is :

(a) C_2H_6 (b) C_4H_8

(c) C_3H_8 (d) CH_3COOH

(e) CH_3CHO

Kerala-CEE-2006

Ans. (b) : Let the organic compound be a hydrocarbon

$$Cx\ Hy + O_2 \rightarrow xCO_2 + \frac{y}{2}H_2O$$

17.6g of CO_2 = 0.4 moles

7.2g of H_2O = 0.4 moles

From reaction x = 0.4 and $\frac{y}{2} = 0.4$

$\therefore \frac{x}{y} = \frac{1}{2}$

Hence, the organic compound is C_4H_8 is in ratio 1:2

719. In a compound C, H and N are present in 9 : 1 : 3.5 by weight. If molecular weight of the compound is 108, then the molecular formula of the compound is

(a) $C_2H_6N_2$ (b) C_3H_4N

(c) $C_6H_8N_2$ (d) $C_9H_{12}N_3$

UP CPMT-2006

@apna_pdf

Ans. (c) : Molecular weight of compound = 108

C	H	N
9	1	3.5
$\frac{9}{12}=0.75$	$\frac{1}{1}=1$	$\frac{3.5}{14}=0.25$
$\frac{0.75}{0.25}=3$	$\frac{1}{0.25}=4$	$\frac{0.25}{0.25}=1$

So, empirical formula = C_3H_4N

Molecular weight of C_3H_4N = 54

$$\Rightarrow \quad n=\frac{108}{54}=2$$

$\therefore$ Molecular formula = $(C_3H_4N)_2$
= $C_6H_8N_2$

720. Equal moles of water and urea are taken in a flask. What is mass percentage of urea in the solution?

(a) 23.077% (b) 230.77%
(c) 2.3077% (d) 0.23077%

UPTU/UPSEE-2006

Ans. (a) : If H_2O = x mol = 18x g

Then urea = x mol = 60x g

Total mass of the solution = 18x + 60x = 78x g

Mass % of urea = $\frac{18x}{78x}\times100=23.077\%$

721. 4g of hydrogen (C_xH_y) on complete combustion gave 12g of CO_2. What is the empirical formula of the hydrocarbon? (C = 12, H = 1)

(a) CH_3 (b) C_4H_9
(c) CH (d) C_3H_8

AP-EAMCET (Engg.)-2005

Ans. (d) : $C_xH_y+\left(x+\frac{y}{4}\right)O_2\rightarrow xCO_2+\frac{y}{2}H_2O$

1 mole of C_xH_y gives x moles of CO_2.

Given:- $\frac{4}{12x+y}$ mole of C_xH_y gives $\frac{12}{44}$ moles of CO_2.

$$\therefore \quad \frac{4x}{12x+y}=\frac{12}{44}$$

$$\Rightarrow \quad \frac{x}{12x+y}=\frac{3}{44}$$

$$44x = 36x + 3y$$

$$8x = 3y$$

$$\Rightarrow \quad \boxed{\frac{x}{y}=\frac{3}{8}}$$

The empirical formula of the hydrocarbon is C_3H_8.

722. Dry air is passed through a solution containing 10 g of a solute in 90 g of water and then through pure water. The loss in weight of solution is 2.5 g and that of pure solvent of 0.05 g. Calculate the molecular weight of the solute.

(a) 50 (b) 180
(c) 100 (d) 25
(e) 51

Kerala-CEE-2005

Ans. (c) :

Loss of weight of the solution = V.P of solution

Loss of weight of the solvent ∝ P^O-P_S

$$\therefore \frac{P^o-P_s}{P_s}=\frac{\text{Loss in weight of solvent}}{\text{Loss in weight of solution}}$$

$$\frac{\frac{W_2}{M_2}}{\frac{W_1}{M_1}}=\frac{W_2M_1}{W_1M_2}\Rightarrow\frac{0.05}{2.5}=\frac{\frac{10}{M_2}}{\frac{90}{18}}=\frac{2}{M_2}$$

M_2 = 100g/mol

723. The molecular formula of potash alum is

(a) $KAl_2S_4H_{48}O_{40}$ (b) $K_2Al_2S_4H_{48}O_{39}$
(c) $K_2Al_2S_4H_{48}O_{40}$ (d) $KAl_2S_4H_{48}O_{40}$

AP EAMCET- 2004

Ans. (c) : Potash alum is a double salt of potassium sulphate and aluminium sulphate.

$K_2SO_4.\ Al_2(SO_4)_3\cdot 24H_2O$ or $K_2Al_2S_4H_{48}O_{40}$.

724. Study the following table

	Compound (molecular wt.) (in g) taken	Weight of compound
I.	CO_2 (44)	4.4
II.	NO_2 (46)	2.3
III.	H_2O_2 (34)	6.8
IV.	SO_2 (64)	1.6

Which two compounds have least weight of oxygen ? (molecular weights of compounds are given in brackets)

(a) II and IV (b) I and III
(c) I and II (d) III and IV

AP-EAMCET (Engg.)-2004

Ans. (a) : (I) Mass of oxygen present in CO_2 $=\frac{4.4\times32}{44}=3.2\,g$

(II) Mass of oxygen present in NO_2 $=\frac{2.3}{46}\times32=1.6\,g$

(III) Mass of oxygen present in H_2O_2 $=\frac{6.8}{34}\times32=6.4\,g$

(IV) Mass of oxygen present in SO_2 $=\frac{1.6}{64}\times32=0.8\,g$

$\therefore$ II and IV have least mass of oxygen.

725. A compound contains 54.55% carbon, 9.09% hydrogen, 36.36% oxygen. The empirical formula of this compound is

(a) C_3H_5O (b) $C_4H_8O_2$
(c) $C_2H_4O_2$ (d) C_2H_4O

UPTU/UPSEE-2004

Ans. (d) :

Element	%comp.	moles	Ratio moles
C	54.55	$54.55/12=4.54$	$4.54/2.27\approx2$
H	9.09	$9.09/1=9.09$	$9.09/2.27\approx4$
O	36.36	$36.36/16=2.27$	$2.27/2.27=1$

C : H : O = 2 : 4 : 1

$\therefore$ Empirical formula is C_2H_4O.

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726. A petroleum fraction having boiling range 70-200°C and containing 6-10 carbon atoms per molecule is called:

(a) Natural gas (b) Gas oil
(c) Gasoline (d) Kerosene

UPTU/UPSEE-2004

Ans. (c) : $(70^o - 200^oC)$ $(C_6 - C_{10})$ = Gasoline
$(200^oC - 275^oC)$ $(C_{10} - C_{16})$ = Kerosene
$(250^oC - 400^oC)$ $(C_{17} - C_{20})$ = fuel oil or gas oil
$> 400^oC$ lubricating oil.
So, a petroleum fraction having boiling range to – 200^oC and containing 6–10 carbon atoms per molecule is called gasoline.

727. 0.078 g of hydrocarbon occupy 22.144 mL off volume at STP. The empirical formula of the hydrocarbon is CH. The molecular formula of the hydrocarbon is :

(a) C_2H_2 (b) C_6H_6
(c) C_8H_8 (d) C_4H_4

AP-EAMCET (Medical), 2002

Ans. (b) : 22.414 mL of gaseous hydrocarbon at S.T.P. has mass = 0.078 g.
22414 mL of gaseous hydrocarbon at STP will have mass $= \frac{0.078}{22.4} \times 22400\text{g} = 78\text{g}$.
$\therefore$ Molar mass of hydrocarbon = 78 g mol^{-1}
Empirical formula mass of hydrocarbon (CH) = 12 + 1 = 13

$$\therefore \quad n = \frac{\text{Molecular mass}}{\text{Empirical formula Mass}} = \frac{78}{13} = 6$$

$\therefore$ Molecular formula of hydrocarbon = $(CH)_6$ = C_6H_6 (Benzene).

728. In an organic compound of molar mass 108 g mol^{-1} C, H and N atoms are present in 9 : 1 : 3.5 by weight. Molecular formula can be

(a) $C_6H_8N_2$ (b) $C_7H_{10}N$
(c) $C_5H_5N_3$ (d) $C_4H_{18}N_3$

[AIEEE-2002]

Ans. (a): Given,
Molar mass= 108g/mol.
Total part by weigh = 9+1+3.5=13.5

Weight of carbon $= \frac{9}{13.5} \times 108 = 72\text{g}$

Number of carbon atoms$= \frac{72}{12} = 6$

Weight of hydrogen $= \frac{1}{13.5} \times 108 = 8\text{g}$

Number of hydrogen atoms $= \frac{8}{1} = 8$

Weight of nitrogen $= \frac{3.5}{13.5} \times 108 = 28\text{g}$

Number of nitrogen atom$= \frac{28}{14} = 2$

The mole ratio C:H:M = 6:8:2
The molecular formula is $C_6H_8N_2$

729. A compound is 60g on analysis produce carbon, hydrogen and oxygen 24g, 4g and 32g respectively. The empirical formula is

(a) $C_2H_2O_2$ (b) $C_2H_4O_2$
(c) CH_2O (d) $C_2H_4O_6$

UP CPMT-2002

Ans. (c) :

Element	Analysis produce	% of element	Relative number
C	24	$\frac{24}{60} \times 100 = 40\%$	$\frac{40}{12} = 3.33 = 1$
H	4	$\frac{4}{60} \times 100 = 6.66\%$	$\frac{6.66}{1} = 6.66 = 2$
N	32	$\frac{32}{60} \times 100 = 53.33\%$	$\frac{53.33}{14} = 3.33 = 1$

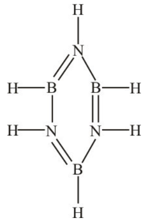
Hence, the empirical formula is CH_2O.

730. What is the molecular formula of borazole?

(a) B_2H_6 (b) $B_6N_6H_6$
(c) $B_3N_3H_6$ (d) $B_3N_3H_3$

AP EAMCET- 2001

Ans. (c) : Borazine, also known as **borazole**, is a polar inorganic compound with the chemical formula $B_3N_3H_6$.



• B_2H_6 is the molecular formula of diborane.

731. Percentage of Se in peroxidase anhydrous enzyme is 0.5% by weight (at wt. = 78.4) then minimum molecules weight of peroxidase anhydrous enzyme is

(a) 1.568×10^4 (b) 1.568×10^3
(c) 15.68 (d) 2.136×10^4

NEET-2001

Ans. (a) : Since, 0.5g Se = 100 gm peroxidase anhydrous enzyme

$$78.4\text{g Se} = \frac{100 \times 78.4}{0.5} = 1.568 \times 10^4$$

Minimum molecular mass of peroxidase anhydrous enzyme means molecule atleast contains one selenium atom.

732. What is the molecular formula of gypsum?

(a) $CaSO_4.H_2O$ (b) $CaSO_4.2H_2O$
(c) $2CaSO_4.H_2O$ (d) $CaSO_4.3H_2O$

AP EAMCET- 2000

Ans. (b) : Gypsum is a soft sulfate mineral composed of calcium sulfate dihydrate, with the chemical formula $CaSO_4.2H_2O$. The major use of Gypsum are in the cement industries.

733. What is the molecular formula of white phosphorus?

(a) P_2 (b) P_4
(c) P_5 (d) P_{16}

AP EAMCET- 2000

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Ans. (b) : The molecular formula of white phosphorus is P_4. P_4 is very poisonous and explosive. It is used as reagent to prepare the phosphene gas (PH_3).

734. The empirical formula of a compound is CH_2O. Its molecular weight is 180. The molecular formula of compounds is:

(a) $C_2H_4O_2$ (b) $C_3H_6O_3$
(c) $C_6H_{12}O_6$ (d) $C_5H_{10}O_5$

AIIMS-1999

Ans. (c): Given,
Molecular formula weight = 180
Empirical formula weight of CH_2O is = 12+2+16=30
We know that,

$$n = \frac{\text{Molecular formula weight}}{\text{Emperical formula weight}} = \frac{180}{30} = 6$$

Molecular formula = $6\times CH_2O$
= $C_6H_{12}O_6$
Therefore, Molecular formula of compound is $C_6H_{12}O_6$

735. 60g of an organic compound on analysis is found to have, C=24 g, H=4 g and O=32g. The empirical formula of compound is:

(a) CH_2O (b) C_2H_4O
(c) C_2H_2O (d) $C_2H_2O_2$

AIIMS-1998

Ans. (a): Given, Organic compound = 60g
Mass of C = 24 g, mass of H = 4g , mass of O=32g
The ratio of number of gram atoms

$$C : H : O$$

$$\frac{24}{12} : \frac{4}{1} : \frac{32}{16}$$

$$2 : 4 : 2$$

The Empirical formula is = $C_2H_4O_2 = CH_2O$

736. The percentage of oxygen in NaOH is

(a) 16% (b) 4%
(c) 40% (d) 8%

AIIMS-1996

Ans. (c): Given that,
Molar mass of sodium atom = 23
Molar mass of oxygen atom = 16
Molar mass of hydrogen atom = 1
Total molar mass of NaOH = 40

$$\% \text{ composition of oxygen } = \frac{\text{Mass of oxygen}}{\text{Mass of NaOH}}\times 100$$

$$= \frac{16}{40}\times 100$$

= 40 %

737. The mole percentage of oxygen in a mixture of 7.0 g of nitrogen and 8.0 g of oxygen is

(a) 8 (b) 16
(c) 24 (d) 50

A-P EAMCET-1995

Ans. (d) : Given,
mass of O_2 = 8 gm

$$\therefore \text{ No. of moles of } O_2 = \frac{8}{32} = 0.25 \text{ mole}$$

and mass of N_2 = 7 gm

$$\text{No. of moles of } N_2 = \frac{7}{28} = 0.25$$

$$\text{Since, mole percentage of oxygen } = \frac{0.25}{0.25+0.25}\times 100$$

$$= \frac{25}{50}\times 100$$

= 50%

738. Which of the following fertilizers has the highest nitrogen percentage?

(a) Ammonium sulphate (b) Calcium cyanamide
(c) Urea (d) Ammonium nitrate

NEET-1993

Ans. (c):
(a) Mass of N in $(NH_4)_2$ SO_4 = 28 g
Mass of $(NH_4)_2$ SO_4 = 132 g

$$\% \text{ of N in } (NH_4)_2 SO_4 = \frac{28}{132}\times 100 = 21.2\%$$

(b) Mass of N in $CaCN_2$ = 28 g.
Mass of $CaCN_2$ = 80 g

$$\% \text{ of N} = \frac{28}{80}\times 100 = 35\%$$

(c) Mass of N in NH_2 $CONH_2$ = 28 g
Mass of NH_2CONH_2 = 60 g

$$\% \text{ of N} = \frac{28}{60}\times 100 = 46.6\%$$

(d) Mass of N in NH_4NO_3 = 28 g
Mass of NH_4NO_3 = 80g

$$\% \text{ of N} = \frac{28}{80}\times 100 = 35\%$$

739. An organic compound having carbon, hydrogen and sulphur contains 4% of sulphur. The minimum molecular weight of the compound is

(a) 200 (b) 400
(c) 600 (d) 800

VITEEE 2015

Ans. (d) : The minimum molecular weight must contain at least one S atom.

$$\therefore \ \% S = \frac{\text{weight of one S} - \text{atom}}{\text{minimum m. wt.}}\times 100$$

$$4 = \frac{32}{\text{minimum m. wt.}}\times 100 \qquad (\because 4\% \text{ of S})$$

$$\text{minimum m. wt.} = \frac{32\times 100}{4} = 800 \text{ g mol}^{-1}.$$

740. Caffeine has a molecular weight of 194 u. If it contains 28.9% by mass of nitrogen, number of atom of nitrogen in one molecule of caffeine is

(a) 4 (b) 6
(c) 2 (d) 3

VITEEE 2015

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Ans. (a) : Given that,

Molecular weight of Caffeine = 194 amu

∵ % of N present in one molecule of caffeine is 28.9%.

$$\therefore \text{ Mass of nitrogen in } 194\text{amu} = \frac{28.9}{100} \times 194 = 56\,\text{amu}$$

$$\text{Mass of 1N atom} = 14\text{m} \quad (\because 14\text{m} = 14\,\text{u})$$

$$\therefore \text{ One molecule of caffeine} = \frac{56}{14} = 4 \text{ atoms of nitrogen}$$

6. Stoichiometry Calculation

741. An organic compound has an empirical formula CH_2O. Its vapour density is 45. The molecular formula of compound is

(a) CH_2O (b) C_2H_5O

(c) $C_2H_4O_2$ (d) $C_3H_6O_3$

A.P.EAMCET-1995, 1991

Ans. (d) : Given that,

Vapour density = 45

∴ Molecular weight = 2 × vapour density

= 2 × 45 = 90

Hence, Empirical formula weight (CH_2O)

= 12 + 2 + 16 = 30

$$\text{No. of mole (n)} = \frac{\text{Molecular weight}}{\text{Empirical weight}}$$

$$n = \frac{90}{30} = 3 \text{ mole}$$

∴ Molecular formula = n × empirical formula

= 3 × CH_2O

= $C_3H_6O_3$

742. An organic compound containing C,H and N gives the following on analysis :C=40%, H= 13.33% and N=46.67%. What would be its empirical formula?

(a) C_2H_7N (b) $C_2H_7N_2$

(c) CH_4N (d) CH_3N

CG PET- 2012, 2006

Ans. (c): C : H : N

$$\frac{40}{12} : \frac{13.33}{1} : \frac{46.67}{14} \quad \text{(dividing by wt.)}$$

= 3.33 : 13.33 : 3.33

$$= \frac{3.33}{3.33} : \frac{13.33}{3.33} : \frac{3.33}{3.33} \quad \text{(dividing by smallest quotient)}$$

= 1 : 4 : 1

∴ Empirical formula = CH_4N

743. If one atom of an element X weighs 6.643×10^{-23} g. Then find the number of moles of atoms in 50 kg of element X.

(a) 500 moles (b) 125 moles

(c) 1250 moles (d) 50 moles

AP EAPCET 23-08-2021 Shift-I

Ans. (c) : Given, atomic weight of an element

$= 6.643\times10^{-23}\ N_A$

$= 6.643\times10^{-23} \times 6.022\times10^{23}$

= 40

$$\text{No. of moles} = \frac{\text{Weight}}{\text{Molecular weight}}$$

$$= \frac{50\times1000}{40}$$

= 1250 moles.

744. In a non-stoichiometric sample of cuprous sulphide. With the composition $Cu_{1.8}S$. Cupric ions are also present in the lattice. What mole percent of Cu^{2+} is present in the copper content of the crystal?

(a) 99.99% (b) 11.11%

(c) 88.88 % (d) 18%

AP EAPCET-6 Sep. 2021, Shift-II

Ans. (b) : Given that, Non-Stoichiometric sample of cuprous sulphide

$$Cu_{1.8}S \left\{ \begin{array}{l} 10\times2=20\ (-\text{ve})\ \text{charge} \\ 18\times1=18\ (+\text{ve})\ \text{charge} \end{array} \right.$$

$$\Rightarrow 2Cu^{2+}\text{ions} = \frac{2}{18}\times100 = \frac{1}{a}\times100$$

$$= 11.11\%$$

$$= 16\ Cu^{+}\text{ions} = \frac{16}{18}\times100$$

$$= \frac{8}{4}\times100 = 88.89\%$$

Hence, 11.11% of Cu^{2+} is present in the copper content of the crystal.

745. For the reaction: $NH_3 + OCl^- \longrightarrow N_2H_4 + Cl^-$ in basic medium, the coefficients of NH_3, OCl^- and N_2H_4 for the balanced equation are respectively

(a) 2, 2, 2 (b) 2, 2, 1

(c) 2, 1, 1 (d) 4, 4, 2

BITSAT-2021

Ans. (c) : For ammonia

$2NH_3 \rightarrow N_2H_4 + 2H^+ + 2e^-$ (Basic medium) ...(i)

For OCl^-

$OCl^- + 2H^+ + 2e^- \rightarrow Cl^- + H_2O$ ...(ii)

Adding both equation (i) and (ii)

$2NH_3 + OCl^- \rightarrow N_2H_4 + Cl^- + H_2O$

Co-efficients of NH_3, ClO^- and N_2H_4 are 2, 1 and 1.

746. A pure compound contains 2.4 g of C, 1.2×10^{-23} atoms of H, 0.2 moles of oxygen atoms. Its empirical formula is

(a) C_2HO (b) $C_2H_2O_2$

(c) CH_2O (d) CHO

Kerala-CEE-29.08.2021

Ans. (d) : Convert each element into number of moles.

$$\text{Moles of carbon} = \frac{2.4}{12} = 0.2$$

$$\text{Moles of hydrogen} = \frac{1.2\times10^{23}}{6.023\times10^{23}} = 0.199$$

Moles of oxygen = 0.2

Empirical formula is CHO.

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747. **Calculate the amount of CO_2 gas produced, when 32 g moles of CH_4 is burned with sufficient amount of oxygen. (Given, atomic weights of C = 12, O = 16, H = 1)**

(a) 132 g (b) 44 g
(c) 88 g (d) 176 g

AP EAMCET (Engg.) 18.09.2020, Shift-I

Ans. (c) : $\underset{\substack{1\text{mol}\\16\text{g}\\32\text{g}}}{CH_4}+2O_2 \rightarrow \underset{\substack{1\text{mol}\\44\text{g}\\88\text{g}}}{CO_2}+2H_2O$

$\rightarrow$

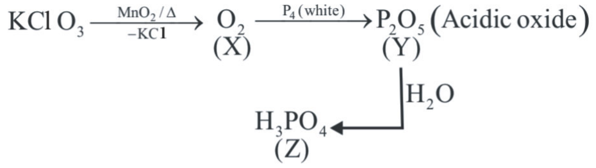
Hence, 88g CO_2 gas produced.

748. **Gas 'X' is obtained on heating $KClO_3$ with catalyst MnO_2. This gas (in excess) on reaction with white phosphorus forms as acidic oxide 'Y'. 'Y' on dissolving in water forms a compound 'Z'. Identify X, Y and Z.**

(a) O_2, P_2O_5, H_3PO_4 (b) O_3, P_2O_5, H_3PO_4
(c) O_2, P_2O_3, H_3PO_3 (d) O_2, P_2O_5, H_3PO_3

AP EAMCET (Engg.) 18.09.2020, Shift-I

Ans. (a) :



$$2KClO_3 \xrightarrow[\Delta]{MnO_2} 2KCl + 3O_2$$

$$P_4 + 5O_2 \rightarrow 2P_2O_5$$

$$P_2O_5 + 3H_2O \rightarrow 2H_3PO_4$$

749. **What are the fractions of Fe^{2+} and Fe^{3+} in $Fe_{0.93}O$ respectively?**

(a) 0.93, 0.07 (b) 0.85, 0.15
(c) 0.75, 0.25 (d) 0.80, 0.20

GUJCET-2020

Ans. (b) : Let Fe^{2+} = x & Fe^{3+} = (0.93 – x)
By charge conservation
$+ 2 (x) + 3(0.93 – x) – 2(1) = 0$
$–x + 0.79 = 0$
$\Rightarrow x = 0.79$

Fraction of $Fe^{2+} = \frac{0.79}{0.93} = 0.85$

Fraction of Fe^{3+} = (1 – 0.85) = 0.15

750. **Consider the following equations:**

$2Fe^{2+} + H_2O_2 \rightarrow x\,A + yB$
(in basic medium)

$2MnO_4^- + 6H^+ + 5H_2O_2 \rightarrow x'\,C + y'\,D + z'E$
(in acidic medium)

The sum of the stoichiometric coefficients x, y, x', y' and z' for products A, B, C, and E, respectively, is..........

[JEE Main 2020, 4 Sep, Shift-II]

Ans. (19) :
$2Fe^{2+} + H_2O_2 \rightarrow xA + yB \rightarrow 2Fe^{3+} + 2OH^-$
$2\,MnO_4^- + 6H^+ + 5H_2O_2 \rightarrow x'C + y'D + z'E \rightarrow 2Mn^{+2} + 5O_2 + 8H_2O$
x = 2; y = 2, x' = 2, y' = 5, z' = 8
2 + 2 + 2 + 5 + 8 = 19

751. **An organic compound contains 24% carbon, 4% hydrogen and remaining chlorine. Its empirical formula is**

(a) CHCl (b) CH_2Cl
(c) $CHCl_2$ (d) CH_2Cl
(e) CH_2Cl_2

Kerala-CEE-2020

Ans. (d) : Given C = 24%
H = 4%
Cl = 100 – (24 + 4)
= 100 – 28 = 72%

Element	%	Ratio	Simplified
C	24%	24/12	2
H	4%	4/1	4
Cl	72%	72/35.5	2.02 ≈ 2

The, empirical formula = $C_2H_4Cl_2$ or CH_2Cl

752. **The amount of calcium carbonate that reacts with 500 cc of 0.5 N hydrochloric acid is**

(a) 150 g (b) 125 g
(c) 12.5 g (d) 100g

COMEDK-2019

Ans. (c) : We know that

$$N = \frac{w \times 1000}{eq.wt \times V(in\,cc)}$$

Mass of HCl in 500 cc of 0.5 N HCl;

$$\Rightarrow w = \frac{0.5 \times 36.5 \times 500}{1000}$$

= 9.125g

The balanced equation for the reaction is

$$\underset{100g}{CaCO_3} + \underset{2\times36.5g}{2HCl} \longrightarrow CaCl_2 + H_2O + CO_2$$

2×36.5 g of HCl react with 100 g of $CaCO_3$

$\therefore$ 9.125 g of HCl will react with $\frac{100 \times 9.125}{2 \times 36.5}$ g of $CaCO_3$

=12.5 g of $CaCO_3$

753. **Pink colour of non-stoichiometric LiCl is due to**

(a) Cl^- ion in the lattice
(b) Li^+ ion in the lattice
(c) electrons in the lattice
(d) Both the ions in the lattice

CG PET -2018

Ans. (c): Metal excess defect caused due to anion vacancies is responsible for the pink colour of LiCl. When LiCl is heated, Li atoms gets deposited on the surface of the crystal. The Cl^- ions diffuse into the surface and combine with Li atoms to give LiCl. This is because of loss of electrons Li atoms to forms Li^+. The released electrons diffuse excess into crystal and occupy anionic sites. As a result, there is an excess of Li. The anionic sites occupied by unpaired electrons imparts a pink color to LiCl crystals.

754. **5 g of $CaCO_3$ completely reacts with**

(a) 36.5 g of HCl (b) 3.65 g of HCl
(c) 0.36 g of HCl (d) 7. 30 g of HCl

COMEDK-2016

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Ans. (b) : The balanced equation for the reaction is:

$$\underset{100g}{CaCO_3}+\underset{2\times36.5g}{2HCl}\longrightarrow CaCl_2+CO_2+H_2O$$

From the above equation,

100 g of $CaCO_3$ reacts completely with 73 g of HCl So, 5 g of $CaCO_3$ will react with

$$\frac{73}{100}\times 5g \text{ of HCl}= 3.65 \text{ g of HCl}$$

755. The mass of oxygen gas which occupies 5.6 litres at STP would be

(a) the gram atomic mass of oxygen
(b) one-fourth of the gram atomic mass of oxygen
(c) double the gram atomic mass of oxyen
(d) half of the gram atomic mass of oxygen.

COMEDK-2015

Ans. (d) : 32 g of oxygen at STP occupies = 22.4 L

5.6 L of oxygen at STP occupies

$$=\frac{32}{22.4}\times 5.6 = 8 \text{ g of oxygen}$$

$$=\frac{1}{2}\times \text{Gram atomic mass of oxygen}$$

756. 20 mL of acetic acid reacts with 20 mL of ethyl alcohol to form ethyl acetate. The density of acid and alcohol are 1 g/mL and 0.7g/mL respectively. The limiting reagent in this reaction is

(a) acetic acid
(b) ethyl alcohol
(c) acetic acid and ethyl alcohol
(d) ester.

COMEDK-2015

Ans. (b) : Mass of 20 mL of acetic acid = 20 ×1= 20 g

Mass of 20 mL of ethyl alcohol = 20 ×0.7 = 14 g

$$\underset{60g}{CH_3COOH}+\underset{46g}{C_2H_5OH}\xrightarrow[-H_2O]{}CH_3COOC_2H_5$$

60 g of acetic acid= 46 g of ethyl alcohol

20 g of acetic acid= 15.3g of ethyl alcohol

Therefore, ethyl alcohol is the limiting reagent.

757. A gas 'X' is dissolved in water at 2 bar pressure. Its mole fraction is 0.02 in solution. The mole fraction of water when the pressure of gas is doubled at the same temperature is :

(a) 0.04 (b) 0.98
(c) 0.96 (d) 0.02

AP-EAMCET (Engg.)-2015

Ans. (c) : Given that, $P_1 = 2$ bar

$P_2 = 2 \times 2 = 4$ bar, $X_1 = 0.02$

∵ We know that

$$\frac{P_1}{P_2}=\frac{X_1}{X_2}$$

Putting the value, we get–

$$\frac{2}{4}=\frac{0.02}{X_2}$$

$X_2 = 0.04$

Therefore, In solution, $X_{solute} + X_{solvent} = 1$

$0.04 + X_{solvent} = 1$

or $X_{solvent} = 1 – 0.04 = 0.96$

758. A metal oxide has the empirical formula, $M_{0.96}O_{1.00}$. What will be the percentage of M^{2+} ions in the crystal?

(a) 90.67 (b) 91.67
(c) 8.33 (d) 9.33

AMU-2015

Ans. (b) : $M_{0.96}$ $O_{1.00}$ may contains M^{2+}, M^{3+} ions.

Amount of M^{2+} ions in crystals = x

Amount of M^{3+} ions will be = 0.96 – x

We know that negative and positive ions are equal.

∴ $2x + 3(0.96 – x) = 2$

$2x + 3 (0.96 – x) – 2 = 0$

$2x + 2.88 – 3x – 2 = 0$

$0.88 – x = 0$

⇒ $x = 0.88$

$$\% \text{ of } M^{2+} \text{ ions in the crystal} = \frac{0.88}{0.96}\times 100 = 91.67\%$$

759. If NaCl is doped with 10^{-3} mol% of $SrCl_2$, the number of cation vacancies will be

(a) 6.023×10^{18} (b) 1×10^{-3}
(c) 6×10^{12} (d) 6.023×10^{23}

CG PET- 2015

Ans. (a): 1 cation of Sr^{2+} will create 1 cation vacancy in NaCl. Therefore, the number of cation vacancy created in the lattice of NaCl is equal to the number of divalent Sr^{2+} ions added.

Concentration of cation vacancy on being doped with 10^{-3} mol% of $SrCl_2$.

$= 10^{-3}$ mol% $= 10^{-3}/100 = 10^{-5}$ mol

$= 10^{-5} \times 6.023 \times 10^{23} = 6.023 \times10^{18}$

Therefore, Number of cation vacancies = 6.023×10^{18}

760. 20.0 g of magnesium carbonate sample decomposes on heating to give carbon dioxide and 8.0 g magnesium oxide. What will be the percentage purity of magnesium carbonate in the sample?

(At. wt. of Mg = 24)

(a) 96 (b) 60
(c) 84 (d) 75

NEET-2015

Ans. (c) : $MgCO_3(s)\xrightarrow{\Delta}MgO(s)+CO_2(g)$

Molar mass of $MgCO_3$ = 24 +12 + 48 = 84g/mol

Molar mass of MgO = 24 + 16 = 40g/mol

∴ 84g of $MgCO_3$ ≡ 40g of MgO

$$\text{And } 20g \text{ of } MgCO_3 \equiv \frac{40}{84}\times 20 = 9.52 \text{ g of MgO}$$

But actual yield = 8g of MgO

$$\therefore \% \text{ purity} = \frac{8}{9.52}\times 100 = 84\%$$

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761. Experimentally, it was found that a metal oxide has formula $M_{0.98}O$. Metal M, present as M^{2+} and M^{3+} in its oxide. Fraction of the metal which exists as M^{3+} would be

(a) 7.01% (b) 4.08%
(c) 6.05% (d) 5.08%

[JEE Main-2013]

Ans. (b) : Given,
Metal oxide = $M_{0.98}O$
Consider one mole of the oxide.
Moles of M = 0.98 mole of O^{2-}=1
Let
Moles of M^{3+}= x
Moles of M^{2+}= 0.98–x
On balancing charge,
(0.98–x)×2+ 3x–2=0
1.96–2x+3x–2=0
X=0.04

$$\% \text{ of } M^{3+} = \frac{0.04}{0.98}\times 100 = 4.08\%$$

762. The number of moles of electrons required to deposit 36g of Al from an aqueous solution of $Al(NO_3)_3$ is (At. wt. of Al = 27)

(a) 4 (b) 2
(c) 3 (d) 1

AP EAMCET (Engg.) - 2012

Ans. (a): Mass of Al in 1 mol of Al $(NO_3)_3$ is the 27g. For 1 mole of Al (27g), 3 mole of electrons are required to deposit 27g of Al.
As 3 mole of electrons required to deposit → 27g of Al

$$\text{So, for } 36g \rightarrow 36\times\frac{3}{27} = \frac{36}{9} = 4\,\text{moles}$$

763. 100 mL of N/5 HCI was added to 1g of pure $CaCO_3$. What would remain after the reaction?

(a) 0.5 g of $CaCO_3$
(b) Neither $CaCO_3$ nor HCl
(c) 50 mL of HCl
(d) 25 mL of HCl

COMEDK-2012

Ans. (b) : ∵ Molar Mass of $CaCO_3 = 100\,g\,mol^{-1}$

$$\therefore \text{No. of moles of } CaCO_3 = \frac{w}{M} = \frac{1}{100} = 0.01\text{ mol}$$

Now, molarity of 100 mL of N/5 HCl=$\frac{100}{1000}\times\frac{1}{5} = 0.02\,\text{mol}$

Thus, the reaction can be represented as :

$$CaCO_3 + 2HCl \longrightarrow CaCl_2 + CO_2 + H_2O$$

∵ 1 mole of $CaCO_3$ reacts with 2 moles of HCl.

Hence, 0.01 mole of $CaCO_3$ will react completely with 0.02 mole of HCl and neither $CaCO_3$ nor HCl would remained after the reaction.

764. 12 g of Mg with excess of HCl at NTP gives

(a) 11.2 dm^3 of H_2 (b) 22.4 dm^3 of H_2
(c) 5.6 dm^3 of H_2 (d) 15.6 dm^3 of H_2

COMEDK-2011

Ans. (a) : $\underset{(24g)}{Mg} + 2HCl \rightarrow MgCl_2 + \underset{(2g\,or\,22.4\,dm^3)}{H_2}$

Thus, 12 g of Mg produces = 1g or 11.2 dm^3 H_2 at NTP.

765. The reaction of calcium with water is represented by the equation:

$$Ca + 2H_2O \rightarrow Ca(OH)_2 + H_2$$

What volume of H_2 at STP would be liberated when 8 g of calcium completely reacts with water?

(a) 0.2cm^3 (b) 0.4cm^3
(c) 2240cm^3 (d) 4480cm^3

AIIMS-2010

Ans. (d): $Ca + 2H_2O \rightarrow Ca(OH)_2 + H_2$
40 gm of Ca on complete reaction with water liberates = 2 gm H_2
∴ 8 gm of Ca, on complete reaction with water will liberates = $\frac{2}{40}\times 8\,gm\ H_2 = 0.40\ gm\ H_2$
At STP, 2g of H_2 have the volume = 22.4 litre = 22400 cm^3

$$\therefore 0.40 \text{ gm of } H_2 \text{ having} = \frac{0.40}{2}\times 22400\,cm^3$$

= 4480 cm^3 of H_2 at S.T.P.

766. The vapour of a substance effuses through a small hole at the rate of 1.3 times faster than SO_2 gas at 1 atm pressure and 500 K. The molecular weight of the gas is

(a) 49.2 (b) 37.9
(c) 41.6 (d) 83.2

AP - EAMCET(Medical)-2009

Ans. (b) : Given that,
$r_1 = 1.3$ $M_1 = ?$
$r_{so_2} = 1$ $M_{so_2} = 64$
From Graham's law–

$$\frac{r_1}{r_{so_2}} = \sqrt{\frac{M_{so_2}}{M_1}}$$

$$\frac{1.3}{1} = \sqrt{\frac{64}{M_1}}$$

or $M_1 = 37.86$
or $M_1 \approx 37.9$

767. The ratio of moles of hydrogen produced when two moles of aluminium react with excess HCl and NaOH separately is

(a) 1 : 1 (b) 1 : 2
(c) 2 : 1 (d) 3 : 2

AP - EAMCET(Medical)-2009

Ans. (a) : The following reactions occurred during the process–

$$2Al + 6HCl \rightarrow 2AlCl_3 + 3H_2\uparrow$$

$$2Al + 2NaOH + 2H_2O \rightarrow 2NaAlO_2 + 3H_2\uparrow$$

∴ The ratio of moles of hydrogen = 3 : 3 = 1 : 1

768. During electrolysis of water the volume of O_2 liberated is 2.24 dm^3. The volume of hydrogen liberated, under same conditions will be

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(a) 2.24 dm^3 (b) 1.12 dm^3
(c) 4.48 dm^3 (d) 0.56 dm^3

AIIMS-2008

Ans. (c) : $\underset{2\,Vol.}{2H_2O} \xrightarrow{\text{Electrolysis}} \underset{2\,Vol.}{2H_2} + \underset{1\,Vol.}{O_2}$

The volume of hydrogen liberated is twice that of the volume of oxygen liberated. When 2.24 dm^3 of oxygen is liberated the volume of hydrogen liberated will be 2 × 2.24 dm^3 or 4.48 dm^3.

769. The stoichiometry of the following reaction is $K_2S_2O_8(aq) + 2KI(aq) \rightarrow 2K_2SO_4(aq) + I_2(aq)$

(a) 2 : 2 (b) 1 : 1
(c) 1 : 2 (d) 2 : 1

J & K CET-(2008)

Ans. (c) : $K_2S_2O_8(aq) + 2KI\ (aq) \rightarrow 2K_2SO_4\ (aq) + I_2(aq)$

In the reaction one mole of $K_2S_2O_8$ reacts with 2 moles of KI, so the stoichiometry of this reaction is 1 : 2.

770. 64 g of an organic compound contains 24 g of carbon, 8 g of hydrogen and the rest oxygen. The empirical formula of the compound is

(a) CH_2O (b) C_2H_4O
(c) CH_4O (d) $C_2H_8O_2$

CG PET-2007

Ans. (c) : Mass of oxygen = 64 – 24 – 8 = 32

Element	**Mole ratio**	**Simple ratio**
C	$\frac{24}{12} = 2$	$\frac{2}{2} = 1$
H	$\frac{8}{1} = 8$	$\frac{8}{2} = 4$
O	$\frac{32}{16} = 2$	$\frac{2}{2} = 1$

Empirical formula is CH_4O.

771. What is the stoichiometric coefficient of Ca in the reaction?

$$Ca + Al^{3+} \rightarrow Ca^{2+} + Al$$

(a) 2 (b) 1
(c) 3 (d) 4

UP CPMT-2007

Ans. (c) : $Ca \rightarrow Ca^{2+} + 2e^-$ ……(i)

$Al^{3+} + 3e^- \rightarrow Al$ …...(ii)

Eq. (i) multiply by 3 and Eq. (ii) multiply by 2, and add Eqs. (i) and (ii)

$3Ca \rightarrow 3\,Ca^{2+} + 6e^-$

$2Al^{3+} + 6e^- \rightarrow 2Al$

$3Ca + 2Al^{3+} \rightarrow 3Ca^{2+} + 2Al$

Therefore, the stoichiometric coefficient of Ca in the given reaction is 3.

772. Value of x in potash alum, $K_2SO_4.Al_x\ (SO_4)_3 \cdot 24H_2O$ is

(a) 4 (b) 1
(c) 2 (d) None of these

UP CPMT-2007

Ans. (c) : Potash alum is double salt.

Given Potash alum, $K_2SO_4 \cdot Al_x(SO_4)_3 \cdot 24H_2O$ ... (1)

But formula of potash alum is

$K_2SO_4 \cdot Al_2(SO_4)_3 \cdot 24H_2O$ ... (2)

After comparing both equations,

Value of x = 2

773. The number of molecules of CO_2 present in 44g of CO_2 is :

(a) 6.0×10^{23} (b) 3×10^{23}
(c) 12×10^{23} (d) 3×10^{10}

BCECE-2005

Ans. (a) : Given mass of CO_2, W = 44g

Molar mass of CO_2, M = 44g/mol

Number of moles, $n = \frac{W}{M} = \frac{44}{44} = 1$ mol

Number of molecules, N $= n \times N_A$

$= 1 \times 6.022 \times 10^{23}$

$= 6.022 \times 10^{23}$ molecule.

774. The weight of one molecule of a compound of molecular formula $C_{60}\,H_{122}$ is

(a) 1.2×10^{-20} g (b) 5.025×10^{-23} g
(c) 1.4×10^{-21} g (d) 6.023×10^{-20} g

AIIMS-2002

Ans. (c) : The molecular weight of $C_{60}H_{122}$ is 842g/mol one mole of $C_{60}H_{122}$ weight 6.02×10^{23} g.

Weight of one molecule of $C_{60}H_{122}$ is

$$\frac{842}{6.02 \times 10^{23}} = 1.4 \times 10^{-21}\,g$$

775. 3 moles of ethanol reacts with one mole of phosphorus tribromide to form 3 moles of bromo-ethane and one mole of X. Which of the following is X?

(a) H_3PO_4 (b) H_3PO_2
(c) HPO_3 (d) H_3PO_3

AP-EAMCET (Engg.)-2001

Ans. (d) : 3 moles of ethanol reacts with 1 mole of phosphorous tribromide to form 3 moles of bromoethane and 1 mole of arthophosphorus acid (H_3PO_3)

$3C_2H_5OH + PBr_3 \rightarrow 3C_2H_5Br + H_3PO_3$

776. What is the value (in litres) of CO_2 liberated at STP when 2.12 g of sodium carbonate (mol. wt. 106) is treated with excess dilute HCl?

(a) 2.28 L (b) 0.448 L
(c) 44.8 L (d) 22.4 L

AP-EAMCET-2000

Ans. (b) : The balanced chemical equation is,

$$\underset{\substack{106g \\ 2.12g}}{Na_2CO_3} + 2HCl \rightarrow 2NaCl + H_2O + \underset{\substack{22.4L \\ ?}}{CO_2}$$

∴ 106 gm Na_2CO_3 required to CO_2 is = 22.4 L

Volume of CO_2 is required to 2.12 gm of Na_2CO_3 is $= \frac{22.4}{106} \times 2.12 = 0.448$ L

Thus, 2.12g of sodium carbonate will produce 0.448L at STP CO_2.

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777. The molecular weight of an organic compound is 180. Its empirical formula is CH_2O. Its molecular formula is

(a) $C_6H_{12}O_6$ (b) $C_7H_{16}O_5$
(c) $C_8H_4O_5$ (d) $C_5H_8O_7$

A.P.EAMCET-1996

Ans. (a) : Given that, the empirical formula $=CH_2O$

$\because$ Molecular weight of $CH_2O = 12 + 2 + 16 = 30$

$$\Rightarrow \text{No. of mole (n)} = \frac{180}{30} = 6\,\text{mole}$$

Hence, the molecular formula = n × empirical formula

$= 6 \times CH_2O$

$= C_6H_{12}O_6$

778. The formula of a metal chloride is MCl_3, it contains 20% of the metal. The atomic weight of the metal is approximately :

(a) 26.5 (b) 11.8
(c) 21.3 (d) 106.5

AP-EAMCET-1994

Ans. (a) : Given that 20 gm of metal in MCl_3.

$\therefore$ 80 gm of Cl combines with 20 g of metal.

$$\therefore \text{ 35.5 gm of Cl combine with } = \frac{35.5\times20}{80} = 8.875$$

$\therefore$ Equivalent weight of metal = 8.875g.

$\therefore$ Atomic weight = Eq. wt. × valency

$= 8.875\times3$

$= 26.5$ gm.

779. The number of molecules present in 3.5 g of CO at 0ºC and 760 mm pressure is :

(a) 6.02×10^{23} (b) $1.25\times6.02\times10^{23}$
(c) $0.125\times6.02\times10^{23}$ (d) $1.25\ N_A$

AP-EAMCET-1992

Ans. (c) : 28 gm CO at STP $= 6.023 \times 10^{23}$ molecules

$$\therefore \text{ 3.5 gm of CO at STP } = \frac{1}{28}\times3.5\times6.023\times10^{23}$$

$= 0.125 \times 6.02 \times 10^{23}$

7. Empirical Formula for Molecular Formula

780. Compound A contains 8.7% Hydrogen, 74% Carbone and 17.3% nitrogen. The molecular formula of the compound is,
Given : Atomic masses of C,H and N are 12, 1 and 14 amu respectively.

(a) $C_4H_6N_2$ (b) C_2H_3N
(c) C_5H_7N (d) $C_{10}H_{14}N_2$

JEE Main-28.06.2022, Shift-II

Ans. (d)

Element of compound A	Mass percentage	Atomic mass	Moles	Ratio
H	8.7	1	$\frac{8.7}{1} = 8.7$	$\frac{8.7}{1.236} = 7.03 \approx 7$
C	74	12	$\frac{74}{12} = 6.176$	$\frac{6.167}{1.236} = 4.989 \approx 5$
N	17.3	14	$\frac{17.3}{14} = 1.236$	$\frac{1.236}{1.236} = 1$

So, Empirical formula is C_5H_7N

Empirical mass $= 5 \times 12 + 7 \times 1 + 14 = 81$g

Molar mass of compound A is 162 g/mol

$$\text{Multiplying factor (n)} = \frac{162}{81} = 2$$

Molecular formula = n × Empirical formula

$= 2 \times C_5H_7N$

Hence, molecular formula $= C_{10}H_{14}N_2$

781. The elemental analysis of an organic compound gave C: 38.71%, H: 9.67% What is the empirical formula of the compound?

(a) CH_2O (b) CH_3O
(c) CH_4O (d) CHO
(e) CH_5O

Kerala CEE -03.07.2022

Ans. (b) : Given,

% of carbon = 38.71

% of hydrogen = 9.67

Then,

% of oxygen = 100 – 38.71 – 9.67

= 51.62

Element	% abundance	At. wt.	Molar ratio	simple ratio
C	38.71	12	$\frac{38.71}{12} = 3.23$	$\frac{3.23}{3.23} = 1$
H	9.67	1	$\frac{9.67}{1} = 9.67$	$\frac{9.67}{3.23} = 3$
O	100 – 38.71 + 9.67 = 51.62	16	$\frac{51.62}{16} = 3.23$	$\frac{3.23}{3.23} = 1$

So, the empirical formula of the compound $= CH_3O$

782. Consider the following reaction:

$$xAs_2S_3 + yO_2 \rightarrow zAs_2O_3 + wSO_2$$

What is y (the coefficient for O_2) when this equation is balanced using whole molecule coefficients?

(a) 5 (b) 7
(c) 9 (d) 11

NDA (II)-2014

Ans. (c) : Balance eq. of the following reaction is-

$x\ As_2S_3 + y\ O_2 \rightarrow z\ As_2O_3 + w\ SO_2$

$2\ As_2S_3 + 9\ O_2 \rightarrow 2\ As_2O_3 + 6\ SO_2$

Here,

x = 2
w = 6
y = 9
z = 2

So, the value of y after the balanced eq. is 9.

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02.

Structure of Atom

1. Atomic Number, Mass Number, Atomic Species

1. **The pair, in which ions are isoelectronic with Al^{3+} is:**
   (a) Br^- and Be^{2+} (b) Cl^- and Li^+
   (c) S^{2-} and K^+ (d) O^{2-} and Mg^{2+}

JEE Main-25.06.2022, Shift-I

Ans. (d) : O^{2-}, Mg^{2+} and Al^{3+} are isoelectronic. Because all have 10 electrons.

2. **Given below are two statements: one is labelled as**
   Assertion (A) and the other is labelled as Reason (R).
   Reason (A): The ionic radii of O^{2-} and Mg^{2+} are same.
   Reason (R): Both O^{2-} and Mg^{2+} are isoelectronic species.
   In the light of the above statements, choose the correct answer form the options given below
   (a) Both (A) and (R) and true and (R) is the correct explanation of (A)
   (b) Both (A) and (R) are true but (R) is not the correct explanation of (A)
   (c) (A) is true but (R) is false
   (d) (A) is false but (R) is true

JEE Main-27.06.2022, Shift-I

Ans. (d) : For ionic radii–

Ion	O^{2-}	Mg^{2+}
Electrons	$(8+2) = 10$	$12-2 = 10$
Atomic number (Z)	8	12

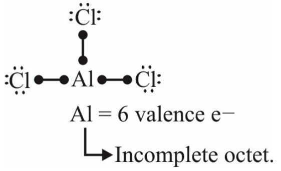
O^{2-} is greater than Mg^{2+}. O^{2-} and Mg^{2+} are isoelectronic species both have 10 electrons.

3. **Which one of the following molecules contains an incomplete octet of the central atom?**
   (a) SF_6 (b) $AlCl_3$
   (c) CH_4 (d) PF_5
   (e) H_2O

Kerala CEE -03.07.2022

Ans. (b) : As we know that octet means 8 electrons in valence shell. Here, $AlCl_3$ contains an incomplete octet atom.

		K	L	M	N
$AlCl_3 \Rightarrow {}_{13}Al$	=	2	8	3	
${}_{17}Cl$	=	2	8	7	



4. **A dinegative ion of the element X consists of 10 electrons and 8 neutrons. A dipositive ion of the element Y consists of 12 protons. The number of neutrons in Y is 1.5 times the number of electrons in atom X. Then the mass numbers of X and Y would be in the ratio**
   (a) 1 : 2 (b) 2 : 3
   (c) 3 : 2 (d) 2 : 5
   (e) 1 : 3

Kerala CEE -03.07.2022

Ans. (b) :

	Proton	Neutron	Electrons
X^{2-}	8	8	10
Y^{2+}	12	$1.5\times 8 = 12$	12

$$\frac{\text{Mass of } X^{2-}}{\text{Mass of } Y^{2+}} = \frac{(8+8)}{12+12} = \frac{16}{24}$$

$X^{2-} : Y^{2+} = 16 : 24$ Or $X^{2-} : Y^{2+} = 2 : 3$

5. **The oxide which contains an odd electron at the nitrogen atom is**
   (a) N_2O (b) NO_2
   (c) N_2O_3 (d) N_2O_5

JEE Main-26.06.2022, Shift-II

Ans. (b) :

Species	Total electron
N_2O	22
NO_2	23
N_2O_3	38
N_2O_5	54

Hence, NO_2 contain an odd electron at the nitrogen atom is 23.

6. **Which of the following is isoelectronic?**
   (a) CO_2, NO_2 (b) NO_2^-, CO_2
   (c) CN^-, CO (d) SO_2, CO_2

NEET-2002

Ans. (c) : CN^- and CO are isoelectronic because they have equal number of electrons. Therefore, in CN^- the number of electrons $\Rightarrow 6+7+1=14$

And, in CO the number of electrons $\Rightarrow 6+8=14$

7. **The cause of instability of nucleus is:**
   (a) High proton to electron ratio
   (b) High proton to neutron ratio
   (c) Low proton to electron ratio
   (d) Low proton to neutron ratio

MPPET - 2012

Ans. (d) : The cause of instability of a nucleus is due to low proton to neutron ratio. when neutron to proton ratio is less than 1, alpha emission occurs. When it is greater than 1.5, beta emission occurs.

8. **The difference between number of Neutrons and Protons is positive for :**
   (a) Hydrogen atom (b) Deuterium atom
   (c) Tritium atom (d) None of these

MPPET-2013

@apna_pdf

Ans. (c) : Isotopes	**n**	**P**	**Difference (n- P)**
Hydrogen (H)	0	1	–1
Deuterium	1	1	0
Tritium	2	1	1

Hence, the difference between number of Neutrons and Protons is positive for tritium atom.

9. One atom of $^{39}_{19}K$ contains :

(a) 19p; 20n and $19e^-$ (b) 19p; 20n and $20e^-$

(c) 20p; 19n and $20e^-$ (d) 20p; 19n and $19e^-$

AP-EAMCET/1991

Ans. (a) : In potassium (K), no. of proton (p) = 19
Number of neutron (n) = 39 – 19 = 20
Number of electron = 19

10. Which one of the following is not an isolectronic pair ?

(a) Mg^{2+}, C^{4-} (b) N^{3-}, O^{2-}

(c) N^{2-}, O^{2-} (d) F^-, Al^{3+}

AP-EAMCET-2002

Ans. (c) : Isoelectronic species have same number of electrons.

$N^{2-} = 7 + 2 = 9$

$O^{2-} = 8 + 2 = 10$

N^{2-} and O^{2-} is not an isoelectronic species.

11. Assertion (A) : Equal moles of different substances contain same number of constituent particles.

Reason (R) : Equal weights of different substances contain the same number of constituent particles.

The correct answer is :

(a) Both (A) and (R) are true and (R) is the correct explanation of (A)

(b) Both (A) and (R) are true, but (R) is not the correct explanation of (A)

(c) (A) is true, but (R) is false

(d) (A) is false, but (R) is true

AP-EAMCET-2007

Ans. (c) : Equal moles of different substances contain same number of constituent particles, but equal weights of different substance do not contain the same number of constituent particles.
Hence, assertion (A) is true but reason (R) is not true.

12. Match of following columns :

Column-I	**Column-II (At STP)**
(A) 10 g $CaCO_3$ $\xrightarrow[\text{Decomposition}]{\Delta}$	(1) 0.224 L CO_2
(B) 1.06 g Na_2CO_3 $\xrightarrow{\text{Excess HCl}}$	(2) 4.48 L CO_2
(C) 2.4 g C $\xrightarrow[\text{combustion}]{\text{Excess } O_2}$	(3) 0.448 L CO_2
(D) 0.56 g CO $\xrightarrow[\text{combustion}]{\text{Excess } O_2}$	(4) 2.24 L CO_2
	(5) 22.4 L CO_2

Codes :

	(A)	**(B)**	**(C)**	**(D)**
(a)	4	1	2	3
(b)	5	1	2	3
(c)	4	1	3	2
(d)	1	4	2	3

AP-EAMCET-2008

Ans. (a) : (A) $\underset{100gm}{CaCO_3} \xrightarrow[\text{Dcomposition}]{\Delta} CaO + \underset{22.4L}{CO_2}$

$\because$ 10 g $CaCO_3$ decomposition $= \dfrac{22.4 \times 10}{100}$

$= 2.24$ L CO_2

(B) $Na_2CO_3 \xrightarrow{\text{Excess HCl}} 2NaCl + H_2O + \underset{22.4L}{CO_2}$

$\therefore$ 1.06 g Na_2CO_3 $= \dfrac{22.4 \times 1.06}{106}$ L CO_2

$= 0.224$ L CO_2

(C) $\underset{12g}{C} \xrightarrow{\text{Excess } O_2} \underset{22.4L}{CO_2}$

$\therefore$ 2.4 g carbon on combustion will give,

$= \dfrac{22.4 \times 2.4}{12} = 4.48$L CO_2

(D) $\underset{56g}{2CO} \xrightarrow[\text{Combustion}]{\text{Excess } O_2} \underset{2\times22.4L}{2CO_2}$

$\therefore$ 0.56 gm Carbon monoxide $= \dfrac{2 \times 22.4 \times 0.56}{56}$

$= 0.448$ L CO_2

13. Among the following, the isoelectronic species is/are

(i) O^{2-}, F^-, Na^+, Mg^{2+} **(ii) Na^+, Mg^+, Al^{3+}, F^-**

(iii) N^{3-}, O^{2-}, F^-, Ne

(a) (i) and (ii) (b) (i), (ii) and (iii)

(c) (ii) and (iii) (d) (i) and (iii)

TS-EAMCET-2016

Ans. (d) : The isoelectronic species are elements that have the same number of electrons. O^{2-}, F^-, Na^+, Mg^{2+}, have 10 electron and N^{3-}, O^{2-}, F^- and Ne have also 10 electrons.

14. There are six electrons, six protons and six neutrons in an atom of an element. What is the atomic number of the element?

(a) 6 (b) 12

(c) 18 (d) 24

NDA (II)-2016

Ans. (a) Given, No. of electron = 6
No. of proton = 6
No. of neutron = 6
We know that,
Atomic No. = No. of Proton
Atomic No. = 6
Hence, the atomic number of element = 6.

15. What is the atomic number of the element with symbol Uus?

(a) 117 (b) 116

(c) 115 (d) 114

TS-EAMCET-2016

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Ans. (a) : The atomic number of the element with symbol Uus is 117. Ununseptium (Uus) is the second heaviest known element and its electronic configuration is $_5f^{14}\ _6d^{10}\ _7s^2\ _7p^6$.

16. The sum of the total number of neutrons present in protium, deuterium and tritium is

(a) 5 (b) 3

(c) 4 (d) 6

TS-EAMCET (Engg.), 05.08.2021 Shift-II

Ans. (b) : No. of neutrons –

Protium $\left({}^1_1H\right)=0$

Deuterium $\left({}^2_1H\right)=1$

Tritium $\left({}^3_1H\right)=2$

The sum of the total number of neutrons is

$\Rightarrow 0+1+2$

$\Rightarrow 3$

17. The number of protons, electrons and neutrons in a species are equal to 17, 18 and 18 respectively. Which of the following will be the proper symbol of this species ?

(a) ${}^{35}_{17}C\ell$ (b) ${}^{35}_{17}C\ell^-$

(c) ${}^{36}_{17}C\ell$ (d) ${}^{36}_{17}C\ell^-$

AP EAMCET (Engg.) 17.09.2020, Shift-II

Ans. (b) : p = 17, e = 18, n = 18 means, Z = 17 ⇒ element is chlorine, which contains one electron more (17 + 1), so it is chloride ion, $C\ell^-$.

⇒ Symbol: ${}^{35}_{17}C\ell^-$;

Mass number, A = n + p = 18 + 17 = 35

Atomic number, Z = 17

18. Which of the following has magic number of protons and neutrons?

(a) $_8O^{17}$ (b) $_{13}Al^{27}$

(c) $_9F^{17}$ (d) $_{20}Ca^{40}$

AP EAMCET (Medical) -1998

Ans. (d): Magic numbers are 2, 8, 20, 28, 50, 82 protons and 2, 8, 20, 28, 50, 82, 126 neutrons in the nucleus. These numbers impart stability to the nucleus.

(a) $_8O^{17} \longrightarrow \text{proton} = 8$

$\text{neutron} = 9$

(b) $_{13}Al^{27} \longrightarrow \text{proton} = 13$

$\text{neutron} = 14$

(c) $_9F^{17} \longrightarrow \text{proton} = 9$

$\text{neutron} = 8$

(d) $_{20}Ca^{40} \longrightarrow \text{proton} = 20$

$\text{neutron} = 20$

Thus, the calcium nucleic has the both proton and neutrons number is 20.

19. The species that has the same number of electrons as ${}^{35}_{17}Cl$ is

(a) ${}^{32}_{16}S$ (b) ${}^{34}_{16}S^+$

(c) ${}^{40}_{18}Ar^+$ (d) ${}^{35}_{16}S^{2-}$

NDA (II)-2017

Ans. (c) : Given, ${}^{35}_{17}Cl$

No. of electron in ${}^{35}_{17}Cl = 17$

No. of electron in ${}^{32}_{16}S$ = 16

No. of electron in ${}^{34}_{16}S^+$ = 16–1=15

No. of electron in ${}^{40}_{18}Ar^+$ = 18–1=17

No. of electron in ${}^{35}_{16}S^{2-} = 16+2 = 18$

Hence, ${}^{40}_{18}Ar^+$ contain same no. of electron as ${}^{35}_{17}Cl$.

20. S + Conc. $H_2SO_4 \longrightarrow$ X+Y

Here X is a gas and Y is a liquid and both are triatomic molecules. The number of electron lone pars present on the central atoms of X and Y are respectively.

(a) 2, 1 (b) 1, 0

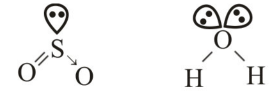
(c) 1, 2 (d) 2, 2

AP EAMCET-2017

Ans. (c) : $S + 2H_2SO_4 \longrightarrow 3SO_2 + 2H_2O$

X and Y are SO_2 and H_2O

The structure of SO_2 and H_2O



1 lone pair 2 lone pair

Hence the option (c) is correct

21. The characteristics of elements X, Y and Z with atomic numbers, respectively, 33, 53 and 83 are:

(a) X, Y and Z are metals.

(b) X and Z are non-metals and Y is a metalloid.

(c) X is a metalloid, Y is a non-metal and Z is a metal.

(d) X and Y are metalloids and Z is metal.

JEE Main 16.03.2021, Shift-II

Ans. (c) : The characteristics of elements X, Y and Z with atomic numbers respectively 33, 53 and 83 are the arsenic, iodine and bismuth. As we know the properties of that iodine, arsenic is metalloid in nature whereas Bismuth is metal.

22. Which of the following is true about sodium chloride ?

(a) Molecular mass = 58.5 amu

(b) Formula mass = 58.5 amu

(c) Molecular mass = 5.85 amu

(d) Formula mass = 5.85 amu

AP EAMCET (Engg.) 18.9.2020 Shift-I

Ans. (b) : Sodium chloride is an ionic crystal of rock salt structure in which 4 NaCl units are present in one unit cell of coordination number, $Na^+ : Cl^{\ominus} = 6 : 6$. So, actual molecule of sodium chloride is not NaCl, NaCl is the molecular formula of formula mass = (23 + 35.5) = 58.5 amu.

23. An alloy of metals X and Y weighs 12g & contains atoms X and Y is the ratio of 2: 5 The percentage of Metal X in the alloy is 20 by mass. If the atomic mass of X is 40. What is the atomic mass of metal Y.

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(a) 64 amu (b) 32 amu
(c) 60 amu (d) 50 amu

AP EAPCET 20.08.2021 Shift-I

Ans. (a): Mass of metal X in alloy $=\frac{12}{100}\times 20 = 2.40\text{g}$

Mass of metal Y in alloy =12–2.4=9.6g

No. of atoms of X = $\frac{2.4}{40}\times 6.02\times 10^{23}$

Ratio of atoms of X and Y = 2:5

No of atoms of Y = $\frac{2.4\times 6.02\times 10^{23}}{40}\times\frac{5}{2}$

$= 9.03\times 10^{22}$ atom

Now, $9,03\times 10^{22}$ atoms of Y are present in 9.6 g

∴ 6.02×1023 atoms of Y area present in

$\Rightarrow \frac{9.6}{9.03\times 10^{22}}\times 6.02\times 10^{23}$ =64 g

∴ atomic mass of Y = 64 amu.

24. The masses of an electron, a proton and a neutron respectively will be in the ratio —

(a) 1836.15 : 1838.68 (b) 1856.15 : 1858.68
(c) 1834.15 : 1836.68 (d) 1846.15 : 1848.68

AP EAPCET 20.08.2021 Shift-I

Ans. (a) : Mass of proton $= 1.673 \times 10^{-27}$ kg
Mass of neutron = 1.675×10^{-27} kg
Mass of electron = 9.109×10^{-31}

∴ Mass ratio of proton and electron = $\frac{m_p}{m_e}$

$= \frac{1.673\times 10^{-27}}{9.1\times 10^{-31}}$

= 1835.16

And Mass ratio of neutron and electron = $\frac{m_n}{m_e}$

$= \frac{1.675\times 10^{-27}}{9.1\times 10^{-31}}$

= 1838.68

25. In the following sets of ions, which one is not isoelectronic with the rest of the species?

O^{2-},F^-,Na,Mg^{2+},Al^{3+}, Ne

(a) Mg^{2+} (b) Al^{3+}
(c) O^{2-} (d) Na

COMEDK-2014

Ans. (d) : $O^{2-}(10e^-), F^-(10e^-), Na(11e^-), Mg^{2+}(10e^-)$, $Al^{3+}(10e^-)$ and $Ne(10e^-)$

Thus, Na is not isoelectronic with the rest of the species.

26. An ion with mass number 56 contains three units of positive charge and 30.4% more neutrons than electrons. The ion is

(a) $^{56}_{28}Ni^{3+}$ (b) $^{56}_{26}Fe^{3+}$
(c) $^{56}_{27}Co^{3+}$ (d) $^{56}_{24}Cr^{3+}$

COMEDK-2016

Ans. (b) : Let no. of electrons in the ion M^{3+} = x

$\therefore$ No. of neutrons $= x + \frac{30.4x}{100} = 1.304x$

No. of electrons in the neutral atom = x+3

$\therefore$ No. of protons $= x + 3 = 23 + 3 = 26$

Hence, the ion is $^{56}_{26}Fe^{3+}$

27. Which of the following clement represents is isoelectronic sequence?

(a) N, O, F, Ne (b) Na^+, Mn^{2+}, Al^{3+}, Si^{4+}
(c) Cl^-, Ar, Ca^{2+}, Ti^{4+} (d) Be, Mg^{2+}, Ca, Si^{2+}

AP-EAMCET (Medical), 2006

Ans. (c) : The species which have same number of electrons are called the isoelectronic

Cl^- = atomic no. ± no. of charge = 17+1 = $18e^{\ominus}$

Similarly,

Ar = 18 + 0 = $18e^{\ominus}$

Ca^{2+} = 20-2 = $18e^{\ominus}$

Ti^{4+} = 22-4 = $18e^{\ominus}$

∴ All these are isoelectronic. Hence, the correct option is (c).

28. Elements X and Y belong to the same group. Which one of the following set of atomic numbers represent X and Y?

(a) 15, 30 (b) 20, 31
(c) 19, 55 (d) 33, 16

AP-EAMCET (Medical), 2002

Ans. (c) : The atomic number 19, 55 belongs to the alkali metal. The name of the atomic number 19, 55 elements is potassium, cesium respectively.

29. The number of protons in a negatively charged atom (anion) is

(a) more than the atomic number of the element
(b) less than the atomic number of the element
(c) more than the number of electrons in the atom
(d) less than the number of electrons in the atom

NDA (II)-2011

Ans : (d) The number of protons in a negatively charged atom. It is less than the number of electron in the atom.

- The atoms of a component are impartial in nature since it contains equivalent number of electrons and protons.

30. Which one among the following most correctly determines the atomic number of an element ?

(a) Number of protons
(b) Number of protons and electrons
(c) Number of ions
(d) Number of nucleons

NDA (II)-2011

Ans : (a) Number of protons are most correctly determines the atomic number of an element.

- Atomic number the quantity of a chemical component in the periodic system by which the component are organized arranged by expanding number of protons in the nucleus.

31. A stable nucleus (light with A < 10) has

(a) exactly the same number of neutrons and protons
(b) more neutrons than protons
(c) no neutrons
(d) no protons

NDA (II)-2011

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Ans : (a) A stable nucleus has exactly the same number of neutrons and protons.

32. Which of the following ratio will give stability to daughter element, when radioactive parent element has less number of protons compared to number of neutrons?

(a) $\frac{N+1}{Z+1}$ (b) $\frac{N-1}{Z+1}$

(c) $\frac{N-1}{Z-1}$ (d) $\frac{N+1}{Z-1}$

GUJCET-2011

Ans. (b): $^1_0n \rightarrow ^1_1H$

or $^1_1p + ^0_{-1}\beta$ (β - particle)

i.e. emitting β-particles the newly formed nuclide has its n/p value lower than its parent nucleide and hence approaches closer to the zone of stability and become stable.

Hence, stability ratio of daughter element $\frac{N-1}{Z+1}$.

33. Isotope used in brain scan is

(a) $_1H^3$ (b) $_6C^{11}$

(c) $_6C^{14}$ (d) $_{80}Hg^{197}$

SRMJEEE-2010

Ans. (b) : The isotope of $_6C^{11}$ is (Choline) used in the scanning of the brain in medical sector.

34. Observe the following statements regarding isotones:

I. ^{39}K and ^{40}Ca are isotones.

II. Nuclides having different atomic (Z) and mass numbers (A) but same number of neutrons (n) are called isotones.

III. ^{19}F and ^{23}Na are isotones.

The correct answer is

(a) 1, 2 and 3 are correct

(b) Only 1 and 2 are correct

(c) Only 1 and 3 are correct

(d) Only 2 and 3 are correct

AP-EAMCET (Engg.)-2005

Ans. (b) : We know that when nuclides have same number of neutrons (N) but have different mass number (A) and proton number (Z) are called isotones.

(i) For $^{39}_{19}K$

atomic number (Z) = 19

atomic mass (A) = 39

neutrons (N) = A – Z = 39 – 19 = 20

For $^{40}_{20}Ca$

atomic number = 20

atomic mass = 40

neutrons = 40 – 20 = 20

Hence, ^{39}K and ^{40}Ca are isotones.

(iii) For $^{19}_{9}F$

atomic number = 9

atomic mass = 19

neutrons = 19–9 = 10

For $^{23}_{11}Na$

atomic number = 11

atomic mass = 23

neutrons = 23 –11

= 12

Hence, (I) and (II) statements are correct.

35. The radius of La^{3+} (Atomic number of La = 57) is 1.06 Å. Which one of the following given values will be closest to the radius of Lu^{3+} (Atomic number of Lu = 71) ?

(a) 1.40 Å (b) 1.06 Å

(c) 0.85 Å (d) 1.60 Å

VITEEE-2018

Ans. (c) : As we move left to right in lanthanide series, there is increase in atomic number but the size of cation get decreases.

So, possible radius for Lu^{3+} is 0.85 Å

36. Assertion: The chemical properties of different isotopes are same.

Reason: Isotopes have same number of neutron.

(a) If both Assertion and Reason are correct and Reason is the correct explanation of Assertion.

(b) If both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.

(c) If Assertion is correct but Reason is incorrect.

(d) If both the Assertion and Reason are incorrect.

AIIMS 25 May 2019 (Morning)

Ans. (c) : The chemical proporties of different isotopes are same. But isotopes does'nt have same number of neutron.

37. The number of electrons and neutrons of an element is 18 and 20 respectively. Its mass number is

(a) 37 (b) 17

(c) 38 (d) 22

AIIMS-1994

Ans. (c) : Mass no = No. of protons + No. of neutrons

No. of protons = No of electrons

⇒ No of Protons ⇒ 18

⇒ Mass No. = 20+18= 38

38. The number of electrons in $[_{19}K^{40}]^{-1}$ is

(a) 28 (b) 19

(c) 40 (d) 20

AIIMS-1994

Ans. (d): The electronic configuration of the given K(19): $1s^2, 2s^2, 2p^6, 3s^2, 3P^6, 4P^1$

The number of electrons present originally = 19

∴ Total number of electrons = 19+1= 20 (from negative charge).

39. Which of the following is the correct sequence of atomic weights of the given elements?

(a) Ni > Co > Fe (b) Fe > Co > Ni

(c) Co > Fe > Ni (d) Co > Ni > Fe

AIIMS-1996

Ans. (d) : Atomic weight of Fe (z=26)=55.85 amu.

Atomic weight of Co(z=27)⇒58.90 amu

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Atomic weight of Ni (z=28) ⇒58.69 amu
Hence, the correct order of atomic weight is follow CO>Ni>Fe.

40. Assertion: Nuclear binding energy per nucleon in the order $^{9}_{4}$Be > $^{7}_{3}$Li > $^{4}_{2}$He

Reason: Binding energy per nucleon increases linearly with difference in number of neutrons and protons.

(a) If both Assertion and Reason are correct and the Reason is a correct explanation of the Assertion.
(b) If both Assertion and Reason are correct but Reason is not a correct explanation of the Assertion.
(c) If the Assertion is correct but Reason is incorrect.
(d) If both the Assertion and Reason, are incorrect.
(e) If the Assertion is incorrect but the Reason is correct.

AIIMS-2004

Ans. (d): Binding energy per nucleon of $_3Li^7$ (5.38 Mev) is less than $_2He^4$ (7.08 Mev) as helium is found to be more stable than Li. As the atomic mass number increases the binding energy per nucleon decreases. As the atomic number and the atomic mass number increase the repulsive electrostatic force within the nucleus increase due to the greater number of protons in the heavy elements. To overcome this increased repulsion, the proportion of neutrons in the nucleus must increase to maintain stability. This increase in the neutron to proton ratio only partially compensates for the growing proton-proton repulsive force in the heavier naturally occurring element.

41. Assertion: Atoms are not electrically neutral.

Reason: Number of protons and electrons are different

(a) If both Assertion and Reason are correct and the Reason is a correct explanation of the Assertion.
(b) If both Assertion and Reason are correct but Reason is not a correct explanation of the Assertion.
(c) If the Assertion is correct but Reason is incorrect.
(d) If both the Assertion and Reason, are incorrect.
(e) If the Assertion is incorrect but the Reason is correct.

AIIMS-1999

Ans. (d): Atoms are electrically neutral because they have an equal number of protons and electrons, and as we know that the protons and electrons contain opposite types of charges, hence their negatively charged electrons are completely balanced with their positively charged protons.
Hence, given both the assertion and reason are false.

42. Let m_p be the mass of a proton, m_n that of a neutron, M_1 that of a $^{20}_{10}$Ne nucleus and M_2 that of a $^{40}_{20}$Ca nucleus. Then

(a) $M_2=2M_1$ (b) $M_1<10(m_p+m_n)$
(c) $M_2>2M_1$ (d) $M_1=M_2$

AIIMS-2015

Ans. (a): $^{20}_{10}$Ne contains 10 protons and 10 neutrons
∴ M_1= 10mp+10 Mn
$^{40}_{20}$Ca contains 20 protons and 20 neutrons
∴ M_2= 20Mp+20 Mn
∴ M_2 = $2M_1$

43. Deuterium nucleus contains:

(a) 1 proton, 1 electron (b) 1 proton, 1 neutron
(c) 2 protons, 1 electron (d) 1 proton, 2 electrons

AIIMS-1998

Ans. (b): Deuterium nucleus contains 1 proton and 1 neutron because it is isotope of hydrogen.

44. If $e = 1.60206\times10^{-19}$C, $\frac{e}{m} = 1.75875\times10^{11}$ Ckg^{-1} then the mass of electron is

(a) 7.5678×10^{-31}kg (b) 9.1091×10^{-31}kg
(c) 11.2531×10^{-31}kg (d) 13.0513×10^{-31}kg

AIIMS-1999

Ans. (b): Mass of electron $= \frac{1.60206\times10^{-19}}{1.75875\times10^{11}}$
$= 9.1091\times10^{-31}$

OR

$$\frac{e}{m} = 1.75875\times10^{11}\,\text{C kg}^{-1}$$

$$e = 1.60206\times10^{-19}\text{ C}$$

$$m = \frac{e/e}{m} = \frac{1.60206\times10^{-19}}{1.75875\times10^{11}}\text{Kg}$$

$= 9.1091\times10^{-31}$ Kg

45. Positron is:

(a) Electron with positive charge
(b) A nucleus with one neutron and one proton
(c) A nucleus with two protons
(d) A helium nucleus

AIIMS-1998

Ans. (a): The positron is the antiparticle or the antimattery counter part of the electron. The positron has an electric charge of +1, an spin of , and has the same mass as an electron. When a low–energy positron collides with a low energy electron, annihilation occurs, resulting in the production of two or more gamma ray photons Positrons may be generated by positron emission radiative energetic photon which is in teracting with an atom is a material.

46. The nitride ion in lithium nitride is composed of

(a) 7 protons + 7 electrons
(b) 10 protons + 7 electrons
(c) 7 protons + 10 electrons
(d) 10 protons + 10 electrons

CG PET -2018

Ans. (c) : Nitride ion can be represented as N^{3-},
Number of protons = 7
Number of electrons = 7+3= 10
Therefore, nitride ion contains 7 protons +10 electrons.

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47. **Increasing order (lowest first) for the values of e/m for electron (e), proton (p), neutron (n) and α-particles is**

(a) e, p, n, α (b) n, α, p, e
(c) n, p, e, α (d) n, p, α, e

CG PET -2009

Ans. (b) : $(e/m)_n = \dfrac{0}{1.675\times10^{-27}}$

$$(e/m)_\alpha = \frac{2\times1.6602\times10^{-19}\,C}{4\times1.675\times10^{-27}\,kg}$$

$$(e/m)_p = \frac{1.602\times10^{-19}\,C}{1.675\times10^{-27}\,kg}$$

$$(e/m)_e = \frac{1.602\times10^{-19}\,C}{9.108\times10^{-31}\,kg}$$

48. **Isoelectronic pair among the following is**

(a) Ca and K (b) Ar and Ca^{2+}
(c) K and Ca^{2+} (d) Ar and K

UPTU/UPSEE-2008

Ans. (b) : Ar and Ca^{2+} are isoelectronic species as they have same number of electrons i.e. 18.

49. **Which of the following is isoelectronic pair?**

(a) CN^-, O_3 (b) ClO_2, BrF_2
(c) BrO_2^-, BrF_2^+ (d) ICl_2, ClO_3

JCECE - 2013

Ans. (c) : Both $BrO_2^-(35+2\times8+1=52)$ and $BrF_2^+(35+2\times9-1=52)$ have 52 electrons.

50. **N_2 and CO are**

(a) Isomers (b) Isoelectronic
(c) Isotopes (d) Isobars

J & K CET-(2002)

Ans. (b) : N_2 have 14×2=28 electrons
CO have 12+16 = 28 electrons
Thus both are iso electronic

OR

Both N_2 and CO contain 14 electrons each thus N_2 and CO are isoelectronic.

51. **Pick out the isoelectronic structures from the following**

$$\underset{\text{I}}{CH_3^+}\quad \underset{\text{II}}{H_3O^+}\quad \underset{\text{III}}{NH_3}\quad \underset{\text{IV}}{CH_3^-}$$

(a) I and II (b) I and VI
(c) I and III (d) II,III and IV

CG PET- 2010

Ans. (d) : CH_3^+ has 6+3–1= 8

Electrons H_3O + has 3+8–1=10 electrons NH_3 has 7+3=10 electrons CH_3^- has 6+3+1=10 electrons so II, III, IV are isoelectronic structures as they have the same number of electrons. Hence, the correct option (d).

OR

H_3O^+, NH_3 and CH_3^- have same number of electrons.

52. **Which of the following is not isoelectronic?**

(a) Na^+ (b) Mg^{2+}
(c) O^{2-} (d) Cl^-

CG PET -2007

Ans. (d) : Na^+, Mg^{2+}, O^- contain 10 electrons each Cl^- has 18 electrons.

53. **The correct symbol of the species with number of electrons, protons and neutrons as 18, 16 and 16 respectively is**

(a) $^{32}_{16}S$ (b) $^{32}_{18}S$
(c) $^{32}_{16}S^{2-}$ (d) $^{32}_{18}S^{2-}$

AMU-2014

Ans. (c) :

Species	No of Electron	No of Protons	No of neutrons
$^{32}_{16}S$	16	16	16
$^{32}_{18}S$	18	18	14
$^{32}_{16}S^{2-}$	$16+2e^-$ 18	16	16
$^{32}_{18}S^{2}$	$18+2e^-$ 20	18	14

54. **The magnitude of the charge on the electron is 4.8 × 10^{-10} esu. What is the magnitude of the charge on the proton on the nucleus of helium atom?**

(a) 4.8 × 10^{-10} esu (b) 9.6 × 10^{-10} esu
(c) 6.4 × 10^{-10} esu (d) 14.4 × 10^{-10} esu

AMU-2013

Ans. (b) : Since, the charge on the proton is equal in magnitude to that on the electron, the charge on the proton is also 4.8×10^{-10} esu. Since, a helium nucleus contains 2 protons, its charge is 9.6×10^{-10} esu.

55. **Atomic number equal to the**

(a) Atomic mass of the element
(b) Sum of protons and neutrons
(c) Number of the protons in the nucleus
(d) Number of the neutrons in the nucleus.

AMU–2001

Ans. (c) : Atomic number is equal to the number of protons in the nucleus.

56. **The ratio of electron, proton and neutron in tritium is**

(a) 1 : 1 : 1 (b) 1 : 1 : 2
(c) 1 : 1 : 3 (d) 1 : 2 : 3

Assam CEE-2014

Ans. (b) : The atomic number and the mass number of tritium are 1 and 3 respectively. Tritium contains 1 electron, 1 proton and 2 neutrons.
Hence, the ratio of the number of electrons. Protons and neutrons in tritium is 1:1:2

57. **The atomic numbers of elements X, Y and Z are 19, 21 and 25 respectively. The number of electrons present in the M shells of these elements follow the order.**

(a) Z > X > Y (b) X > Y > Z
(c) Z > Y > X (d) Y > Z > X

Assam CEE-2014

@apna_pdf

Ans. (c) : The electronic configuration of X with atomic number 19 is $1s^2\ 2s^2\ 2p^6\ 3p^6\ 4s^1$. Now the M shell is the 3rd energy level and hence, it contains (2+6=8) electrons.
The electronic configuration of with atomic number 21 is $1s^2\ 2s^2\ 2p^6\ 3x^2\ 3p^6\ 4s^2\ 3d^1$. Now the M shell is the 3rd energy level and hence, it contains (2+6+1=9) electron.
The electronic configuration of Z with atomic number 25 is $1s^2\ 2s^2\ 2p^6\ 3s^2\ 4s^2\ 3d^5$. Now the M shell is the 3rd energy level and hence it contains (2+6+5=13 electrons).
Since Z contains more electrons in the M shell than Y and Y contains more electrons in the M shell than X. So the number of electrons present in the M–shell of these elements follows the order Z>Y>X Hence, the correct option is c.

58. The number of electrons, protons and neutrons in phosphide ion (P^{3-}) is-
(a) 15, 15, 16 (b) 15, 16, 15
(c) 18, 15, 16 (d) 15, 16, 18

Assam CEE-2021

Ans. (c) : P^{3-} (PHOSPHIDE)
Electron = 15 + 3 = 18
Proton = 15
Neutron = 31 – 15 = 16

59. Nuclides :
(a) Have specific atomic numbers
(b) Have same number of protons
(c) Have specific atomic number and mass numbers
(d) Are isotopes

BCECE-2006

Ans. (c): Nuclides have a definite number of protons and neutrons and consequently definite atomic number and mass number. Such as oxygen nuclei contain 8 protons and 8 neutrons (${}_8O^{16}$).

60. The energy released in an atom bomb explosion is mainly due to
(a) Release of neutrons
(b) Release of electrons
(c) Greater mass of products than initial material
(d) Lesser mass of products than initial material

BCECE-2006

Ans. (d) : The source of large energy, produced during atom bomb explosion, is the mass defect occurring during the fission reaction, which is converted into energy equivalent to mass defect.

61. Number of neutron in C^{12} is :
(a) 6 (b) 7
(c) 8 (d) 9

BCECE-2005

Ans. (a) : Number of neutron = atomic mass– atomic number. For C^{12} number of neutron = 12–6=6

62. The atomic number of elements A, B, C, and D are Z–1, Z+1, Z+2 respectively. If B is a noble gas, choose the correct option.
(1) (A) has higher electron affinity.
(2) (C) exists in +2 oxidation state.
(3) (D) is an alkaline earth metal.
(a) (1) and (2) (b) (2) and (3)
(c) (1) and (3) (d) (1), (2) and (3)

BCECE-2017

Ans. (c) : B is a noble gas so the next element will be in the next period and will be alkali metals. Next element will be than alkaline earth metal.
1 'A' has higher electron affinity. It belongs to halogen family.
2 'C' exists in +1 oxidation state
3 'D' is an alkaline earth metal
Hence, the Statements (1) and (3) are correct.

63. n/p ratio during positron decay
(a) Increases (b) Decreases
(c) Remains constant (d) All of these

CG PET- 2015

Ans. (a) ${}_0n^1 \rightarrow {}_1p^1 + {}_{-1}p^0 + \bar{v}$ i.e. n decreases, p increases.

64. The electronic configuration of an element is $1s^2, 2s^2\ 2p^6, 3s^2\ 3p^6, 3d^{10}, 4s^2\ 4p^3$.
To which of the following elements it is similar in properties?
(a) Boron (b) Oxygen
(c) Nitrogen (d) Chlorine

CG PET -2008

Ans. (c) : The valance shell electronic configuration is $4s^2\ 4p^3$ similar to nitrogen $3s^2 3p^2$.

65. If the de-Broglie wavelength of the electron in n^{th} Bohr orbit in a hydrogenic atom is equal to $1.5\pi a_0$ (a_0 is Bohr radius), then the value of n/Z is
(a) 1.0 (b) 0.75
(c) 0.40 (d) 1.50

[JEE Main 2019, 12 Jan Shift-II]

Ans. (b) : $2\pi rn = n\lambda;\ 2\pi a_o \times \frac{n^2}{z} = n\lambda$

$$2\pi a_o = \frac{n}{z} = 1.5\pi a_o = \frac{n}{z} = \frac{1.5\pi a_o}{2\pi a_o} = 0.75$$

66. The introduction of a neutron into the nucleus of an atom would lead to a change in
(a) Atomic number
(b) Atomic mass
(c) Chemical nature of the atom
(d) Number of electron

CG PET -2019

Ans. (b) : The introduction of a neutron into the nuclear composition, of an atom would lead to a change in its atomic mass. However, its atomic number, the chemical nature of the atom and the number of the electron s will remain unchanged as they are related to the number of protons and they are independent of the number of neutron.

67. The element with atomic number 55 belongs to which block of the periodic table?
(a) s-block (b) p- block
(c) d- block (d) f- block

CG PET -2004

@apna_pdf

Ans. (a) : The electronic configuration of the above element is [Xe]$6s^1$. Since the valence electrons are in the S subshell, the element belongs to S–block.

68. Neutrons are found in atoms of all elements except in

(a) Chlorine (b) Oxygen
(c) Argon (d) Hydrogen

CG PET -2004

Ans. (d) : Neutrons can be found in all atomic nuclear except hydrogen. Hydrogen is that atomic nucleus and it consists of no charge and a mass of slightly over 1 amu.

69. The atomic weight of an element is 39. The number of neutrons in its nucleus is one more than the number of protons. The number of protons, neutrons and electrons-respectively in its atoms would be

(a) 19, 20, 19 (b) 19, 19, 20
(c) 20, 19, 19 (d) 20, 19, 20

CG PET -2004

Ans. (a) : Atomic weight of an element = 39 unit

∴ Atomic weight = no of proton + no of neutron

Hence According to question.

no. of neutron = no. of proton +1

So,

39= no. of neutron + no. of proton

39= no. of proton +1 +no. of proton

2×no. of proton = 38

no. of proton = 19

Also, no. of electron = no. of proton

They, no. of electron = 19

And no. of neutron = 19+1 = 20

Hence, no. of proton = 19

no. of neutron = 20

no. of electron=19

70. In the following reaction

$${}_3Li^6 + ? \rightarrow {}_2He^4 + 1H^3$$

the missing particle is

(a) Electron (b) Neutron
(c) Proton (d) Deuteron

CG PET- 2010

Ans. (b) : In the given reaction

$${}_3Li^6 + ? \rightarrow {}_2He^4 + 1H^3$$

Mass number and atomic number on LHS and RHS will be equal.

Let us assume the missing particle be ${}_xA^y$

Atomic number

$3 + x = 2 + 1$

$x = 0$

Mass number,

$6 + y = 4 + 3$

$y = 1$

It represents neutron,

$${}_3Li^6 + {}_0n^1 \rightarrow {}_2He^4 + 1H^3$$

71. The atomic number of an element is 8. How many electrons will it gain to form a compound with sodium?

(a) One (b) Two
(c) Three (d) Four

NDA (II)-2018

Ans. (b) : It will gain two electron to form a compound with sodium (Na).

Given, atomic no. of element = 8 i.e. oxygen

Electronic configuration of oxygen= $1s^2$, $2s^2$, $2p^4$.

Therefore, valency = 2, 6

Electronic configuration of Na= 2, 8, 1

Valency = 1 (As it is easier to donate one electron)

Hence, the given element will gain 2 electron form two sodium atoms to completes its octet.

Reaction involved –

$$4Na^+ + O_2 \rightarrow 2Na_2O$$

72. The triad of the nuclei that is isotonic :

(a) ${}_6C^{14}, {}_7N^{14}, {}_9F^{19}$ (b) ${}_6C^{14}, {}_7N^{15}, {}_9F^{17}$
(c) ${}_6C^{14}, {}_7N^{14}, {}_9F^{17}$ (d) ${}_6C^{12}, {}_7N^{14}, {}_9F^{19}$

HP CET-2018

Ans. (b) : Isotones are nuclides with same number of neutrons

∴ ${}_6C^{14}, {}_7N^{15}, {}_9F^{17}$ are isotones with 8 neutrons in each case.

73. Three elements X, Y and Z are in the 3rd period of the periodic table. The oxides of X, Y and Z, respectively, are basic, amphoteric and acidic. The correct order of the atomic number of X, Y and Z is

(a) Z < Y < X (b) X < Y < Z
(c) X < Z < Y (d) Y < X < Z

(JEE Main 2020, 2 Sep Shift-II)

Ans. (b) : X<Y<Z $MgO<Al_2O_3<SiO_2$

74. The group having isoelectronic species is

(a) $O^{2-}, F^-, Na^+, Mg^{2+}$ (b) O^-, F^-, Na, Mg^+
(c) O^{2-}, F^-, Na, Mg^{2+} (d) O^-, F^-, Na^+, Mg^{2+}

(JEE Main-2017)

Ans. (a) : Isoelectronic species are those which contains same number of electrons

Species	Atomic number	Number of electrons
O^{2-}	8	10
F^-	9	10
Na^+	11	10
Mg^{2+}	12	10
O^-	8	9
Na	11	11
Mg^+	12	11

Option (a) is correct which contains isoelectronic species $O^{2-}, F^-, Na^+, Mg^{2+}$

75. Which one of the following sets of ions represents a collection of isoelectronic species ?

(a) $K^+, Cl^-, Ca^{2+}, Sc^{3+}$ (b) $Ba^{2+}, Sr^{2+}, K^+, S^{2-}$
(c) $N^{3-}, O^{2-}, F^-, S^{2-}$ (d) $Li^+, Na^+, Mg^{2+}, Ca^{2+}$

Assam CEE-2020
(AIEEE 2006)

Ans. (a) : The ions which have the same number of electrons are called isoelectronic

K^+	Cl^-	Ca^{2+}	Sc^{3+}
(2,8,8)	(2,8,8)	(2,8,8)	(2,8,8)

All these ions contains 18 electrons each. So all these ions are isoelectronic.

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76. According to the periodic law of elements, the variation in properties of elements is related to their

(a) Atomic masses
(b) Nuclear masses
(c) Atomic numbers
(d) Nuclear neutron-proton number ratios

(AIEEE 2003)

Ans. (c) : The modern form of periodic table is the one in which the chemical elements are arranged in order of increasing atomic number.

Elements with similar properties are arranged in the same column (called a group) and elements with the same number of electron shells are arranged in the same row (called a period).

77. The group number, number of valence electrons and valency of an element with atomic number 15, respectively, are

(a) 16, 5 and 2 (b) 15, 5 and 3
(c) 16, 6 and 3 (d) 15, 6 and 2

(JEE Main 2019, 12 April Shift-I)

Ans. (b) : The group number, number of valence electrons and valency of an element with atomic number is are 15, 5 and 3 respectively. Modern periodic table is based on the atomic number. Modern periodic table is based on the atomic number. Number of valence electrons present in an atom decides the group number.

Electronic configuration of element have atomic number 15–$1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^3$

As five electrons are present in valence shell. Its group number is 15. Valency of element having atomic number 15 is +3 (8–5=3).

78. The isoelectronic set of ions is

(a) F^-, Li^+, Na^+ and Mg^{2+}
(b) N^{3-}, Li^+, Mg^{2+} and O^{2-}
(c) Li^+, Na^+, O^{2-} and F^-
(d) N^{3-}, O^{2-}, F^- and Na^+

(JEE Main 2019, 10 April Shift-I)

Ans. (d) : Key idea = Isoelectronic species contains same number of electron.

The species with its atomic number and number of electrons are as follows:

Species (ions)	Atomic number (z)	Number of electrons
N^{3-}	7	7+3=10
O^{2-}	8	8+2=10
F^-	9	9+1=10
Na^+	11	11–1=10
Li^+	3	3–1=2
Mg^{2+}	12	12–2=10

Isoelectronic set of ions are N^{3-}, O^{2-}, F^-, Na^+ and Mg^{2+}.

79. The size of the iso-electronic species Cl^-, Ar and Ca^{2+} is affected by

(a) azimuthal quantum number of valence shell
(b) electron-electron interaction in the outer orbitals
(c) principal quantum number of valence shell
(d) nuclear charge

(JEE Main 2019, 8 April Shift-I)

Ans. (d) : Isoelectronic species contain same number of shells so their size is effected by the nuclear charge.

80. The atomic number of unnilunium is ......

(JEE Main 2020, 6 Sep Shift-II)

Ans. (101) : Synthetic radioactive element, symbol=md with atomic number 101 made by bombarding lighter elements with light nuclei accelerated in cyclotrons.

81. Which one of the following constitutes a group of the isoelectronic species?

(a) C_2^{2-}, O_2^-, CO, NO
(b) NO^+, C_2^{2-}, CN^-, N_2
(c) CN^-, N_2, O_2^{2-}, CO_2^{2-}
(d) N_2, O_2^-, NO^+, CO

JEE Main-09.10.2018

Ans. (b) : Number of electrons in each species are given below

N_2=14 CN^- =14
O_2^- =17 C_2^{2-} =14
NO^+ =14 O_2^- =18
CO = 14 No = 15

It is quite evident from the above that NO^+, C_2^{2-}, CN^-, N_2 and Co are isoelectronic in natures.

82. Hydrogen has three isotopes (A), (B) and (C). If the number of neutron(s) in (A), (B) and (C) respectively, are (x), (y) and (z), the sum of (x), (y) and (z) is

(a) 4 (b) 3
(c) 2 (d) 1

[JEE Main 2020, 8 Jan Shift-II]

Ans. (b) : Number of neutrons in protium $\left({}_1^1H\right)$ is zero (x), number of neutron in deuterium $\left({}_1^2H \text{ or } {}_1^2D\right)$ is 1(y) and number of neutrons in tritium $\left({}_1^3H \text{ or}, {}^3T\right)$ is 2(z) the sum of x, y and z is x+y+z = 3.

83. Atoms with identical atomic number but different atomic mass number are known as

(a) Polymers (b) Isobars
(c) Isotopes (d) Isomers.

J & K CET-(2014)

Ans. (c) : Isotope, one of two or more species of atoms of a chemical element with the same atomic number and position in the periodic table and nearly identical chemical behavior but with different atomic masses and physical properties every chemical element has one or more isotopes.

Example:– H_1^1, H_1^2, H_1^3 are the isotopes of hydrogen.

84. Negatively charged particles are called

(a) Electrons (b) Protons
(c) Neutrons (d) None of the above

J & K CET-(2014)

Ans. (a) :

Particles	Symbol	Relative charge
Electrons	e	–1
Protons	p	+1
Neutrons	n	0

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85. Mass number of an atom is the sum of

(a) Number of protons + number of neutrons + number of electrons
(b) Number of protons + number of neutrons
(c) Number of protons + number of electrons
(d) Number of electrons + number of neutrons.

J & K CET-(2014)

Ans. (b) : The total number of nucleous is termed as mass number (A) of the atom.
Hence, mass number (A)= No. of protons (p)+No. of neutrons(n).

86. Mass of a proton is

(a) 0.00727 amu
(b) 1.0087 amu
(c) 0.00054 amu
(d) 1.00727 amu.

J & K CET-(2014)

Ans. (d) : A mass of proton is 1.00727 amu. A proton is a subatomic particle, with a positive electrical charge of +1e elementary charge and a mass slightly less than that of a neutrons. Protons and neutrons, each with masses of approximately one atomic mass unit, are collectively referred to as "nucleons" (particles present in atomic nuclei).

87 $^{39}_{19}$K and $^{40}_{20}$C are

(a) Isomers
(b) Isobars
(c) Isotones
(d) Isotopes

J & K CET-(2001)

Ans. (c) : No. of neutron in K= 39–19= 20
No. of neutron in Ca= 40–20= 20
So, No, of neutron are equal
∴ They are isotones.

88. Neutron is a fundamental particle carrying

(a) A charge of +1 unit and a mass of one unit
(b) No charge and a mass of one unit
(c) No charge and no mass
(d) A charge of–1 unit and no mass

J & K CET-(2000)

Ans. (b) : Proton and e^- which are electrically charged, neutron have no charge they are electrically neutral. The mass of a neutron is slightly greater than the mass of a proton, which is 1 atomic mass unit (amu.)

89. The specific heat of a metal is 0.11 and its equivalent weight is 18.61. Its exact atomic weight is

(a) 58.2
(b) 29.1
(c) 55.83
(d) 27.91

J & K CET-(1998)

Ans. (c) : Approximate atomic wt. of the metal

$$= \frac{6.4}{\text{specific heat}} = \frac{6.4}{0.11} = 58.18$$

$$\text{Valency of the metal} = \frac{\text{Approx at.wt}}{\text{Eq.wt.}}$$

$$= \frac{58.18}{18.61} = 3(\text{whole no.})$$

So, exact at. wt. of the element = eq.wt.×Valency
= 18.61×3
= 55.83

90. Which of the following species is isotonic with $_{37}Rb^{86}$?

(a) $_{36}Kr^{84}$
(b) $_{37}Mg^{85}$
(c) $_{38}Sr^{87}$
(d) $_{39}Y^{89}$

J & K CET-(1997)

Ans. (c) : The number of neutrons in Rb= (86–37)= 49 and in Sr = (87–38) = 49.
Therefore, both of them are isotonic species.

91. Atoms with same atomic number and different mass numbers are called

(a) isobars
(b) isomers
(c) isotones
(d) isotopes

JCECE - 2009

Ans. (d) : Isobars, are the atom having the same mass number but different atomic number. For example, the atomic number of carbon and nitrogen is 6 and 7 respectively. Isotopes are the atoms with same atomic no and different atomic mass Ex. $_6C^{14}$, $_6C^{13}$.

92. The number of electrons, neutrons and protons in a species are equal to 10,8 and 8 respectively. The proper symbol of the species is

(a) $^{16}_{8}O$
(b) $^{18}_{8}O$
(c) $^{18}_{10}Ne$
(d) $^{16}_{8}O^{2-}$

JIPMER-2011

Ans. (d) : From the given data, it is clear that the atomic number z, of the species is 8 (number of protons).
Since the number of electron are two more than the number of protons, hence, it is a binegative species.
Thus, the species is $^{16}_{8}O^{2-}$.

93. In long form of periodic Table the properties of the elements are a periodic function of their

(a) Atomic size
(b) Ionization energy
(c) Atomic mass
(d) Atomic number

JIPMER-2010

Ans. (d): In modern periodic table, the physical and chemical properties of the element are a periodic function their atomic number, i.e. if the element are arrange in order of their atomic number, the element with similar properties are repeated after certain regular intervals.

94. An element with mass number 81 contains 31.7% more neutrons as compared to protons. It symbol is

(a) $_{40}X^{81}$
(b) $_{35}X^{81}$
(c) $_{81}X^{317}$
(d) $_{40}X^{81}$

JIPMER-2019

Ans. (b) : Let, the number of protons= x

$$\text{Number of neutrons} = x + \frac{31.7x}{100} = \frac{131.7x}{100}$$

Mass number= number of protons + number of neutrons

$$81 = x + \frac{131.7x}{100}$$

∴ x= 35
Thus, the symbol of the element is $_{35}X^{81}$.

95. Which of the following is not iso electronic with H_2S?

(a) F_2 gas
(b) Oxide ion
(c) Ca^{+2}
(d) Sc^{+3}

JIPMER-2019

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Ans. (b) : Iso electronic species are those which have same number of electron. The total number of electron in the given species are as follows.

H_2S= 2+16 = 18 electron
F_2= 9+9 = 18 electron
O^{2-}= 8+2=10 electron
Ca^{2+} = 20–2 18 electron
Sc^{3+} = 21–3 = 18 electron

Thus O^{2-} (Oxide ion) is not iso–electronic with H_2S.

96. If two atoms have equal number of electron it is called

(a) isoelectronic (b) isotone
(c) isobar (d) None of these

JIPMER-2019

Ans. (a) : The species having same number of electrons are called isoelectronic. For example Na^+ and Mg^{2+} have 10 electron thus are isoelectronic.

97. An odd electron molecule among the following is

(a) CO (b) SO_2
(c) CO_2 (d) NO
(e) OF_2

Kerala-CEE-2015

Ans. (c) : N(z=7) and O (z=8)
have 7 and 8 electrons respectively
∴ number of electrons in NO= 7+8= 15
Hence, no is an odd electron molecule.

98. The effective nuclear charge of an elements with three valence electrons is 2.60. What is the atomic number of the element?

(a) 1 (b) 2
(c) 3 (d) 4
(e) 5

Kerala-CEE-2018

Ans. (e) : Effective nuclear charge = 2.60 and valence shell contain 3 electrons.

Thus, the minimum number of main shells for the given element are two i.e. (x=2) and its configuration will be $1s^2, 2s^2, 2p^1$

So, that the given element has 5 electrons in all also, for a neutral atom.

Therefore, no. of electrons= Atomic number

There, the atomic number of the element is 5.

99. The number of electrons, protons and neutrons in a species are equal to 10, 11 and 12 respectively. The proper symbol of the species is

(a) ${}^{22}_{11}Na^+$ (b) ${}^{23}_{11}Na$
(c) ${}^{23}_{10}Ne$ (d) ${}^{23}_{11}Na^+$
(e) ${}^{23}_{11}Na^{2+}$

Kerala-CEE-2020

Ans. (d) : No. of electron present = no. of atomic no.

No. of protons = No. of electron = atomic no.

${}^{22}_{11}Na^+$ ⇒ No. of electron = 10
⇒ No. of proton = 11
⇒ No. of neutron = A – Z
= 23 – 11
= 12

100. 1 u (amu) is equal to

(a) 1.492×10^{-10} J (b) 1.492×10^{-7} J
(c) 1.492×10^{-13} J (d) 6.023×10^{23} J

MHT CET-2010

Ans. (a) : 1u (unified mass) is equal to exactly 1/12th of the mass of C^{12} atom.

$$\text{Thus, } 1u = \frac{1}{12}\times\frac{12g}{6.022\times10^{23}}$$

$$1u = 1.66\times10^{-24} = -1.66\times10^{-27}\ Kg$$

Since, $E = mc^2$, thus

$$= 1.66\times10^{-27}\times(3\times10^8)\ Kg\ m^2s^2$$
$$= 1.492\times10^{-10}\ J$$

101. Chlorine (Cl^{17}) free radical contains how many electrons around the nucleus?

(a) 16 (b) 17
(c) 18 (d) 19

MHT CET-2010

Ans. (b) : In free radicals, the number of electrons are same as that in isolated neutral atom.

∵ In Cl atom, the number of electrons= 17

∴ In Cl free radicals, the number of electrons, = 17.

102. From the following pairs of ions which one is not an iso-electronic pair?

(a) Fe^{2+}, Mn^{2+} (b) O^2, F
(c) Na^+, Mg^{2+} (d) Mn^{2+}, Fe^{3+}

NEET-2021

Ans. (a) : Total no. of e–
${}_{26}Fe \rightarrow 3d^6\,4s^2$, $Fe^{2+}\rightarrow 3d^6$ 24
${}_{25}Mn \rightarrow 3d^5\,4s^2$, $Mn^{2+}\rightarrow 3d^5$ 23

103. The number of protons, neutrons and electrons in ${}^{175}_{71}Lu$, respectively, are

(a) 71, 107 and 71 (b) 104, 71 and 71
(c) 71, 104and 71 (d) 175, 104 and 71

NEET-2020

Ans. (c) : ${}^{104}_{71}Lu$

Number of protons = number of element = 71
Number of neutrons = 175 = 71 104

104. Be^{2+} is isoelectronic with which of the following ions?

(a) H^+ (b) Li^+
(c) Na^+ (d) Mg^+

NEET-2014

Ans. (b) : Be^{2+} = (4–2) = 2 is isoelectronic with Li+ (3–1=2) since, both have the same number of electron in their outermost shell.

105. Isoelectronic speicies are

(a) CO, CN^-, NO^+, C_2^{2-} (b) CO–, CN, NO, C_2^-
(c) CO^+, CN^+, NO^-, C_2 (d) CO, CN^-, NO^+, C_2^{2-}

AMU-2011
NEET-2000

Ans. (a) : Species having same no. of electrons are called isoelectronics.

The no of electrons in $CO = CN^- = NO^+ = C_2^{2-} = 14$

So, these are isoelectronic species.

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106. Which one of the following is not isoelectronic with O^{2-}?

(a) Tl^+ (b) Na^+

(c) N^{3-} (d) F^-

NEET-1994

Ans. (a) : O^{2-}, N^{3-} F^- and Na^+ have 10 electrons.

107. The mass number and atomic number of Z in the following sequence are respectively

$${}^{A}_{B}X \xrightarrow{-2\alpha} Y \xrightarrow{-1\beta} Z$$

(a) A – 4, B + 1 (b) A, B –1

(c) A – 4, B – 2 (d) A – 4, B – 1

UP CPMT-2010

Ans. (d) : ${}^{A}_{B}X \xrightarrow{-2\alpha} {}^{A-4}_{B-2}Y \xrightarrow{-1\beta} {}^{A-4}_{B-1}Z$

Thus, the mass umber and atomic number of Z are A – 4 and B – 1 respectively.

108. The atomic number of an element 'M' is 26. How many electrons are present in the M-shell of the element in its M^{3+} state?

(a) 11 (b) 15

(c) 14 (d) 13

UP CPMT-2008

Ans. (d):

	K	L	M	N
M(26)	$1s^2$,	$2s^2\ 2p^6$,	$3s^23p^63d^6$	$4s^2$
M^{3+}	$1s^2$,	$2s^2\ 2p^6$,	$3s^23p^63d^5$	$4s^0$

Hence, 13 electrons are present in the M-shell of M^{3+} state.

109. Atomic number of an element is equal to the number of

(a) protons (b) neutrons

(c) protons+electrons (d) protons+neutrons

UP CPMT-2005

Ans. (a) : Atomic number= number of protons
=number of electrons
Mass number = number of protons
+ number of neutrons

110. How many neutrons are present in tritium nucleus?

(a) 2 (b) 3

(c) 1 (d) 0

UP CPMT-2003

Ans. (a) : Tritium $({}^{3}_{1}H)$ is an isotope of hydrogen

$\therefore$ atomic number = 1

$\therefore$ protons = electrons = 1

No. of neutrons = Atomic mass–No. of protons
= 3–1
= 2

111. Which one of the following has unit positive charge and 1 amu mass?

(a) Electron (b) Neutron

(c) Proton (d) None of these

UP CPMT-2003

Ans. (c) : Mass of neutron = 1.675×10^{-24} g = 1.008 amu,
Charge = 0
Mass of electron = 9.11×10^{-28} g,
Charge unit negative = -1.602×10^{-19}C
Proton has mass of 1.677×10^{-24} g = 1.007 amu and proton has one unit positive charge = 1.602×10^{-19}C

112. The atomic number of an element is 17. The number of orbitals containing electron pairs in its valence shell is

(a) 3 (b) 4

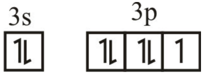
(c) 6 (d) 8

UP CPMT-2001

Ans. (a) : Write the electronic configuration and then count number of paired electrons in valence shell.

Atomic number 17 = $1s^2, 2s^2, 2p^6, 3s^2, 3p^5$

Valence shell has $3s^2$ and $3p^5$ orbitals



$\therefore$ Valence shell has 3 paired electrons.

113. The binding energy of an atom is 128 MeV. The binding energy per nucleon is 8, the number of nucleon is

(a) 4 (b) 8

(c) 16 (d) 32

UP CPMT-2001

Ans. (c) : Number of nucleons in an atom

$$= \frac{\text{binding energy of atom}}{\text{binding energy per nucleon}}$$

$$= \frac{128}{8} = 16$$

$\therefore$ Atom has 16 nucleons.

114. Which of the following is correct increasing order for the value of $\frac{e}{m}$?

(a) e < p < n < α (b) n < p < e < α

(c) n < p < α < e (d) n < α < p < e

UPTU/UPSEE-2015

Ans. (d) : n < α < p < e

	n	α	p	e
e	0	+2	+1	1
m	1	4	1	1/1836
$\frac{e}{m}$	0	$\frac{1}{2}$	1	1836

115. For which element the inertness of the electron pair will not be observe?

(a) Sn (b) Fe

(c) Pb (d) In

WB-JEE-2010

Ans. (b) : Inert pair effect is exhibited only by heavy metals of p–block elements. Fe belongs to d–block elements.

116. If species has 16 protons, 18 electrons 16 neutrons, find the species and its charge

(a) S^{1-} (b) Si^{2+}

(c) P^{3-} (d) S^{2-}

AP EAMCET (Engg.) 21.09.2020, Shift-II
COMEDK-2017
WB-JEE-2010

Ans. (d) : 16p means z=16
18 e means 2 unit negative charge is present.
Hence, species is S^{2-}

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2. Atomic Models

117. Which one of the following statements is correct?
(a) Rutherford's alpha-particle scattering experiment lead to the discovery of electron
(b) J. J. Thomson suggested that the nucleus of an atom contains protons
(c) The atomic number of an element is the same as the number of protons in the nucleus of its atom
(d) The mass number of an atom is equal to the number of electrons in its shells

NDA (II)-2015

Ans : (c) The atomic number of an element is the same as the number of proton in the nucleus of its atom.

118. Rutherford's alpha-particle scattering experiment was responsible for the discovery of
(a) Electron (b) Proton
(c) Nucleus (d) Helium

NDA (I)-2017

Ans : (c) Rutherford's alpha–particle scattering was responsible for the discovery of atomic nucleus. Nucleus contains most of the mass. Most of atom has empty space.

119. The number of periods present in the long form of the periodic table is :
(a) 6 (b) 7
(c) 8 (d) 18

AP-EAMCET (Med.)-1999

Ans. (b) : The number of groups in the long form of periodic table is 18. The number of periods in the long form of periodic table is 7.

120. Who discovered that cathode rays are made up of electrons
(a) William Crookes (b) G. J. Stoney
(c) R. A. Millikan (d) J. J. Thomson

MPPET- 2009

Ans. (d) :
- J.J. Thomson discovered that cathode rays are made up of electrons.
- William Crookes investigated cathode rays in 1879 and found that they were bent by a magnetic field.
- Robert Millikan was a physicist who discovered the elementary charge of electron using the oil drop experiment.
- G.J. Stoney – He is introducing the term electron as the "Fundamental unit quantity of electricity".

121. When 4p orbital in any atom is filled completely, the next electron goes in :
(a) 5s (b) 3d
(c) 4d (d) 4f

AP-EAMCET-1991

Ans. (a) : According to the Aufbau principle and (n + 1) rule, the orbitals with increasing order their energies is as follows,

$$\boxed{1s < 2s < 2p < 3s < 3p < 4s < 3d < 4p < 5s}$$

Therefore, after 4p orbital is completely filled, the next electron goes in 5s orbital.

122. According to Aufbau principle, the sub-shell which is occupied by the electron first has :
(a) higher energy (b) lower stability
(c) lower energy (d) can't b predicted

AP-EAMCET-1993

Ans. (c) : The Aufbau Principle states that in the ground state of atom or ion, electron fill atomic orbital of the lowest available energy level's before occupying higher levels (e.g. is before 2s). In this way, the electron of an atom or ion from the most stable electron configuration possible.

123. The constancy of $\frac{e}{m}$ ratio for electrons inspite of variations of gas present in the discharge tube or of the material of the cathode shows that :
(a) electrons are negatively charged
(b) electrons are universal constituents of matter
(c) electrons are the lightest of all particles
(d) mass of the electron is $\frac{1}{1838}$ of the mass of H-atom

AP-EAMCET-1994

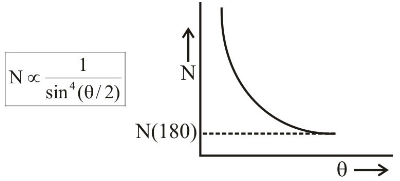
Ans. (b) : The constancy of e/m ratio for electrons inspite of variation of gas present in the discharge tube or the material of the cathode shows that electrons are universal constituents of matters.

124. Rutherford's experiment on scattering of α-particles showed for the first time that the atom has :
(a) nucleus (b) electron
(c) proton (d) neutron

AP-EAMCET-1995

Ans. (a) : Rutherford's show that for first time atom has positively charged nucleus through his □-particles scattering experiment.

Number of scattered particles–



125. In Rutherford's α-ray scattering experiment, the alpha particles are detected using a screen coated with :
(a) carbon black
(b) platinum black
(c) zinc sulphide
(d) polytetrafluoro ethylene

AP-EAMCET-1999

Ans. (c) : Rutherford's Alpha Scattering Experiment directed high energy streams of α-particles from a radioactive source at a thin sheet (100 nm thickness) of gold.

- In order to study the deflection caused to the α-particles, he placed a fluorescent zinc sulphide screen around the thin gold foil.

@apna_pdf

126. Which of the following statements is correct about the cathode rays ?

1. These rays start from anode and move towards cathode.

2. They are visible with human eye.

3. In presence of electric and magnetic fields, they behave like positively charged particles.

4. Their characteristic does not depend on the nature of material electrode.

(a) 1 (b) 2

(c) 3 (d) 4

AP EAMCET (Engg.) 21.09.2020, Shift-I

Ans. (d) : Characteristics of cathode rays are:

(1) The cathode rays start from cathode and move towards the anode. Thus, statement (1) is incorrect.

(2) These rays themselves are not visible but their behaviour can be observed with the help of phosphor materials such as ZnS. Thus, statement (2) is incorrect.

(3) In the absence of electrical or magnetic field, these rays travel in straight lines. In the presence of electrical or magnetic field, the behaviour of cathode rays are similar to that expected from negatively charged particles, suggesting that the cathode rays consist of negatively charged particles, called electrons. Thus statement (3) is incorrect.

(4) The characteristics of cathode rays (electrons) do not depend upon the material of electrodes and the nature of the gas present in the cathode ray tube. Hence, statement (4) is correct.

127. The nucleus of an atom contains

(a) Proton and electron

(b) Neutron and electron

(c) Proton and neutron

(d) Proton, neutron and electron

MPPET-2008

Ans. (c) : The nucleus of an atom contain of proton and neutron.

128. "The properties of elements are periodic functions of their atomic weights." This periodic law was given by

(a) Dobereiner (b) Lother Meyer

(c) Mendeleev (d) Alexander

AP EAMCET (Engg.) 17.09.2020 Shift-I

Ans. (c) : "The properties of elements are periodic functions of their atomic weights."

It is Mendeleev's periodic ion.

129. If the velocity of the electron in the hydrogen atom in its first orbit is 2.18 × 10^6 ms^{-1}, then will be the velocity of the electron in the second orbit of Li^{2+} ?

(a) $2.18\times10^6\text{ms}^{-1}$ (b) $3.27\times10^6\text{ms}^{-1}$

(c) $6.54\times10^6\text{ms}^{-1}$ (d) $1.45\times10^6\text{ms}^{-1}$

SCRA - 2009

Ans. (b) : Given: The velocity of electron in the first orbit $=2.18\times10^6\text{ms}^{-1}$

We know that, $V=2.18\times10^6\dfrac{z}{n}\text{ms}^{-1}$

There, n = 2 and z = 3 for Li

Putting these values, we get-

$$\Rightarrow V=\frac{2.18\times10^6\times3}{2}=3.27\times10^6\text{ms}^{-1}$$

So, option (b) is correct.

130. The number of protons. Neutrons and electrons in $^{13}_{6}$C respectively are —

(a) 6, 7, 6 (b) 13, 6, 6

(c) 6, 7, 13 (d) 6, 6, 13

AP EAPCET 20.08.2021 Shift-I

Ans. (a) : For 13_{C_6}

Atomic number = Number of protons = 6

Number of neutrons = Atomic mass number of protons

= 13 – 6 = 7

Number of electrons = number of protons = 6

131. The wavelength of a spectral line emitted by hydrogen atom in the Lyman series is $\dfrac{16}{15R}$ cm. What is the value of n$_2$? (R = Rydberg constant)

(a) 2 (b) 3

(c) 4 (d) 1

AIIMS-2011

Ans. (c) : For Lyman series.

$$\frac{1}{\lambda}=R\left[\frac{1}{n_1^2}-\frac{1}{n_2^2}\right]$$

$$\frac{15R}{16}=R\left[\frac{1}{1^2}-\frac{1}{n_2^2}\right]$$

$$\frac{15R}{16R}=\left[\frac{n_2^2-1}{n_2^2}\right]$$

$$\frac{15}{16}=\left[\frac{n_2^2-1}{n_2^2}\right]$$

$$16n_2^2-15n_2^2-16=0$$

$$n_2^2-16=0$$

$$n_2=4$$

132. In which of the following options, the law of triad is applicable?

(a) Na, K, Rb (b) Cl, Br, I

(c) C, N, O (d) Ca, Sr

TS-EAMCET 09.08.2021, Shift-I

Ans. (b) : For Dobereiner's triads, the atomic weight of a middle element is almost average of the other two.

The law of triad is applicable to following species.

1) For $\underset{35.5}{\text{Cl}}$ $\underset{80}{\text{Br}}$ and $\underset{126.9}{\text{I}}$ $=\dfrac{35.5+126.9}{2}=81.2$

2) For $\underset{7}{\text{Li}}$ $\underset{23}{\text{Na}}$ and $\underset{39}{\text{K}}$ $=\dfrac{7+39}{2}=23$

3) For $\underset{40}{\text{Ca}}$ $\underset{88}{\text{Sr}}$ and $\underset{137}{\text{Ba}}$ $=\dfrac{40+137}{2}=88.5$

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133. Match the following

	List-I		List-II
A.	Chadwick	I.	Cathode rays
B.	Rutherford	II.	X-rays spectra
C.	Mosley	III.	Discovery of neutrons
D.	J.J. Thomson	IV.	Nuclear atom model

The correct match is

	A	B	C	D
(a)	IV	I	II	III
(b)	III	II	IV	I
(c)	III	II	I	IV
(d)	III	IV	II	I

TS-EAMCET (Engg.), 06.08.2021

Ans. (d): List-I **List-II**

Chadwick → Discovery of neutrons

Rutherford → Nuclear atom model

Mosley → X-rays spectra

J.J. Thomson → Cathode rays

134. According to Moseley, a straight line group is obtained on plotting

(a) the frequencies of characteristics X-rays of elements against their atomic numbers

(b) the square of the frequencies of characteristics X-rays of elements against their atomic numbers

(c) the square root of the frequencies of characteristics X-rays of elements against the atomic numbers

(d) the reciprocal of the frequencies of characteristics X-rays of elements against the atomic numbers.

SRMJEEE – 2008

Ans. (c) : According to Moseley, the square root of the frequencies of characteristic X-rays of elements against the atomic numbers. $\sqrt{v} = a(Z-b)$

where, a = Proportionality constant

b = Another constant

Z = Atomic number

135. The position of both an electron and helium atom is known within 1.0 nm. The momentum of the electron is known within 5.0×10^{-26} kg ms^{-1}. The minimum uncertainty in the measurement of the momentum of the helium atom is

(a) 7.0×10^{-26} kg ms^{-1}

(b) 5.0×10^{-26} kg ms^{-1}

(c) 8.0×10^{-26} kg ms^{-1}

(d) 6.0×10^{-26} kg ms^{-1}

AIIMS-1994

Ans. (b) : The Heisenberg uncertainty principle

$$\Delta x \times \Delta p \geq \frac{h}{4\pi}$$

Where Δx = Uncertainty in position,

Δp = Uncertainty in momentum

$$\frac{h}{4\pi} = \text{constant}$$

As Δx is same for electron and helium and $\frac{h}{4\pi}$ is a constant, therefore minimum uncertainty in the measurement of the momentum of the helium atom will be same as that of an electron which is 5.0×10^{-26} kg ms^{-1}.

136. Television picture tube is basically

(a) cathode ray tube

(b) anode ray tube

(c) hybrid of cathode and anode tube

(d) none of the above

AMU-2014

Ans. (a) : The CRT (cathode ray tube) is basically the picture tube of a television set. A television screen is the front surface of a large picture tube, properly called a cathode ray tube.

137. The charge on an electron was discovered by :

(a) J.J. Thomson

(b) Neil Bohr

(c) James Chadwick

(d) Mullikan

BCECE-2004

Ans. (d) : The charge of the electron was measured by Mullikan in 1909 and it was found to be 1.602×10^{-19} coulombs.

138. Rutherford's famous experiment with α-particles used this metal

(a) Ni

(b) Au

(c) Fe

(d) Zn

BCECE-2009

Ans. (b) : Rutherford conducted an experiment by bombarding a thin sheet of gold (Au) with α-particles and then studied the trajectory of these particles after their interaction with gold foil.

139. Which of the following transition of an electron in H-atom will emit maximum energy?

(a) $n_6 \longrightarrow n_5$

(b) $n_1 \longrightarrow n_2$

(c) $n_3 \longrightarrow n_2$

(d) $n_4 \longrightarrow n_3$

BCECE-2017

Ans. (c) : We know that energy can we calculated by using formula $(E) = \frac{hc}{\lambda}$.

$$\frac{1}{\lambda} = RZ^2\left[\frac{1}{n_1^2} - \frac{1}{n_2^2}\right]$$

$$E = RZ^2hc\left[\frac{1}{n_1^2} - \frac{1}{n_2^2}\right]$$

When, transition is from $n_3 - n_2$, it produce highest energy.

140. The energy of an electron in nth orbit of hydrogen atom is

(a) $\frac{13.6}{n^4}$eV

(b) $\frac{13.6}{n^3}$eV

(c) $-\frac{13.6}{n^2}$eV

(d) $\frac{13.6}{n}$eV

CG PET -2007

Ans. (c) : Energy of an electron in Bohr's orbit is given by the relationship.

$$E_n = -\frac{13.6}{n^2}\text{eV}$$

141. Which of the following is incorrect regarding Rutherford's atomic model?

(a) Atom contains nucleus

(b) Size of nucleus is very small in comparison to that of atom

@apna_pdf

(c) Nucleus contains about 90% mass of the atom
(d) Electrons revolve around the nucleus with uniform speed.

HP CET-2018

Ans. (c) : According to Rutherford's majority of the mass was concentrated in a minute positively changed region (the nucleus surrounded by electrons).

142. Given below are two statements:
Statement-I Rutherford's gold foil experiment cannot explain the line spectrum of hydrogen atom.
Statement-II Bohr's model of hydrogen atom contradicts Heisenberg's uncertainty principle.
In the light of the above statements, choose the most appropriate answer from the options given below:
(a) Statement I is false but statement II is true.
(b) Statement I is true but statement II is false.
(c) Both statement I and statement II are false.
(d) Both statement I and statement II are true.

[JEE Main 2021, 27 July Shift-I]

Ans. (d) : Rutherford's gold foil experiment only proved that electrons are held towards nucleus by electrostatic forces of attraction and move in circular orbit with very high speeds.

Bohr's model gave exact formula for simultaneous calculation of speed and distance of electrons from the nucleus, something which was deemed impossible according to Heisenberg.

143. If the Thomson model of the atom was correct, then the result of Rutherford's gold foil experiment would have been
(a) All of the α-particles pass through the gold foil without decrease in speed.
(b) α-particles are deflected over a wide range of angles
(c) all α-particles get bounced back by 180^0.
(d) α-particles pass through the gold foil deflected by small angles and with reduced speed.

[JEE Main 2021, 27 July Shift-II]

Ans. (d) : As in Thomson model, protons are diffused (charge is not centered) α–
Particles deviate by small angles and due to repulsion from protons this speed decreases.

144. For d-electron, the orbital angular momentum is

(a) $\frac{\sqrt{6}\,h}{2\pi}$	(b) $\frac{\sqrt{2}\,h}{2\pi}$
(c) $h/2\pi$	(d) $2h/\pi$

J & K CET-(2004)

Ans. (a) : The angular momentum $L=\sqrt{l(l+1)}\cdot\frac{h}{2\pi}$

For d orbital, $l = 2$

$$\therefore L=\sqrt{2(2+1)}\cdot\frac{h}{2\pi}=\sqrt{6}.\frac{h}{2\pi}$$

145. Neutron is discovered by

(a) Chandwick	(b) Rutherford
(c) Yukawa	(d) Dalton

JIPMER-2008

Ans. (a) : Neutron was discovered by J. Chadwick in may 1932. According to Chadwick it is another sub-atomic particle and part of an atom. It has no charge i.e. it is electrically neutral and it is represented by n.

146. Which of the following is not true in Rutherford's nuclear model of atom?
(a) Protons and neutrons are present inside nucleus
(b) Volume of nucleus is very small as compared to volume of atom
(c) The number of protons and neutrons are always equal
(d) The number of electrons and protons are always equal

Manipal-2019

Ans. (c) : The sum of protons and neutrons give the mass number, the number of neutrons can be very different to the number of protons.

147. Rutherford's experiment on the scattering of α-particles showed for the first time that the atom has:

(a) electrons	(b) Protons
(c) Nucleus	(d) neutrons

UPTU/UPSEE-2005

Ans. (c) : The conclusion of Rutherford from his α-ray experiment are:
(i) Most of the space inside the atom is empty because most of the alpha–particles passed through the gold foil without getting deflected.
(ii) Very few particles were deflected from their path, indicating that the positive charge of the atom occupies very little space.
(iii) A very small fraction of alpha–particles were deflected by 180^o.

Indicating that all the positive charges and mass of the gold atom were concentrated in very small volume within the atom. From the data he also calculated that the radius of the nucleus is about 105 times less the radius of the atom.

3. Dual Nature of Electron

148. The energy of mole of photons of radiation of wavelength 300 nm is (given $h = 6.63 \times 10^{-34}$Js, $N_A = 6.02 \times 10^{23}$ mol^{-1} $C = 3 \times 10^8$ ms^{-1})

(a) 235 kJ mol^{-1}	(b) 325 kJ mol^{-1}
(c) 399 kJ mol^{-1}	(d) 435 kJ mol^{-1}

JEE Main-24.06.2022, Shift-II

Ans. (c) : Given,
Wavelength of photon = 300 nm
Planck's constant = 6.63×10^{-34} Js
$N_A = 6.02 \times 10^{23}$mol^{-1}
$C = 3 \times 10^8$ ms^{-1}

As we know that–

$$\text{Energy} = \frac{hc}{\lambda}$$

$$\text{Energy} = \frac{6.63\times10^{-34}\times3\times10^{8}}{300\times10^{-9}}$$

$$= 6.63 \times 10^{-19}\text{ J}$$

@apna_pdf

Energy of one mole of photon

$= 6.63 \times 10^{-19} \times 6.02 \times 10^{23}\ \text{mol}^{-1}$

$= 399$ kJ/mol.

149. If wavelength of photon is 2.2×10^{-11} m and $h = 6.6\times10^{-34}$ J s, then momentum of photon

(a) $1.452\times10^{-44}\,\text{kg m s}^{-1}$ (b) $6.89\times10^{43}\,\text{kg m s}^{-1}$

(c) $3\times10^{-23}\,\text{kg m s}^{-1}$ (d) $3.33\times10^{-22}\,\text{kg m s}^{-1}$

Karnataka CET-17.06.2022, Shift-II

Ans. (c) : Given that –

Wavelength of proton (λ) = 2.2×10^{-11} m

Planck's constant = 6.6×10^{-34} Js.

Momentum of photon = ?

According to de – Broglie equation

$$\lambda = \frac{h}{p}$$

$$p = \frac{h}{\lambda}$$

$$p = \frac{6.6\times10^{-34}}{2.2\times10^{-11}}$$

$$p = 3 \times 10^{-34} \times 10^{11}$$

$$p = 3 \times 10^{-23}\ \text{kg. ms}^{-1}$$

150. The minimum energy that must be possessed by photons in order to produce the photoelectric effect with platinum metal is [Given: The threshold frequency of platinum is $1.3\times 10^{15}\ s^{-1}$ and $h = 6.6 \times 10^{-34}$ Js.]

(a) 3.21×10^{-14} J (b) 6.24×10^{-16} J

(c) 8.58×10^{-19} J (d) 9.76×10^{-20} J

JEE Main-25.06.2022, Shift-II

Ans. (c) : Given,

Threshold frequency of platinum = $1.3 \times 10^{15}\ s^{-1}$

Planck's constant (h) = 6.6×10^{-34} Js

As we know that–

$$\text{Energy} = \frac{hc}{\lambda}$$

And frequency (ν) $= \frac{c}{\lambda}$

Then,

Energy = hν

$= 6.6 \times 10^{-34}\ \text{Js} \times 1.3 \times 10^{15}\ s^{-1}$

$= 8.58 \times 10^{-19}$ J

151. A particle of mass 6.6×10^{-31} kg is moving with a velocity of $1 \times 10^{7}\ ms^{-1}$. The de Broglie wavelength (in Å) associated with the particle, is ($h = 6.6 \times 10^{-34}$ Js)

(a) 1 (b) 10

(c) 5 (d) 2

(e) 4

Kerala CEE -03.07.2022

Ans. (a) : Given that –

Mass particle (m) = 6.6×10^{-31} kg

Velocity of particle (v) = 1×10^{7} m/s

Wave length (λ) = ?

$h = 6.6 \times 10^{-34}$ Js

We know that –

$$\lambda = \frac{h}{mv}$$

$$\lambda = \frac{6.6\times10^{-34}}{6.6\times10^{-31}\times10^{7}}$$

$$\lambda = 10^{-34} \times 10^{24}$$

$$\lambda = 10^{-10}$$

$$\lambda = 1\text{A}^{o}$$

$\therefore\ 1\text{A}^{o} = 10^{-10}$

152. What is the approximate wavelength in Å of a photon having energy 2eV? [Planck's constant = 6.63×10^{-34}J.s]

(a) 6200 (b) 5100

(c) 4600 (d) 3900

SCRA-2010

Ans. (a) : We know that, E = nhν

Where, h = Planck's constant (6.67×10^{-34} Js)

ν = Frequency of radiation

c = Velocity of light (3×10^{8} m/s)

$$\therefore \quad E = nh\frac{c}{\lambda}$$

$$\text{or} \quad \lambda = \frac{nhc}{E}$$

$$\text{or} \quad \lambda = \frac{6.67\times10^{-34}\times3\times10^{8}}{1.6\times10^{-19}} \qquad (1\text{eV}) = 1.6\times10^{-19}\ \text{J}$$

$$\lambda = \frac{20.01\times10^{-7}}{2\times1.6}$$

$$\lambda = 6.2531\times10^{-7}$$

$$\lambda = 6253\times10^{-10}$$

$$\text{or} \quad \lambda = 6253\text{Å}$$

153. The longest wavelength present in Balmer series lines is [Given Rydberg constant = $1.097 \times 10^{7}\ m^{-1}$]

(a) 640 nm (b) 656 nm

(c) 662 nm (d) 670 nm

SCRA-2014

Ans. (b) : In the Balmer series, the energy gap is very less between n = 2 to n = 3.

So, the wavelength high in nature.

Given that, Rydberg constant = $1.097 \times 10^{7}\ m^{-1}$

Using the following Formula–

$$\bar{\nu} = 1.097 \times 10^{7}\left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right)$$

$$\text{or} \quad \bar{\nu} = 1.097\times10^{7}\left(\frac{1}{4}-\frac{1}{9}\right)$$

$$\text{or} \quad \bar{\nu} = 1.097\times10^{7}\times\frac{5}{36}$$

$$\text{or} \quad \bar{\nu} = 0.1523\times10^{7}\ \text{m}^{-1}$$

We know that,

$$\lambda = \frac{1}{\bar{\nu}}$$

@apna_pdf

$$\lambda = \frac{1}{0.1523\times10^{7}\,m^{-1}}$$

$$\lambda = 6.56\times10^{-7}\,m$$

or $\lambda = 656nm$

154. The energy of an electromagnetic radiation is 19.875×10^{-13} erg. What is its wave number in cm^{-1} ? ($h=6.625\times10^{-27}$ erg-s; $c=3\times10^{10}$ cm s^{-1})

(a) 1000 (b) 10^{6}

(c) 100 (d) 10,000

AP-EAMCET-2002

Ans. (d) : Given that :

$E = 19.875 \times 10^{-13}$ erg

$h = 6.625 \times 10^{-27}$ erg sec.

$C = 3 \times 10^{10}$ cm.sec^{-1}

$\therefore$ $E = h\overline{v}$

$$\overline{v} = \frac{E}{h}$$

$$\overline{v} = \frac{19.875\times10^{-13}}{6.625\times10^{-27}\times3\times10^{10}}$$

$\overline{v} = 10^{4} = 10,000$

155. If the wavelength of an electromagnetic radiation is 2000 Å, what is its energy in erg?

(a) 9.94×10^{-12} (b) 9.94×10^{-19}

(c) 4.97×10^{-12} (d) 4.97×10^{-19}

AP-EAMCET-2003

Ans. (a) : Given, □ = 2000 Å = 2000 × 10^{-10}m, E = ?

$$\therefore \quad E = \frac{hc}{\lambda} = \frac{6.626\times10^{-27}\,\text{erg sec}\times3\times10^{8}\,m/sec}{2000\times10^{-10}\,m}$$

$= 9.94 \times 10^{-12}$ erg

156. The energy of a photon is 3×10^{-12} erg. What is its wavelength in nm?
($h = 6.62 \times 10^{-27}$ erg-s, $c = 3 \times 10^{10}$ cm s^{-1})

(a) 662 (b) 1324

(c) 66.2 (d) 6.62

AP-EAMCET-2006

Ans. (a) : Given that :

$E = 3 \times 10^{-12}$ erg

$h = 6.62 \times 10^{-27}$ erg – s

$C = 3 \times 10^{10}$ cm/sec

$\therefore$ we know that :

$$E = \frac{hc}{\lambda}$$

$$\lambda = \frac{6.62\times10^{-27}\times3\times10^{10}}{3\times10^{-12}}$$

$\lambda = 6.62 \times 10^{-27+22}$

$\lambda = 6.62 \times 10^{-5}$ cm

$\lambda = 662 \times 10^{-7}$ cm

$\lambda = 662 \times 10^{-9}$ m

$\lambda = 662$ nm

157. The velocities of two particles A and B are 0.05 and 0.02 ms^{-1} respectively. The mass of B is five times the mass of A. The ratio of their de-Broglie's wavelength is :

(a) 2 : 1 (b) 1 : 4

(c) 1 : 1 (d) 4 : 1

AP-EAMCET-2008

Ans. (a) : Given that :

velocity of A = 0.05 m/sec.

velocity of B = 0.02 m/sec.

Let, the mass of particle A = x

$\therefore$ mass of particle B = 5x

According to de-Broglie equation

$$\lambda = \frac{h}{mv}$$

For particle A : $\lambda_A = \dfrac{h}{x\times0.05}$ (i)

For particle B : $\lambda_B = \dfrac{h}{5x\times0.02}$ (ii)

Divide equation (i) and (ii) we get

$$\frac{\lambda_A}{\lambda_B} = \frac{5x\times0.02}{x\times0.05} = \frac{2}{1}$$

$\lambda_A : \lambda_B = 2 : 1$

158. Two particles of masses m & 2m have equal kinetic energies. The de-Broglie wavelength are in the ratio of_____

(a) 1 : 1 (b) 1 : 2

(c) $1 : \sqrt{2}$ (d) $\sqrt{2} : 1$

AP EAPCET 23-08-2021 Shift-I

Ans. (d) : de-Broglie wavelength equation is-

$$\lambda = \frac{h}{p} = \frac{h}{mv}$$

where,

λ = Wavelength

h = Planck's constant

P = Momentum

m = Mass of the particle

v = Velocity

$\therefore$ P = mv

Squaring both side and divide 1/2 we get-

$$\frac{1}{2}P^2 = \frac{1}{2}m^2v^2$$

$$\frac{1}{2}P^2 = (K.E.).m \qquad \left\{\therefore K.E. = \frac{1}{2}mv^2\right\}$$

$$P = \sqrt{2(K.E.)m}$$

$$\text{So, } \lambda = \frac{h}{\sqrt{2(K.E.)m}}$$

Given, two particles of mass m and 2m and kinetic energy are same –

$$\lambda_1 = \frac{h}{\sqrt{2(K.E.).m}} \qquad ....(i)$$

$$\lambda_2 = \frac{h}{\sqrt{2(K.E.)2m}} \qquad ....(ii)$$

dividing (i) & (ii) we get

$$\frac{\lambda_1}{\lambda_2} = \frac{h}{\sqrt{2(KE)m}} \times \frac{\sqrt{2(KE)2m}}{h}$$

$$\frac{\lambda_1}{\lambda_2} = \frac{\sqrt{2}}{1}$$

$\therefore$ Wavelength ratio $= \sqrt{2} : 1$

@apna_pdf

159. With what velocity must an electron travel so that its momentum is equal to that of a photon of wavelength 663 nm?

(a) 1098 m/s (b) 109.8 m/s

(c) 10.98 m/s (d) 1.098 m/s

AP EAPCET 23-08-2021 Shift-I

Ans. (a) : Given, $\lambda = 663\text{ nm} = 663\times10^{-9}$ m

$m_e = 9.1\times10^{-31}$ kg

V = ?

$$\therefore \quad \lambda = \frac{h}{p} = \frac{h}{m_e v}$$

Where, h = Planck's constant

p = Momentum

$$V = \frac{h}{m_e\lambda}$$

$$V = \frac{6.626\times10^{-34}}{9.1\times10^{-31}\times663\times10^{-9}}$$

$$V = \frac{6.626}{9.1\times663}\times10^{6}$$

V = 1098 m/sec.

160. The ratio of de-Broglie wavelength of two particles A and B is 2 : 1. If the velocities of A and B are 0.05 ms^{-1} and 0.02 ms^{-1} respectively then the ratio of their masses $M_A : M_B$ must be ______.

(a) 5 : 1 (b) 10 : 1

(c) 1 : 5 (d) 1 : 8

AP-EAMCET 25-08-2021 Shift - I

Ans. (c) : From de-Broglie equation–

$$\lambda = \frac{h}{mv}$$

Where, λ = Wavelength

h = Planck's constant

$$\therefore \quad \frac{\lambda_A}{\lambda_B} = \frac{m_B V_B}{m_A V_A}$$

$$\frac{m_A}{m_B} = \frac{\lambda_B V_B}{\lambda_A V_A}$$

$$= \frac{1\times0.02}{2\times0.05}$$

$$= \frac{0.01}{0.05}$$

$$\boxed{m_A : m_B = 1:5}$$

161. The relation between the stopping potential (V_0) and frequency (ν) is correctly represented in [ϕ = Work function]

(a) $V_0 = \frac{\phi}{e} - \frac{h\nu^2}{e}$ (b) $V_0 = \frac{he}{\nu} + \frac{\phi}{e}$

(c) $V_0 = \frac{h\nu}{e} - \frac{\phi}{e}$ (d) $V_0 = \frac{h\nu}{e^2}$

TS-EAMCET (Engg.), 05.08.2021 Shift-II

Ans. (c) : The relation between the stopping potential (V_0) and frequency (ν) is correctly represented by the following equation.

$$\boxed{V_0 = \frac{h\nu}{e} - \frac{\phi}{e}}$$

Where, V_0 = Stopping potential

ν = Frequency

ϕ = Work function

162. The energy required to overcome the attractive forces on the electrons, w, of some metals is listed below. The number of metals showing photoelectric effect when light of 300 nm wavelength falls on it is

(1eV = 1.6 × 10^{-19} J)

Metal	**Li**	**Na**	**K**	**Mg**	**Cu**	**Ag**	**Fe**	**Pt**	**W**
w(eV)	**2.4**	**2.3**	**2.2**	**3.7**	**4.8**	**4.3**	**4.7**	**6.3**	**4.75**

(a) 6 (b) 8

(c) 5 (d) 4

AP EAMCET (Medical) - 2013

Ans. (d) : Given:

wavelength (λ) = 300 nm = 300×10^{-9} m

1 eV = 1.6 × 10^{-19} J

∴ Energy of a photon of radiation of wavelength 300nm will be -

E = hν

or $E = \frac{hc}{\lambda}$

or $E = \frac{6.6\times10^{-34}(\text{JS})\times3\times10^{8}\left(\text{ms}^{-1}\right)}{300\times10^{-9}\text{m}}$

or $E = 6.6\times10^{-19}$J

$E = \frac{6.6\times10^{-19}}{1.6\times10^{-19}}$eV

or E = 4.14 eV

There are 4 metals for which the energy required to overcome the attractive forces on the electrons, w, is less than 4.14 eV, the energy of light of wavelength 300 nm. Thus the number of metals showing a photoelectric effect is 4.

163. If, the binding energy of electrons in a metal is 250 kJ/mol, what should be the threshold frequency of the striking photons in order to free an electron from the metal surface ?

(a) 6.26 × 10^{14} s^{-1} (b) 12.4 × 10^{14} s^{-1}

(c) 6.26 × 10^{12} s^{-1} (d) 12.4 × 10^{12} s^{-1}

AP EAMCET (Engg.) 21.09.2020, Shift-I

Ans. (a) Binding energy of 1 mole of electrons = 250 kJ

Binding energy of 1 electron = (250)/(6.022 × 10^{23}) kJ

= 4.15 × 10^{-22} kJ

= 4.15 × 10^{-19} J

Threshold energy ($h\nu_0$) = Binding energy

∴ $h\nu_0$ = 4.15 × 10^{-19} J

or ν_0 = (4.15 × 10^{-19} J)/ h

= (4.15 × 10^{-19} J)/(6.626 × 10^{-34} J s)

= 6.26 × 10^{14} s^{-1}

Hence, the correct option is (a).

164. de Broglie was awarded the Nobel Prize in the year

(a) 1921 (b) 1922

(c) 1929 (d) 1928

TS EAMCET 10.08.2021, Shift-I

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Ans. (c) : de Broglie was awarded by Nobel Prize in 1929 for his discovery of the wave nature of electrons.

165. Upon irradiation with radiation of a suitable wavelength on the cathode, the photocurrent produced was reduced to zero by applying a stopping potential of 2.63 V. If the work function of the cathode is 4.3 eV. Find the approximate wavelength of the radiation (in nm)How many among the given species have the highest bond order? CN^-, CO, NO^+, O_2^+, O_2, N_2

(a) 224 (b) 179

(c) 190 (d) 165

TS EAMCET 10.08.2021, Shift-I

Ans. (b) : By Einstein photoelectric equation

$$KE_{max} = h\nu - \phi, \boxed{KE_{max} = ev}$$

$$ev = \frac{hc}{\lambda} - \phi \qquad \phi = \text{wort function}$$

$$\frac{hc}{\lambda} = ev + \phi \qquad c = 3\times10^8 m/s$$

$$\lambda = \frac{hc}{ev+\phi} \qquad h = 6.63\times10^{-34}/s$$

$$\lambda = \frac{6.63\times10^{-34}\times3\times10^8}{1.6\times10^{-19}\times2.63+1.6\times10^{-19}\times4.3}$$

$$\lambda = \frac{19.89\times10^{-26}}{1.6\times10^{-19}(2.63+4.3)}$$

$$\lambda = \frac{19.89\times10^{-26}\times10^{19}}{1.6\times6.93}$$

$$\lambda = 1.792\times10^{-7}$$

$$\lambda = 179.2\times10^{-9}$$

$$\boxed{\lambda = 179nm}$$

166. The work functions of Ag, Mg, K and Na respectively in eV are 4.3, 3.7, 2.25, 2.30, When an electromagnetic radiation of wavelength of 300 nm is allowed to fall on these metal surface, the number of metals from which the electrons are ejected is (1ev = 1.6022 × 10^{-19}J)

(a) 4 (b) 3

(c) 2 (d) 5

AP EAMCET-2017

Ans. (b) : Given that,

λ = 300 nm = 300 × 10^{-9} m

$$E = \frac{hc}{\lambda}$$

$$E = \frac{6.6\times10^{-34}\times3\times10^8}{300\times10^{-9}}$$

$$E = \frac{19.8\times10^{-26}}{300\times10^{-9}}$$

E = 6.6 × 10^{-19} Joule

And work function for Ag, Mg, K and Na in Joules are –

Ag = 4.3 × 1.6022 × 10^{-19} = 6.89 ×10^{-19} Joule

Mg = 3.7 × 1.6022 × 10^{-19} = 5.93 × 10^{-19} joule

K = 2.25 × 1.6022 × 10^{-19} = 3.60 × 10^{-19} joule

Na = 2.30 × 1.6022 × 10^{-19} = 3.68 × 10^{-19} Joule

Thus Mg, K and Na metal will eject electron only when W ≤ $E_{(300)}$.

Hence the option (b) is correct

167. $[Ti(H_2O)_6]^{3+}$ absorbs light of wavelength 498 nm during a d - d transition. The octahedral splitting energy for the above complex is ---------×10^{-19} J. (Round off to the Nearest Integer). h = 6.626×10^{-34} Js; c = 3×10^8 ms^{-1}

JEE Main 16.03.2021, Shift-II

Ans. (4) : Given-λ = 498nm

The octahedral splitting energy is:

$$\Delta_0 \text{ or } E = \frac{hc}{\lambda}$$

$$E = \frac{6.66\times10^{-34}\times3\times10^8}{498\times10^{-9}}$$

or E = 4.00×10^{-19}J (rounding off)

168. Calculate the wave number and frequency of orange radiation having wavelength 6300 Å.

(a) $1.587\times10^8 m^{-1}, 4.761\times10^{16} s^{-1}$

(b) $1.587\times10^4 m^{-1}, 4.761\times10^{14} s^{-1}$

(c) $1.587\times10^6 m^{-1}, 4.761\times10^{14} s^{-1}$

(d) $1.587\times10^6 m^{-1}, 4.761\times10^{16} s^{-1}$

AP EAMCET (Engg.) 17.09.2020 Shift-I

Ans. (c) : For orange radiation (EMR) of λ = 6300Å

(i) Wave number,

$$\bar{v} = \frac{1}{\lambda} = \frac{1}{6300Å} = \frac{1}{6300\times10^{-10}m}$$

= 1.587 × 10^6 m^{-1}

(ii) Frequency, $$\frac{c}{\lambda} = \frac{3\times10^8 ms^{-1}}{6300\times10^{-10}m}$$

= 4.761 × $10^{14}$$s^{-1}$

169. Which of the following statements is correct about photoelectric effect ?

(A) The number of electrons ejected from metal surface is inversely proportional to intensity of light.

(B) Below threshold frequency, photoelectric effect can be observed.

(C) At higher frequency than threshold frequency, the ejected electrons have certain kinetic energy.

(D) At higher frequency than threshold frequency, the electron is still on the metal surface.

(a) 1 (b) 2

(c) 3 (d) 4

AP EAMCET (Engg.) 18.09.2020, Shift-I

Ans. (c) : Kinetic energy of photoelectrons

KE = hv – hv_0

⇒ When > V_0, KE > 0

So, statement C is correct.

Where, v = Frequency of incident light

V_0 = Threshold frequency

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Now, other options will be correct when

A. Number of photoelectrons ejected from metal surface intensity of light.

B. When, $v < V_0$, $KE < 0$ phtoelectric effect cannot be observed.

D. When, $v = v_0$, $KE = 0$ the electrons will be still on the metal surface.

170. Calculate energy of half mole of photons of a radiation with frequency 3×10^{12} Hz.

(a) 598.2 kJ mol^{-1} (b) 0.598 kJ mol^{-1}

(c) 1.196 kJ mol^{-1} (d) 119.6 kJ mol^{-1}

AP EAMCET (Engg.) 21.09.2020, Shift-II

Ans. (b) : Energy of a photon, E = hv, where,

v = Frequency = 3×10^{12} Hz

Therefore, energy

$= 6.6 \times 10^{-34} \times 3 \times 10^{12}$ Hz $= 1.9878 \times 10^{-21}$ J

1 mole $= 6.02 \times 10^{23}$ photons,

Therefore, $\frac{1}{2}$ mole $= 3.01 \times 10^{23}$ photons

Therefore, energy of $\frac{1}{2}$ mole of photons

$= 1.9878 \times 10^{-21} \times 3.01 \times 10^{23}$

= 0.5982 kJ/mol

Hence, the correct option is (b).

171. One mole of alkene $\underline{X}$ on ozonolysis gave one mole of acetaldehyde and one mole of acetone. The IUPAC name of $\underline{X}$ is

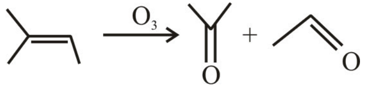
(a) 2-methyl-2butene (b) 2-methyl-1-butene

(c) 2-butene (d) 1-butene

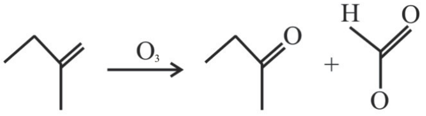
AP EAMCET (Engg.)-2009

Ans. (a): $X \xrightarrow{O_3} CH_3CHO + CH_3COCH_3$

The molecule X must be a compound containing 5 carbon atoms, and thus, X cannot be 1–butene or 2–butene as they contain 4 carbon atoms only.



2–methyl–2–butene



2-methyl – 1 – butene

2–methybut –2– ene gives desired products.

172. The de-Broglie wavelength of a tennis ball of mass 60 g moving with a velocity of 10 ms^{-1} is approximately .... (Planck's constant h = 6.63 × 10^{-34} J. s)

(a) 1.1×10^{-31} m (b) 1.1×10^{-33} m

(c) 1.1×10^{-34} m (d) 1.1×10^{-32} m

AP EAMCET (Engg.) 18.9.2020 Shift-I

Ans. (b) : de-Broglie's wave equation is

$$\lambda = \frac{h}{mv} = \frac{6.63 \times 10^{-34}}{\left(60 \times 10^{-3}\right) \times 10} = 1.10 \times 10^{-33} \text{m}$$

[m = Mass of the ball = 60g = 60×10^{-3}kg,

v = velocity of the ball = 10 ms^{-1}]

173. If two particles A and B are moving with the same velocity. But wavelength of A is found to be double than that of B. Which of the following statements are correct?

(a) Both A and B have same mass

(b) Mass of A is half that of B

(c) Mass of B is half that of A

(d) Mass of B is one-fourth that of A

AP EAPCET 19-08-2021 Shift-I

Ans. (b) : From the equation of De-Broglie

$\lambda = \frac{h}{p}$ Where λ = wavelength

Or $\lambda = \frac{h}{m.v}$ h = Plank's constant

P = Momentum

For particle A –

$$2\lambda = \frac{h}{m_A v} \ \ldots\ldots (i)$$

For particle B –

$$\lambda = \frac{h}{m_B v} \ \ldots\ldots (ii)$$

From equation (i) and (ii)

$$2 = \frac{h}{m_A v} \times \frac{m_B v}{h}$$

Or $$2 = \frac{m_B}{m_A}$$

$$m_A = \frac{m_B}{2}$$

174. Identify the correct statements regarding Balmer series: The wave number of each line in the spectrum of atomic hydrogen is given the equation $\bar{v} = R_H\left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right)$ where R_H is a constant and n_1 and n_2 are integers.

(i) As wave length decrease, the lines in the series constant

(ii) The integer n_1 is equal to 2

(iii) The ionization energy of hydrogen can be calculated from the wave number of these lines

(iv) The line of longest wavelength corresponds to $n_2 = 3$

Options:

(a) (i), (ii) & (iii) only (b) (i), (iii) & (iv) only

(c) (ii) & (iv) only (d) (ii), (iii) & (iv) only

AP EAPCET-6 Sep. 2021, Shift-II

Ans. (c) : Explanation:– For Balmer series in the spectrum of hydrogen,

$$\bar{v} = R_H\left[\frac{1}{n_1^2} - \frac{1}{n_2^2}\right]$$

Where, R_H = Rydberg's constant Incase of Balmer series, transition takes place from various energy levels such as n_2 =3,4,5…..to n_1=2.

@apna_pdf

For longest wavelength, minimum energy transition takes place $n_2 = 3$ to $n_1 = 2$. Since, energy is inversely proportional to wavelength.

i.e, $\boxed{E \propto \frac{1}{\lambda}}$ As, the wavelength decreases, the lines in the series converge.

175. It the work function for the photoelectron emission of a mental is 3.75 e*V*, then the threshold wave length of the radiation needed for the ejection of the electron is approximately_____.

(a) 315 nm (b) 280 nm
(c) 330 nm (d) 290 nm

AP EAPCET 20.08.2021 Shift-II

Ans. (c): $\lambda(\in \text{Å}) = \frac{12.375}{3.75}\text{Å} \approx 3300\text{Å}$

$\text{Or}\,\lambda \approx 330\,\text{nm} \quad [\because 1\,\text{Å} = 0.1\text{ nm}]$

176. A 150 watt bulb emits light of wavelength 6600 Å and only 8% of the energy is emitted as light. How many photons are emitted by the bulb per second?

(a) 4×10^{19} (b) 3.24×10^{19}
(c) 4.23×10^{20} (d) 3×10^{20}

COMEDK-2014

Ans. (a) : Power of the bulb= 150 watt= 150 J s^{-1}

As only 8% of the energy is emitted as light so, the total energy emitted per second

$$= \frac{150\text{J}\times 8}{100} = 12\text{J}$$

Energy of one photon, $E = h\upsilon = \frac{hc}{\lambda}$

$$= \frac{(6.626\times10^{-34}\,\text{Js})\times(3\times10^{8}\,\text{m s}^{-1})}{6600\times10^{-10}\,\text{m}} = 3.0118\times10^{-19}\text{ J}$$

$\therefore$ Number of photons emitted

$$= \frac{12\text{J}}{3.0118\times10^{-19}\,\text{J}} = 3.98\times10^{19} \approx 4.0\times10^{19}$$

177. The energy of an electromagnetic radiation is 3 × 10^{-12} ergs. What is the wavelength in nanometers?
h = 6.625 × 10^{-27} erg sec.,
c = 3 × 10^{10} cm sec.$^{-1}$

(a) 400 (b) 228.3
(c) 3000 (d) 662.5

AP-EAMCET (Medical), 2002

Ans. (d) : Given that –

$E = 3 \times 10^{-12}$ ergs
λ = ? (nanometer)
$h = 6.625 \times 10^{-27}$ erg. sec
$C = 3 \times 10^{10}$ cm sec^{-1}

Now, $E = \frac{hc}{\lambda}$

or $\lambda = \frac{hc}{E}$

or $\lambda = \frac{6.625\times10^{-27}\,(\text{erg.sec})\times 3\times10^{10}\,(\text{cm sec}^{-1})}{3\times10^{-12}\,(\text{ergs})}$

or $\lambda = 6.625 \times 10^{-5}$ cm
or $\lambda = 6.625 \times 10^{-7}$ m
or $\lambda = 662.5 \times 10^{-9}$ m
or $\lambda = 662.5$ nm

178. Calculate the velocity of an electron having wavelength of 0.15 nm. Mass of an electron is 9.109 × 10^{-28} grams. (h = 6.626 × 10^{-27} erg-second).

(a) 4.85×10^{8} cm. sec.$^{-1}$
(b) 2.062×10^{15} cm. sec.$^{-1}$
(c) 2.062×10^{10} cm. sec.$^{-1}$
(d) 4.85×10^{9} cm. sec.$^{-1}$

GUJCET-2011

Ans. (a): Given that,

$\lambda = 0.15\text{ nm} = 0.15 \times 10^{-9}$ m
$M = 9.109 \times 10^{-28}$ gm $= 9.109 \times 10^{-31}$ kg
$h = 6.626 \times 10^{-27}$ erg-second $= 6.626 \times 10^{-34}$ J sec.

According to de Broglie equation–

$$\lambda = \frac{h}{p} = \frac{h}{mv}$$

$$v = \frac{h}{m\lambda} = \frac{6.626\times10^{-34}}{9.109\times10^{-31}\times0.15\times10^{-9}}$$

$v = 4.8494 \times 10^{6}$ m/sec $= 4.849 \times 10^{8}$ cm/sec.

179. Which of the following relations is correct, if the wavelength (λ) is equal to the distance travelled by the electron in one second?
h is the Planck's constant and m is the mass of electron

(a) $\lambda = h/p$ (b) $\lambda = h/m$
(c) $\lambda = \sqrt{h/p}$ (d) $\lambda = \sqrt{h/m}$

TS EAMCET 04.08.2021, Shift-I

Ans. (d) : We know that–

$$\lambda = \frac{h}{mv} \quad .....(i)$$

Here, m = Mass of electron
v = Velocity of electron
λ = Wavelength of electron

If wavelength (λ) is equal to distance travelled by the electron in one second i.e.

$\lambda = v$

Put in equation (i), we get–

$$\lambda = \frac{h}{m\lambda}$$

$$\Rightarrow \quad \lambda^2 = \frac{h}{m}$$

$$\boxed{\lambda = \sqrt{\frac{h}{m}}}$$

180. When light of wavelength 248nm falls on a metal of threshold energy 3.0 eV, the de-Broglie wavelength of emitted electrons is______Å. (Round off to the Nearest Integer).

$[m_e = 9.1\times10^{-31}\text{kg}; c = 3.0\times10^{8}\text{ms}^{-1}; 1\text{eV} = 1.6\times10^{-19}\text{Js}]$

JEE Main 16.03.2021, Shift-I

@apna_pdf

Ans. (9Å) : Given that, Wavelength $(\lambda) = 248\text{nm}$

Threshold energy $(\phi) = 3.0\text{eV}$

de–Broglie wavelength $(\lambda) = ?$

Now, Energy incident $= \frac{hc}{\lambda}$

Where, h = Planck's constant
c = Speed of light
$\lambda =$ Wavelength

$$\therefore\ E = \frac{6.6\times10^{-34}\times3\times10^{8}}{248\times10^{-19}\times1.6\times10^{-19}}\text{eV}$$

$E = 5\text{eV}$

From the Einstein photoelectric equation–

$E = \phi + \text{K.E.}$

or K.E. = 5 eV – 3 eV

or K.E. = 2 eV

or K.E. $= 2\times1.6\times10^{-19} = 3.2\times10^{-19}$ J

For de-Broglie wavelength $(\lambda) = \frac{h}{mv}$

$$\text{K.E.} = \frac{1}{2}mv^2$$

So, $v = \sqrt{\frac{2(\text{K.E.})}{m}}$

Hence, $\lambda = \frac{h}{\sqrt{2(\text{K.E.})\times m}}$

or $\lambda = \frac{6.6\times10^{-34}}{\sqrt{2\times3.2\times10^{-19}\times9.1\times10^{-31}}}$

or $\lambda = \frac{6.6\times10^{-34}}{\sqrt{58.24\times10^{-50}}}$

or $\lambda = 9$ Å

181. If the energies of two light radiations E_1 and E_2 are 25 eV and 100 eV respectively, then their respective wavelength λ_1 and λ_2 would be in the ratio $\lambda_1 : \lambda_2 =$ ______

(a) 2:1 (b) 4:1
(c) 1:4 (d) 1:2

AP EAPCET 19-08-2021, Shift-II

Ans. (b) : Given that, $E_1 = 25$ eV, $E_2 = 100$ eV

$\lambda_1 : \lambda_2 = ?$

From the equation of energy -

$$E = \frac{hc}{\lambda}$$

Where, E = Energy
h = Planck's constant
λ = Wavelength
c = Speed of light

For first radiation–

$$E_1 = \frac{hc}{\lambda_1} \Rightarrow \frac{hc}{25\text{ eV}} = \lambda_1 \quad \text{...(i)}$$

For second radiation–

$$E_2 = \frac{hc}{\lambda_2} \Rightarrow \frac{hc}{100\text{ eV}} = \lambda_2 \quad \text{...(ii)}$$

Dividing equation (i) by (ii) we get–

$$\frac{\lambda_1}{\lambda_2} = \frac{hc}{25\text{ eV}}\times\frac{100\text{eV}}{hc}$$

$\lambda_1 : \lambda_2 = 4 : 1$

182. de Broglie relationship has no significance for

(a) An electron (b) A proton
(c) A neutron (d) An iron ball.

SRMJEEE – 2009

Ans. (d) : According to the de-Broglie, every object in motion has a wave character. The wavelength associated with ordinary objects are so sort because of their large masses that their wave properties cannot be detected. The light mass of the particle can be detected experimentally but not in the case of large mass.

183. The wavelength associated with a particle of mass 3.313×10^{-31} kg moving with velocity 10^3 m/s is

(a) 2×10^{-6} m (b) 2×10^{-6} cm
(c) 2×10^{-7} m (d) 2×10^{-7} cm

SRMJEEE – 2010

Ans. (a) : Given that, Mass of particle = 3.313×10^{-31}kg

$v = 10^3$ m/s, λ = ?

Now, from de–Broglie equation –

$$\lambda = \frac{h}{p}$$

Where, λ = Wavelength
h = Planck's constant
p = Momentum

$$\therefore\ \lambda = \frac{6.626\times10^{-34}\text{kgm}^2\text{s}^{-1}}{3.313\times10^{-31}\text{kg}\times10^{3}\text{ms}^{-1}}$$

$= 2 \times 10^{-6}$ m

184. Which one of the following frequencies of radiation (in Hz) has a wavelength of 600 nm?

(a) 2.0×10^{13} (b) 5.0×10^{16}
(c) 2.0×10^{14} (d) 5.0×10^{14}

AP-EAMCET- (Engg.)-2011

Ans. (d) : Given that,

Wavelength (λ) = 600 nm = 600×10^{-9} m

We know that–

$$\nu = \frac{c}{\lambda} = \frac{3\times10^{8}}{600\times10^{-9}}$$

$\nu = 5\times10^{14}$ Hz.

185. If the kinetic energy of a particle is reduced to half, de-Broglie wavelength becomes :

(a) 2 times (b) $\frac{1}{\sqrt{2}}$ times
(c) 4 times (d) $\sqrt{2}$ times

AP-EAMCET (Engg.) 2015

Ans. (d) : Given that, $(\text{K.E.})_2 = 1/2\ (\text{K.E.})_1$

According to de-Broglie equation

$$\lambda = \frac{h}{mv} = \frac{h}{p} = \frac{h}{\sqrt{2m\text{K.E.}}}$$

Where, K.E. = Kinetic energy

@apna_pdf

So, the de-Broglie wavelength is inversely proportional to square root of kinetic energy (K.E.)

Therefore, $\frac{\lambda_1}{\lambda_2} = \sqrt{\frac{(\text{K.E.})_2}{(\text{K.E.})_1}}$

Then, $\frac{\lambda_1}{\lambda_2} = \sqrt{\frac{1}{2}\frac{(\text{K.E.})_1}{(\text{K.E.})_1}}$

or $\lambda_2 = \sqrt{2}\lambda_1$

Thus, de-Broglie wavelength becomes $\sqrt{2}$ times to the original wavelength.

186. The frequency of radiation emitted, when an electron falls from n = 3 to n = 1. in a hydrogen atom would be _____

(a) $2.92 \times 10^3 \text{hour}^{-1}$
(b) $2.92 \times 10^{-15} \text{s}^{-1}$
(c) $2.92 \times 10^{15} \text{s}^{-1}$
(d) 2.92 min^{-1}

AP- EAPCET- 07-09-2021, Shift-I

Ans. (c) : Given that, $n_1 = 1$, $n_2 = 3$

According to the Rydberg's formula–

$$\therefore \quad \frac{1}{\lambda} = R_H\left[\frac{1}{n_1^2} - \frac{1}{n_2^2}\right]$$

$$\frac{1}{\lambda} = 1.096 \times 10^5\left[\frac{1}{1} - \frac{1}{3^2}\right]$$

$$\frac{1}{\lambda} = 1.096 \times 10^5 \times \frac{8}{9} = 0.968 \times 10^5 \text{cm}^{-1}$$

We know that,

$$\therefore \quad v = \frac{c}{\lambda}$$

$$= 3 \times 10^{10} \times 0.968 \times 10^5$$

$$= 2.92 \times 10^{15} \text{ sec}^{-1}$$

187. Which one of the following transitions of an electron in hydrogen atom emits radiation of the lowest wavelength?

(a) $n_2 = \infty$ to $n_1 = 2$
(b) $n_2 = 4$ to $n_1 = 3$
(c) $n_2 = 2$ to $n_1 = 1$
(d) $n_2 = 5$ to $n_1 = 3$

AP-EAMCET- (Engg.) - 2010

Ans. (c) : $\Delta E = \frac{hc}{\lambda}$

When the value of 'n' increases the difference of energy between successive orbit decreases.

i.e, $E_2 - E_1 > E_3 - E_2 > E_4 - E_3$ so on---

$\therefore$ λ is lowest for n_2=2 to n_1 =1 transitions.

188. The basis of quantum mechanical model of an atom is

(a) Angular momentum of electron
(b) Quantum numbers
(c) Dual nature of electron
(d) Black body radiation

AP-EAMCET (Engg.) 2013

Ans. (c) : The basis of quantum mechanical model of an atom is dual nature of electron i.e. electron possesses particle nature as well as wave nature. It means when the matter is moving its shows the wave property are associated with it and when it is in the state.

189. What is the wave number of 4th line in Balmer series of hydrogen spectrum? (R = 1,09,677 cm^{-1})

(a) $24{,}630 \text{ cm}^{-1}$
(b) $24{,}360 \text{ cm}^{-1}$
(c) $24{,}730 \text{ cm}^{-1}$
(d) $24{,}372 \text{ cm}^{-1}$

AP - EAMCET (Medical) - 2007

Ans. (d) : We know that,

$$\bar{v} = R\left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right)$$

Where, $\bar{v}$ = Wave number

R = Rydberg constant

4th line in Balmer series that means–

$n_1 = 2$, $n_2 = 6$

$$\therefore \quad \bar{v} = 1{,}09{,}677\left(\frac{1}{2^2} - \frac{1}{6^2}\right)\text{cm}^{-1}$$

$$\bar{v} = 1{,}09{,}677\left(\frac{1}{4} - \frac{1}{36}\right)\text{cm}^{-1}$$

or $\bar{v} = 24372 \text{cm}^{-1}$

190. What is the wavelength (in m) of a particle of mass 6.62 × 10^{-29} g moving with a velocity of 10^3 ms^{-1}?

(a) 6.62×10^{-4}
(b) 6.62×10^{-3}
(c) 10^{-5}
(d) 10^5

AP-EAMCET (Engg.)-2005

Ans. (c) : Given that, $m = 6.62 \times 10^{-29}\text{g} = 6.62 \times 10^{-32}$ kg

$v = 10^3 \text{ ms}^{-1}$, λ (in m) = ?

Now, from the de-Broglie equation–

$$\because \quad \lambda = \frac{h}{mv}$$

$$\therefore \quad \lambda = \frac{6.6 \times 10^{-34} \text{J s}}{6.62 \times 10^{-32}(\text{kg}) \times 10^3(\text{ms}^{-1})}$$

or $\lambda = 1 \times 10^{-5}$ m

191. The wavelengths of two photons are 2000Å and 4000Å respectively. What is the ratio of their energies?

(a) 1/4
(b) 4
(c) 1/2
(d) 2

VITEEE 2019

Ans. (d) : Given that, $\lambda_1 = 2000\,\text{Å}$, $\lambda_2 = 4000\,\text{Å}$

We know that,

$$\therefore \quad E = \frac{hc}{\lambda}$$

$$\text{So,} \quad \frac{E_1}{E_2} = \frac{hc}{\lambda_1} \times \frac{\lambda_2}{hc}$$

$$\frac{E_1}{E_2} = \frac{4000\,\text{Å}}{2000\,\text{Å}}$$

$$\frac{E_1}{E_2} = 2$$

192. The values of Planck's constant is 6.63 × 10^{-34} Js. The velocity of light is 3.0 × 10^8 m s^{-1}. Which value is closest to the wavelength in nanometers of a quantum of light with frequency of 8 × 10^{15} s^{-1}?

@apna_pdf

(a) 5×10^{-18} (b) 4×10^{1}
(c) 3×10^{7} (d) 2×10^{-25}

AIPMT 2003

Ans. (b) : Given that, $h = 6.626\times10^{-34}\,\text{J sec.}$

$$c = 3\times10^{8}\,\text{m/sec.},\ \nu = 8\times10^{15}\,\text{sec}^{-1}$$

$$\because \quad E = h\nu = \frac{hc}{\lambda}$$

$$8\times10^{15} = \frac{3\times10^{8}}{\lambda}$$

$$\lambda = \frac{3\times10^{8}}{8\times10^{15}} = 0.375\times10^{-7} \approx 4\times10^{1}\,\text{nm}$$

193. The ratio of slopes of K_{max} vs ν and ν_0 vs ν curves in the photoelectric effects gives (ν = frequency, K_{max} = maximum kinetic energy, ν_0 = stopping potential)

(a) The ratio of Planck's constant of electronic charge
(b) Work function
(c) Planck's constant
(d) Charge of electron

VITEEE 2015

Ans. (d) : We know that, $h\nu = h\nu_0 + e\nu_0$

$$e\nu_0 = h\nu - h\nu_0\,, \qquad \nu_0 = \frac{h}{e}\nu - \frac{h}{e}\nu_0$$

On comparing this equation with the straight line equation i.e $y = mx + c$

The slope of ν_0 vs ν is

$$(\text{slope})_1 = \frac{h}{e}$$

$h\nu = h\nu_0 + KE$
$KE = h\nu - h\nu_0$ (constant)
$y = mx + (-h\nu_0)$
Thus, slope of K_{max} vs ν is

$$(\text{slope})_2 = h$$

$$\therefore \frac{(\text{slope})_2}{(\text{slope})_1} = \frac{h}{h/e} = e \text{ (charge of electron)}$$

194. A certain metal when irradiated by light (r = 3.2×10^{16}Hz) emits photoelectrons with twice kinetic energy as did photoelectrons when the same metal is irradiated by light (r = 2.0×10^{16}Hz). The ν_0 of metal is

(a) 1.2×10^{14} Hz (b) 8×10^{15} Hz
(c) 1.2×10^{16} Hz (d) 4×10^{12} Hz

Ans. (b) : According to question

$$(KE)_1 = 2\times(KE)_2$$
$$h\nu_1 - h\nu_0 = 2(h\nu_2 - h\nu_0)$$
$$h\nu_0 = 2h\nu_2 - h\nu_1$$
$$\nu_0 = 2\nu_2 - \nu_1$$
$$\nu_0 = 2\times(2\times10^{16}) - (3.2\times10^{16})$$
$$\nu_0 = 8\times10^{15}\,\text{Hz}$$

195. A near UV photon of 300 nm is absorbed by a gas and then re-emitted as two photons. One photon is red with wavelength of the second photon is

(a) 1060 nm (b) 496 nm
(c) 300 nm (d) 215 nm

VITEEE 2013

Ans. (b) : $E = E_1 + E_2$

$$\frac{hc}{\lambda} = \frac{hc}{\lambda_1} + \frac{hc}{\lambda_2}$$

$$\frac{1}{300} = \frac{1}{760} + \frac{1}{\lambda_2}$$

$$\frac{1}{\lambda_2} = \frac{1}{300} - \frac{1}{760}$$

$$\lambda_2 = 496\,\text{nm}$$

196. Electrons with a kinetic energy of 6.023×10^{4} J/mol are evolved from the surface of a metal, when it is exposed to radiation of wavelength of 600 nm. The minimum amount of energy required to remove an electron from the metal atom is

(a) 2.3125×10^{-19} J (b) 3×10^{-19} J
(c) 6.02×10^{-19} J (d) 6.62×10^{-34} J

VITEEE- 2009

Ans. (a) : Given that, KE of 1 mol = 6.023×10^{4} J
or KE of 6.023×10^{23} atoms = 6.023×10^{4} J

$$\therefore \quad \text{KE of 1 atom} = \frac{6.023\times10^{4}}{6.023\times10^{23}}$$

we know that, $= 1.0 \times 10^{-19}$ J

$$\because \quad h\nu_{energy} = \frac{hc}{\lambda} = \frac{6.626\times10^{-34}\times3\times10^{8}}{600\times10^{-9}}$$

$= 3.313 \times 10^{-19}$ J

Now Threshold energy $= h\nu - KE$

$= 3.313 \times 10^{-19} - 1.0 \times 10^{-19}$

$= 2.313 \times 10^{-19}$J

Hence minimum amount of energy required to remove an electron from the metal ion will be 2.313×10^{-19} J

197. The wavelengths of electron waves in two orbits is 3 : 5. The ratio of kinetic energy of electrons will be

(a) 25 :9 (b) 5 : 3
(c) 9 : 25 (d) 3 : 5

VITEEE- 2009

Ans. (a) : According to de-Broglie's equation -

$$\lambda = \frac{h}{mv}$$

squaring both side, we get –

$$\lambda^2 = \frac{h^2}{m^2v^2}$$

$$\text{or} \quad mv^2 = \frac{h^2}{m\lambda^2}$$

$$\because KE = \frac{1}{2}mv^2$$

$$\text{Therefore,} \quad \frac{K_1}{K_2} = \left(\frac{\lambda_2}{\lambda_1}\right)^2 = \left(\frac{5}{3}\right)^2$$

$$\therefore \quad K_1 : K_2 = 25 : 9$$

@apna_pdf

198. A bulb emitted electromagnetic radiation of 660 nm wavelength. The total energy of radiation is 3×10^{-18} J. The number of emitted photon will be:
($h = 6.6 \times 10^{-34}$ Js, $c = 3 \times 10^8$ m/s)

(a) 1 (b) 10
(c) 100 (d) 1000

AIIMS 26 May 2019 (Morning)

Ans. (b): Given that, total energy of radiation = 3×10^{-18}J

$h = 6.6\times10^{-34}$ Js, $c = 3\times10^8$, $\lambda = 660\times10^{-9}$

Number of photons emitted = n

We know that,

$$E = \frac{nhc}{\lambda}$$

Where, h = the plank's constant
c = the speed of light
and λ = wavelength

Now, by substituting the value of these, we get–

$$3\times10^{-18} = \frac{6.6\times10^{-34}\times3\times10^8\times n}{660\times10^{-9}}$$

$$n = \frac{30}{3} = 10$$

199. Assertion: Threshold frequency is the maximum frequency required for the ejection of electron from the metal surface.
Reason: Threshold frequency is characteristic of a metal.

(a) If both Assertion and Reason are correct and the Reason is the correct explanation of Assertion
(b) If both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.
(c) If Assertion is correct but Reason is incorrect.
(d) If both the Assertion and Reason are incorrect.

AIIMS-26 May, 2018

Ans. (d): Threshold frequency is a minimum frequency required for the emission of electron from the metal surface.

200. Assertion: All photons possess the same amount of energy.
Reason: Energy of photon does not depend upon wavelength of light used.

(a) If both Assertion and Reason are correct and the Reason is a correct explanation of the Assertion.
(b) If both Assertion and Reason are correct but Reason is not a correct explanation of the Assertion.
(c) If the Assertion is correct but Reason is incorrect.
(d) If both the Assertion and Reason, are incorrect.
(e) If the Assertion is incorrect but the Reason is correct.

AIIMS-1998

Ans. (d): Energy of a photon = hν

$$\because \nu = \frac{c}{\lambda}$$

Hence, $E = \frac{hc}{\lambda}$

So, energy depends on wavelength.

201. Wavelength of a particular transition for H atom is 400 nm. What can be wavelength of He^+ for same transition?

(a) 400 nm (b) 100 nm
(c) 1600 nm (d) 200 nm

AIIMS-26 May, 2018

Ans. (b): According to the Rhyberg's equation–

$$\frac{1}{\lambda} = R_H\left(\frac{1}{n_1^2}-\frac{1}{n_2^2}\right)\times Z^2$$

$$\frac{1}{400} = R_H\left(\frac{1}{n_1^2}-\frac{1}{n_2^2}\right)(1)^2 \quad .....(i)$$

$$\frac{1}{\lambda_{He^+}} = R_H\left(\frac{1}{n_1^2}-\frac{1}{n_2^2}\right)(2)^2 \quad .....(ii)$$

On dividing equation (i) by (ii), we get

$$\lambda_{He+} = \frac{400}{2^2} = \frac{400}{4} = 100\,nm$$

202. Find the frequency of light that corresponds to photons of energy 5.0×10^{-5} erg?

(a) $7.5\times10^{-21}\,sec^{-1}$ (b) $7.5\times10^{-21}\,sec$
(c) $7.5\times10^{21}\,sec^{-1}$ (d) $7.5\times10^{21}\,sec$

AIIMS-2010

Ans. (c): We know that, E= hν.

$$\nu = \frac{E}{h} = \frac{5.0\times10^{-5}\,erg}{6.63\times10^{-34}\,Js}$$

$$\nu = \frac{5.0\times10^{-5}\,erg}{6.63\times10^{-34}\times10^{7}\,erg\,sec}$$

$\therefore$ [1J= 10^7 erg]

$\nu = 7.54\times10^{21}\,sec^{-1}$

203. Ratio of energy of photon of wavelength 3000Å and 6000Å is

(a) 3 : 1 (b) 2 : 1
(c) 1 : 2 (d) 1 : 3

AIIMS-2012

Ans. (b): Given that, ratio of energy of photon of wavelength 3000Å and 6000Å

$$E = \frac{hc}{\lambda}$$

$$\frac{E_1}{E_2} = \frac{\lambda_2}{\lambda_1} = \frac{6000}{3000} = 2:1$$

204. The de Broglie wavelength associated with a ball of mass 1 kg having kinetic energy 0.5 J is :

(a) 6.626×10^{-34} m (b) 13.20×10^{-34} m
(c) 10.38×10^{-21} m (d) 6.626×10^{-34} Å

AIIMS-2006

@apna_pdf

Ans. (a): Given data, mass of ball = 1 kg

Kinetic energy (K.E) = 0.5 J

de-Broglie wavelength (λ) = ?

Now, as we know that,

$$\text{K.E.} = \frac{1}{2}mv^2$$

$$0.5 = \frac{1}{2} \times 1 \times v^2$$

$$v^2 = 1$$

$$v = 1\ ms^{-1}$$

Therefore, de-Broglie wavelength $\lambda = \frac{h}{mv}$

$$= \frac{6.63 \times 10^{-34}}{1 \times 1}$$

$$= 6.63 \times 10^{-34}\ m$$

205. The de- Broglie wavelength of an electron in the ground state of hydrogen atoms is: (K.E.= 13.6eV; 1ev=1.602×10^{-19} J)

(b) 33.28nm
(b) 3.328nm
(c) 0.3328nm
(d) 0.0332 nm

AIIMS-2000

Ans. (c): For electron in the ground state,

$$\because \quad mvr = \frac{h}{2\pi}$$

Or $$mv = \frac{h}{2\pi r}$$

Now, $$mv = \frac{h}{\lambda}$$

So, $$\frac{h}{\lambda} = \frac{h}{2\pi r}$$

$$\lambda = 2\pi r$$

$$\lambda = 2 \times 3.14 \times 0.53\ \text{Å} = 3.328\ \text{Å}$$

$$= 3.328 \times 10^{-10}\ m \quad \because 1\ \text{Å} = 10^{-10} m$$

$$= 0.3328 \times 10^{-9}\ m$$

$$= 0.3328\ nm$$

206. The de- Broglie wavelength associated with a particle of mass 10^{-6} Kg moving with a velocity of 10 ms^{-1} is :

(a) 6.63×10^{-7} m
(b) 6.63×10^{-16} m
(c) 6.63×10^{-21} m
(d) 6.63×10^{-29} m

AIIMS-2001

Ans. (d): According to the de Broglie equation, $\lambda = \frac{h}{mv}$

Where, h = Planck's constant

v = velocity

m = mass of the particle

λ = wavelength of the particle.

$$\lambda = \frac{6.63 \times 10^{-34}\ Js}{10^{-6} Kg \times 10 ms^{-1}}$$

$$= \frac{6.63 \times 10^{-34}}{10^{-5}}$$

$$= 6.63 \times 10^{-29}\ m$$

207. The wavelength of visible light is:

(a) 2000Å–3700Å
(b) 7800Å–8900Å
(c) 3800Å–7600Å
(d) None of these

AIIMS-1998

Ans. (c): The visible spectrum is the portion of the electromagnetic spectrum that is visible to the human eye.

Electromagnetic radiation in this range of wavelengths is called visible light or simple light. A typical human eye will respond to wavelengths from about.

380 to 700 nm or 3800Å – 7600Å

The visible spectrum is VIBGYOR. Violet has the shortest wavelength, at around 380 nanometers, and red has the longest wavelength, at around 700 nanometers in this spectrum.

208. The wavelength of a 150 g rubber ball moving with a velocity of 50 ms^{-1} is :

(a) 3.43×10^{-33} cm
(b) 5.86×10^{-33} cm
(c) 7.77×10^{-33} cm
(d) 8.83×10^{-33} cm

AIIMS-1998

Ans. (d): Given that, v = 50 m/sec, m = 150 gm = 150×10^{-3} kg

According to de-Broglie –

$$\lambda = \frac{h}{mv} = \frac{6.626 \times 10^{-34}}{(150 \times 10^{-3}) \times 50}$$

$$\Rightarrow 8.83 \times 10^{-35}\ m$$

$$\Rightarrow 8.83 \times 10^{-33}\ cm$$

209. The de-Broglie wavelength of a particle with mass 1 g and velocity 100 m/s is

(a) 6.63 × 10^{-35} m
(b) 6.63 × 10^{-34} m
(c) 6.63 × 10^{-33} m
(d) 6.65 × 10^{-35} m

NEET-1999

Ans. (c) : Given that, m=1g, v=100 m/s

h= 6.63×10^{-34} J-s

According to de-Broglie wave equation –

$$\lambda = \frac{h}{mv} = \frac{6.63 \times 10^{-34} J\text{-}s}{1 \times 10^{-3} Kg \times 100 m/s}$$

$$= 6.63 \times 10^{-33}\ m$$

210. If the Planck's constant h = 6.6 × 10^{-34} Js, the de Broglie wavelength of a particle having momentum of 3.3 × 10^{-24} kg ms^{-1} will be

(a) 0.002 Å
(b) 0.5 Å
(c) 2 Å
(d) 500 Å

BITSAT 2018

Ans. (c) : Given that,h = 6.6 × 10^{-34}, p = 3.3 × 10^{-24}

We know that, $\lambda = \frac{h}{mv}$ $(\because p = mv)$

Or $$\lambda = \frac{h}{p}$$

$$\lambda = \frac{h}{p} = \frac{6.6 \times 10^{-34}}{3.3 \times 10^{-24}} = 2 \times 10^{-10} m = 2\text{Å}$$

211. The energy required to remove an electron from metal X is E = 3.31 × 10^{-20} J. Calculate the maximum wavelength of light that can photo eject an electron from metal X.

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(a) 6.01×10^{-6} m (b) 3.01×10^{-3} m
(c) 5.01×10^{-6} m (d) None of these

AMU-2014

Ans. (a) : Given that, $E = 3.31 \times 10^{-20}$ J
$h = 6.626 \times 10^{-34}$ J.sec ,$c = 3 \times 10^{8}$ m/s

$$\text{Energy (E)} = \frac{hc}{\lambda}$$

$$\text{Or } \lambda = \frac{hc}{E} = \frac{6.626\times10^{-34}\times3\times10^{8}}{3.31\times10^{-20}}$$

$$\Rightarrow 6.01\times10^{-6}\ \text{m}$$

212. The energy of one mole of photons of radiation whose frequency is 5×10^{14} Hz will be

(a) 19.951 KJ mol^{-1} (b) 199.51 KJ mol^{-1}
(c) 39.90 KJ mol^{-1} (d) 399.0 KJ mol^{-1}

AMU-2015, 2007

Ans. (b) : Energy of quantum (or photon), $E=h\nu$
Where, Planck's constant, $h = 6.62 \times 10^{-34}$ J-s
1 mol of photon = 6.023×10^{23} molecules of photon so the Energy of 1 mole of photon will be,
$E= N_0h\nu$
$=6.023\times10^{23}\times6.62\times10^{-34}\times5\times10^{14}$ J/mole
$=199.36 \times 10^{3}$ J/mole
or 199.36KJ mol^{-1}

213. In hydrogen atom, the de Broglie wavelength of an electron in the second Bohr orbit is [Given that Bohr radius, a_0 =52.9 pm]

(a) 211.6 pm (b) 211.6 π pm
(c) 52.9 π pm (d) 105.8 pm

NEET-Odisha 2019

Ans. (b) : According to Bohr,

$$mvr = \frac{nh}{2\pi}$$

$$2\pi r= \frac{nh}{mv} =n\lambda \qquad \text{………..(i)}$$

Where, r= Radius
λ= Wavelength
n= Number of orbit

$$\text{Also, } r= \frac{a_o n^2}{z} \qquad \text{………..(ii)}$$

Where, a_o = Bohr radius= 52.9 pm
Z= Atomic number
On substituting the value of 'r' from equation (ii) to equation (i) we get

$$n\lambda = \frac{2\pi n^2 a_o}{z}$$

$$\lambda = \frac{2\pi n a_o}{z}$$

$$\lambda = 2\pi\times2\times52.9 \qquad [\because n = 2,\ z = 1]$$

$$\lambda = 211.6\pi\ \text{pm}$$

214. The mass of a photon with wavelength 3.6Å shall be

(a) 61.35×10^{-34} kg (b) 6.135×10^{-29} kg
(c) 7.185×10^{-29} kg (d) 71.85×10^{-29} kg

AMU-2006

Ans. (a) : We know that, $E=h\nu=\frac{hc}{\lambda}$

Again, $E=mc^2$

$$\therefore \quad mc^2= \frac{hc}{\lambda}$$

$$\text{or} \quad m = \frac{h}{c\lambda} = \frac{6.626\times10^{-37}}{3\times10^{8}\times3.6\times10^{-10}}\text{kg}$$

$$=0.6135\times10^{-32}\ \text{kg} =61.35\times10^{-34}\ \text{kg}$$

215. The de-Broglie wavelength (λ) associated with a photoelectron varies with the frequency (ν) of the incident radiation as, [ν_0 is threshold frequency]

(a) $\lambda \propto \frac{1}{(\nu-\nu_0)^{\frac{1}{4}}}$ (b) $\lambda \propto \frac{1}{(\nu-\nu_0)^{\frac{3}{2}}}$
(c) $\lambda \propto \frac{1}{(\nu-\nu_0)}$ (d) $\lambda \propto \frac{1}{(\nu-\nu_0)^{\frac{1}{2}}}$

[JEE Main 2019, 11 Jan Shift-II]

Ans. (d) : For electron

$$\lambda_{DB} = \frac{\lambda}{\sqrt{2mK.E}} \qquad (\text{de-broglie wave length})$$

Where λ = Wavelength of particles
h = Planck's constant
K.E = Kinetic energy
According to photoelectric effect

$$h\nu = h\nu_0 + KE$$

$$KE= h\nu - h\nu_0$$

$$\lambda_{DB} = \frac{h}{\sqrt{2m\times(h\nu-h\nu_0)}}\ ,\quad \lambda_{DB} \propto \frac{1}{(\nu-\nu_0)^{\frac{1}{2}}}$$

216. The energy of a photon is given as, ΔE/atom = 3.03×10^{-19} J $atom^{-1}$ then, the wavelength (λ) of the photon is

(a) 0.656 nm (b) 6.56 nm
(c) 65.6 nm (d) 656 nm

AMU–2001

Ans. (d) : Given that, $\Delta E = 3.03\times10^{-19}$J $atom^{-1}$
According to formula –

$$\Delta E = \frac{hc}{\lambda} = \frac{6.626\times10^{-34}\times3\times10^{8}}{\lambda}$$

$$\lambda= \frac{hc}{\lambda} = 656\ \text{nm}$$

217. The wavelength of a ball of mass 100 g moving with a velocity of 100 ms^{-1} be

(a) 6.626×10^{-30} m (b) 6.626×10^{-35} m
(c) 6.626×10^{-32} m (d) 6.626×10^{-34} m

Assam CEE-2020

Ans. (b) : Given that, m = 100g , v = 100 m/s
According to the de-Broglie equation –

$$\lambda = \frac{h}{mv} = \frac{6.626\times10^{-34}\text{kg}-\text{m}^2/\text{sec}}{0.1\text{kg}\times100\,\text{m/sec}}$$

$$=6.626\times10^{-35}\text{m}$$

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218. The energy ratio of a photon of wavelength 3000 Å and 6000 Å is

(a) 1 : 1 (b) 2 : 1

(c) 1 : 2 (d) 1 : 4

BCECE-2007

Ans. (b) : Given that, λ_1=3000 Å, λ_2=6000 Å

$$E_1 = \frac{hc}{\lambda_1} = \frac{hc}{3000} \text{ and } E_2 = \frac{hc}{\lambda_2} = \frac{hc}{6000}$$

$$\frac{E_1}{E_2} = \frac{\frac{hc}{3000}}{\frac{hc}{6000}} = \frac{hc}{3000} \times \frac{6000}{hc} = \frac{2}{1}$$

$E_1:E_2=2:1$

219. A photon having a wavelength of 845 Å, causes the ionisation of N atom. What is the ionisation energy of N?

(a) 1.4 kJ (b) 1.4×10^4 kJ

(c) 1.4×10^2 kJ (d) 1.4×10^3 kJ

BCECE-2003

Ans. (d) : The ionisation energy is the amount of energy required to take out most loosely bonded electron from isolated gaseous atom.

∴ Ionisation energy of nitrogen

= energy of photon

$$= N h \frac{c}{\lambda}$$

Where $N = 6.02 \times 10^{23}$

$c = 3 \times 10^8$

$$\lambda = 854\,\overset{0}{A} = 854 \times 10^{-10}\,M$$

$$= \frac{6.02\times10^{23}\times6.6\times10^{-34}\times3\times10^{8}}{854\times10^{-10}}$$

$= 1.4 \times 10^6$ J mol^{-1} = 1.4×10^3 kJ mol^{-1}

220. The increasing order of wavelength for He^+ ion, neutron (n) and electron (e) particles, moving with the same velocity is–

(a) $\lambda_{He^+} < \lambda_e < \lambda_n$ (b) $\lambda_{He^+} = \lambda_n = \lambda_e$

(c) $\lambda_{He^+} < \lambda_n < \lambda_e$ (d) $\lambda_e < \lambda_n < \lambda_{He^+}$

BCECE-2016

Ans. (c) : $\lambda = \frac{h}{m.v}$

(As per de–Broglie relation)

$\therefore \lambda \propto \frac{1}{m}$ (h and v are constant)

Also; $\because m_{He^+} > m_n > m_e$

$\therefore \lambda_{He+} < \lambda_n < \lambda_e$

221. The relationship between energy (E) of wavelengths 2000 Å and 8000 Å, respectively is–

(a) $E_1 = 4E_2$ (b) $E_1 = 2E_2$

(c) $E_1 = \frac{E_2}{2}$ (d) $E_1 = \frac{E_2}{4}$

BCECE-2016

Ans. (a) : Given that, λ_1 = 2000 Å and λ_2 = 8000 Å

Using the equation of energy–

$$E = \frac{hc}{\lambda}$$

$$\frac{E_1}{E_2} = \frac{\lambda_2}{\lambda_1} \qquad \left(\because E \propto \frac{1}{\lambda}\right)$$

Thus, $\frac{E_1}{E_2} = \frac{8000}{2000} = 4$

∴ $E_1 = 4E_2$

222. Which of the following equations represent de-Broglie relation?

(a) $\frac{h}{mv} = p$ (b) $\lambda m = \frac{v}{p}$

(c) $\lambda = \frac{h}{mp}$ (d) $\lambda = \frac{h}{mv}$

CG PET -2008
WB-JEE-2008
J & K CET-(1999)
AIIMS-1994

Ans. (d) : De-Broglie proposed that an electron like light behaves both as a material particle and as a wave. This proposal gave birth to a new theory known as wave mechanical theory of matter. De-Broglie equation is given as–

$$\lambda = \frac{h}{mv}$$

$$\lambda = \frac{h}{p}$$

Where, λ = Wavelength of light
h = Planck's constant
m = Mass of particle
v = Velocity of particle

223. If radius of first Bohr's orbit of hydrogen atom is 'X', then the de- Broglie wavelength of electron in 3rd orbit is nearly

(a) $2\pi x$ (b) $6\pi x$

(c) 9x (d) $\frac{x}{3}$

CG PET- 2016

Ans. (b) : For a particular element, radius of an orbit–

$$r_n \propto n^2$$

Where, n is the principal quantum number–

$$\therefore \quad \frac{r_1}{r_2} = \frac{1}{3^2}$$

If, $r_1 = X$ then $r_3 = 9X$

For third shell,

$2\pi r_3 = 3\lambda$

$$\lambda = \frac{2\pi.9X}{3} \Rightarrow 6\pi X$$

224. A particle 'A' moving with a certain velocity has the de- Broglie wavelength 1 Å. For a particle 'B' with mass 25%of 'A' and velocity 75% of 'A'. The de- Broglie wave length of 'B' will be

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(a) 3 Å (b) 5.33 Å
(c) 6.88 Å (d) 0.68 Å

CG PET- 2013

Ans. (b) : Given,
For, particle 'A'–

$\lambda_A = 1$ Å

Let, the mass of particle A(m_A) = x
Velocity of particle A(V_A) = y
For, particle 'B'–

$$\text{Mass of particle (B)} = \frac{x \times 25}{100} = \frac{x}{4}$$

$$\text{Velocity of particle (B)} = \frac{y \times 75}{100} = \frac{3y}{4}$$

de-Broglie equation for the particle 'A', we get–

$$\lambda_A = \frac{h}{m_A V_A}$$

$$1\times10^{-10} = \frac{h}{x \times y} \quad .....(i)$$

de-Broglie equation for the particle 'B', we get–

$$\lambda_B = \frac{h}{m_B V_B}$$

$$\lambda_B = \frac{h}{\left(\frac{x}{4}\right)\left(\frac{3y}{4}\right)}$$

or $$\lambda_B = \frac{16}{3}\frac{h}{xy} \quad .....(ii)$$

From equation (i) and (ii), we get–

$$\lambda_B = \frac{16}{3} \times 1\times10^{-10}$$

$\lambda_B = 5.33 \times 10^{-10}$

or $\lambda_B = 5.33$ Å

225. The wavelength of associated wave of a particle moving with a speed of one-tenth that of light is 7Å. The particle must be

(a) Electron (b) Proton
(c) Nanoparticle (d) Photo

CG PET -2017

Ans. (a) : Given that, $\lambda = 7\,\text{Å} = 7\times10^{-10}\,\text{m}$

Particle moves with a speed of $\left(\frac{1}{10}\right)^{\text{th}}$ of speed of light–

$$\therefore \text{ Velocity of particle} = \frac{1}{10}\times3\times10^{8} = 3\times10^{7}\,\text{ms}^{-1}$$

From de-Broglie equation we get–

$$\because \quad \lambda = \frac{h}{mv}$$

$$m = \frac{h}{\lambda v} = \frac{6.6\times10^{-34}\,\text{Js}}{7\times10^{-10}\times3\times10^{7}}$$

$$m = 0.3142\times10^{-31}\,\text{kg}$$

$$m = 0.31\times10^{-31} \approx 10^{-31}\,\text{kg}$$

Which is in accordance with mass of electron Thus among the given particles, electron is the correct choice.

226. What is the work function of the metal, if the light of wavelength 4000Å generates photoelectron of velocity 6×10^5 ms^{-1} from it? (Mass of electron = 9×10^{-31} kg Velocity of light = 3×10^8 ms^{-1} Planck's constant = 6.626×10^{-34} Js Charge of electron = 1.6×10^{-19} JeV^{-1}

(a) 4.0 eV (b) 2.1 eV
(c) 0.9 eV (d) 3.1 eV

[JEE Main 2019, 12 Jan Shift-I]

Ans. (b) : Given that, λ= 4000 $\overset{\circ}{\text{A}}$

$v = 6 \times 10^5$ ms^{-1}

From the Einstein's photoelectric equation–

$$h\nu = w_o + \frac{1}{2}mv^2$$

$$w_o = h\nu - \frac{1}{2}mv^2$$

$$= \frac{6.626\times10^{-34}\times3\times10^{8}}{4000\times10^{-10}} - \frac{1}{2}\times9\times10^{-31}\times(6\times10^{5})^2$$

$= (4.9695–1.62)10^{-19}$

$= 3.3495\times10^{-19}$ J

$$w_o = \frac{3.3495\times10^{-19}}{1.6\times10^{-19}}\text{eV} = 2.0934 = 2.1\,\text{eV}$$

227. If p is the momentum of the fastest electron ejected from a metal surface after the irradiation of light having wave length λ then for 1.5 p momentum of the photoelectron, the wavelength of the light should be (Assume kinetic energy of ejected photoelectron to be very high in comparison to work function)

(a) $\frac{4}{9}\lambda$ (b) $\frac{3}{4}\lambda$
(c) $\frac{2}{3}\lambda$ (d) $\frac{1}{2}\lambda$

[JEE Main 2019, 8 April Shift-II]

Ans. (a) : $h\nu - \phi = \text{KE}$

$$\left(\frac{hc}{\lambda}\right)_{\text{incident}} = \text{KE} + \phi$$

$$\text{K.E} = \frac{1}{2}mv^2 \times \frac{m}{m} = \frac{1}{2}\frac{P^2}{m}$$

$$\text{KE} = \frac{P^2}{2m} = \frac{hc}{\lambda_{\text{incident}}} = \frac{hc}{\lambda} \quad ....(i)$$

$$\frac{P^2\times(1.5)^2}{2m} = \frac{hc}{\lambda'} \quad ....(ii)$$

On dividing equation (ii) by (i), we get

$$\lambda' = \frac{4\lambda}{9}$$

228. The work function of sodium metal is 4.41×10^{-19} J. If photons of wavelength 300 nm are incident on the metal, the kinetic energy of the ejected electrons will be ($h = 6.63\times10^{-34}$ J s; $c = 3\times10^8$ m/s)..........$\times10^{-21}$J.

[JEE Main 2020, 2 Sep Shift-II]

Ans. (2.23×10^{-19}J) : Given that:–

ϕ work function of sodium = 4.41×10^{-19} J

Wavelength (λ) = 300 nm

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We have to find kinetic energy, E_k=?

We know the equation, $\frac{hc}{\lambda} = E_k + \phi$

$$E_k = \frac{hc}{\lambda} - \phi$$

$$= \frac{6.64\times10^{-34}\times3\times10^{8}}{300\times10^{-9}} - 4.41\times10^{-19}\,J$$

$$= 6.64\times10^{-34+8+9-2} - 4.41\times10^{-19}\,J$$

$$E_k = 2.23\times10^{-19}\,J$$

229. A source of monochromatic radiation of wavelength 400 nm provides 1000J of energy in 10 seconds. When this radiation falls on the surface of sodium, x×10^{20} electrons are ejected per second. Assume that wavelength 400 nm is sufficient for ejection of electron from the surface of sodium metal. The value of x is.......... (Nearest integer)

(h = 6.626×10^{-34} Js)

[JEE Main 2021, 25 July Shift-I]

Ans. (2) : According to the question, work function of metal is equal to energy of photon

λ_{photon} = 400nm

$$E_{photon} = \frac{hc}{\lambda} = \frac{6.626\times10^{-34}\times3\times10^{8}}{400\times10^{-9}}$$

$= 4.95 \times 10^{-19}$J

In 10 second, the amount of energy provided is 1000J. In 1 second, the amount of energy provided is 100J.

Number of photons emitted per second

$$= \frac{\text{Total energy}}{\text{Energy of one photon}}$$

$$\text{Number of photons} = \frac{100}{4.95\times10^{-19}}$$

$= 2.02 \times 10^{20}$ photons

So, 2.02×10^{20} photons eject 2.02×10^{20} electrons from the sodium metal.

230. The wavelength of electrons accelerated from rest through a potential difference of 40 kV is x×10^{-12}m. The value of x is ....(Nearest integer) Given : Mass of electron = 9.1×10^{-31} kg Charge on an electron = 1.6×10^{-19}C, Plank's constant = 6.63×10^{-34} Js

[JEE Main 2021, 20 July Shift-II]

Ans. (6) : $\lambda = \frac{h}{p} = \frac{h}{\sqrt{2meV}}$

$$= \frac{6.6\times10^{-34}}{\sqrt{2\times9.1\times10^{-31}\times1.6\times10^{-19}\times40\times10^{3}}}\,m$$

$= 0.614 \times 10^{-11}$m

$= 6.14 \times 10^{-12}$m

So,

x = 6

231. When light of wavelength 248 nm falls on a metal of threshold energy 3.0 eV, the de–Broglie wavelength of emitted electrons is.........Å. [Round off to the nearest integer]

[Use : $\sqrt{3}$ =1.73, h = 6.63×10^{-34} Js, m_e = 9.1×10^{-31} kg, c = 3.0×10^{8} ms^{-1}, 1eV = 1.6×10^{-19}J]

[JEE Main 2021, 16 March Shift-I]

Ans. (9) : $\lambda = 248\times10^{-9}\,m;\quad w_0 = 3\times1.6\times10^{-9}\,J$

$$\frac{hc}{\lambda} = w_0 + K.E$$

$$K.E = \frac{6.63\times10^{-34}\times3\times10^{8}}{246\times10^{-9}} - 3\times1.6\times10^{-19}$$

K.E = 3.2×10^{-19}J

$$p = \sqrt{2m\,K.E}$$

$$= \sqrt{2\times9.1\times10^{-31}\times3.2\times10^{-19}}$$

$= 7.63 \times 10^{-25}$

$$\lambda = \frac{h}{p} = \frac{6.63\times10^{-34}}{7.63\times10^{-25}}$$

$\lambda = 8.7 \times 10^{-10}$

$\lambda = 8.7Å$ $\qquad \because 1Å = 10^{-10}\,m$

$\boxed{\lambda \approx 9}$

232. A 50 watt bulb emits monochromatic red light of wavelength of 795 nm. The number of photons emitted per second by the bulb is x × 10^{20}. The value of x is ....

[Given, h = 6.63×10^{-34} Js and c = 3.0×10^{8} ms^{-1}

[JEE Main 2021, 1 Sep Shift-II]

Ans. (2) : Total energy per sec = 50 J

$$E = \frac{nhc}{\lambda}$$

$$50 = \frac{n\times6.63\times10^{-34}\times3\times10^{8}}{795\times10^{-9}}$$

$n = 1998.49\times10^{17}$ [n = no. of photons per second]

$\Rightarrow 1.998\times10^{20}$

$\Rightarrow 2\times10^{20}$

$\Rightarrow x\times10^{20}$

x=2

233. The number of photons emitted by a monochromatic (single frequency) infrared range finder of power 1 mW and wavelength of 1000 nm, in 0.1 second is x × 10^{13}. The value of x is ....(Nearest integer)

(h = 6.63×10^{-34} Js, c = 3.00×10^{8} ms^{-1})

[JEE Main 2021, 27 Aug Shift-II]

Ans. (50) : Given data, P = 1mW

10^{-3} J → 1 sec.

10^{-4} → 0.1 sec.

$$\therefore E = \frac{nhc}{\lambda}$$

$$10^{-4} = \frac{n\times6.63\times10^{-34}\times3\times10^{8}}{1000\times10^{-9}}$$

$n = 50.2\times10^{13}$

$\therefore$ x = 50

234. A metal surface is exposed to 500 nm radiation. The threshold frequency of the metal for photoelectric current is 4.3×10^{14} Hz. The velocity of ejected electron is ....×10^{5} ms^{-1} (Nearest integer) (Use h = 6.63×10^{-34} Js, m_e = 9.0×10^{-31} kg]

[JEE Main 2021, 26 Aug Shift-II]

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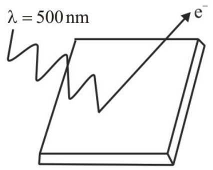
Ans. (5) : Given data,



Let v be speed of electron having max. K.E.

We know that, E = ϕ + $K.E_{max}$

$$\frac{hc}{\lambda} = h\nu_o + \frac{1}{2}mv^2$$

$$\frac{6.63\times10^{-34}\times3\times10^{8}}{500\times10^{-9}} = 6.63\times10^{-34}\times4.3\times10^{14}+\frac{1}{2}mv^2$$

$$\frac{6.63\times30\times10^{-20}}{5} = 6.63\times4.3\times10^{-20}+\frac{1}{2}mv^2$$

$$11.271\times10^{-20}\,J = \frac{1}{2}\times9\times10^{-31}\times v^2$$

$$v = 5\times10^{5}\ m/sec.$$

235. A gas absorbs photon of 355 nm and emits at two wavelengths. If one of the emission is at 680 nm, the other is at

(a) 1035 nm
(b) 325 nm
(c) 743 nm
(d) 518 nm

[AIEEE-2011]

Ans. (c) : We know that –

$\lambda = 355$ mm

$\lambda_1 = 680$ nm

$$E = h\nu = \frac{hc}{\lambda}$$

$$E = E_1 + E_2 \text{ or } \frac{hc}{\lambda} = \frac{hc}{\lambda_1}+\frac{hc}{\lambda_2}$$

$$\frac{1}{\lambda} = \frac{1}{\lambda_1}+\frac{1}{\lambda_2} \Rightarrow \frac{1}{355} = \frac{1}{680}+\frac{1}{\lambda_2}$$

$$\frac{1}{\lambda_2} = \frac{1}{355}-\frac{1}{680}$$

$$\frac{355\times680}{680-355} = 742.769\,nm \approx 743nm.$$

236. For emission line of atomic hydrogen from n_i = 8 to n_f = n, the plot of wave number (ν) against $\left(\frac{1}{n^2}\right)$ will be (The Rydberge constant, R_H is in wave number unit)

(a) non linear
(b) linear with slope $-R_H$
(c) linear with slope R_H
(d) linear with intercept $-R_H$

[JEE Main 2019, 9 Jan Shift-I]

Ans. (c) : $\frac{1}{\lambda} = \bar{v} = R_H z^2\left(\frac{1}{n_f^2}-\frac{1}{8^2}\right)$

Let n_f = n and z = 1 for H,

$$\bar{v} = R_H\times\left(\frac{1}{n^2}-\frac{1}{8^2}\right)$$

$$\bar{v} = R_H\times\frac{1}{n^2}-\frac{R_H}{8^2}$$

$$\bar{v} = R_H\times\frac{1}{n^2}-\frac{R_H}{64}$$

Compounding it with y = mx+c

$m=R_H$

Linear with slope R_H.

237. The de Broglie wavelength of particle is

(a) Proportional to its mass
(b) Proportional to its velocity
(c) Inversely proportional to its momentum
(d) Proportional to its total energy

J & K CET-(2012)

Ans. (c) : De-Broglie wavelength (λ) is given by–

$$\lambda = \frac{h}{mv} = \frac{h}{p} = \frac{k}{p}$$

$$\therefore \quad \lambda \propto \frac{1}{p}$$

238. Calculate the wavelength associated with an electron moving with a velocity of 10^6 m/s. (mass of e^-=9.1 × 10^{-31} kg, h = 6.6 × 10^{-34} kg m^2s^{-1})

(a) 6.2 × 10^{-8}m
(b) 7.25 × 10^{-8}m
(c) 6.25 $\overset{0}{A}$
(d) none of these

J & K CET-(2013)

Ans. (d) : From de– Broglie equation –

$$\lambda = \frac{h}{mv}$$

$$= \frac{6.6\times10^{-34}}{9.1\times10^{-31}\times10^{6}}$$

$= 7.325\times10^{-10}$ m.

239. The de Broglie wavelength of a ball of mass 10 g moving with a velocity of 10 ms^{-1} is [h = 6.626 × 10^{-34} Js]

(a) 6.626 × 10^{-33}m
(b) 6.626 × 10^{-29}m
(c) 6.626 × 10^{-31}m
(d) 6.626 × 10^{-36}m

J & K CET-(2011)

Ans. (a) : We know that –

$$\lambda = \frac{h}{mv}$$

h= 6.626×10^{-34}Js, m $=\frac{10}{1000}$ =0.01 kg,

v=10ms^{-1}

Putting the values,

$$\lambda = \frac{6.626\times10^{-34}}{0.01\times10} = 6.626\times10^{-33}\,m$$

240. Two oxides of a metal contain 36.4% and 53.4% of oxygen by mass respectively. If the formula of the first oxide is M_2O then that of the second is

(a) M_2O_3
(b) MO
(c) MO_2
(d) M_2O_5

J & K CET-(2011)

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Ans. (b) : Consider atomic mass of metal = x
We know that,

$$\%\text{ of oxygen in } M_2O = \frac{16}{2x+16}\times 100 = 36.4$$

$$\Rightarrow \frac{1600}{2x+16} = 36.4$$

$$\Rightarrow 1600 = 72.8x + 582.4$$

$$x = 13.978$$

Second oxide oxygen % = 53.4%
Second oxide metal % = 46.6%
Atomic Ratio M : O

$$\frac{46.6}{13.978} : \frac{53.4}{16}$$

$$3{\cdot}3 \ : \ 3{\cdot}3$$

$$1 \ : \ 1$$

Hence, the formula of metal oxide = MO.

241. If the de-Broglie wavelength of a particle of mass m is 100 times its velocity, then its value in terms of its mass (m) and planck's constant (h) is

(a) $\frac{1}{10}\sqrt{\frac{m}{h}}$ (b) $10\sqrt{\frac{h}{m}}$
(c) $\frac{1}{10}\sqrt{\frac{h}{m}}$ (d) $10\sqrt{\frac{m}{h}}$

J & K CET-(2009)

Ans. (b) : Let wavelength of particle be x

Velocity, $v = \frac{x}{100}$

We know that –

$$\lambda = \frac{h}{mv}$$

$$x = \frac{h\times 100}{m\times x}$$

$$x^2 = 100\frac{h}{m}$$

$$\Rightarrow x = \sqrt{100\frac{h}{m}}$$

$$x = 10\sqrt{\frac{h}{m}}$$

242. The de-Broglie wavelength of helium atom at room temperature is

(a) 6.6×10^{-34} m (b) 4.39×10^{-10} m
(c) 7.34×10^{-11} m (d) 2.335×10^{-20} m

JCECE - 2013

Ans. (c) : $V_{rms} = \sqrt{\frac{3RT}{M}} = \sqrt{\frac{3\times 8.314\times 298}{4\times 10^{-3}}} = 1363\,ms^{-1}$

$$\lambda = \frac{h}{mv} = \frac{6.626\times 10^{-34}\times 6.023\times 10^{23}}{4\times 10^{-3}\times 1363}$$

$= 7.32\times 10^{-11}$ m

243. Which particle among the following will have the smallest de-Broglie wavelength, assuming that they have the same velocity?

(a) A positron (b) A photon
(c) An α-particle (d) A neutron

JCECE - 2014

Ans. (c) : The de-Broglie equation is $\lambda = \frac{h}{p} = \frac{h}{mv}$.

Here, h and v are constant. So, $\lambda \propto \frac{1}{m}$. Since, the α-particle has the highest mass among the given entities, it has the smallest de-Broglie wavelength.

244. A 600 W mercury lamp emits monochromatic radiation of wavelength 331.3 nm. How many photons are emitted form the lamp per second?($h=6.626\times10^{-34}$J-s; velocity of light $=3\times10^{8}$ ms^{-1})

(a) 1×10^{19} (b) 1×10^{20}
(c) 1×10^{21} (d) 1×10^{23}

JIPMER-2011

Ans. (c): We know that–

$$E = \frac{nhc}{\lambda}$$

$$n = \frac{E\lambda}{hc}$$

$$n = \frac{600\times 331{\cdot}3\times 10^{-9}}{6.626\times 10^{-34}\times 3\times 10^{8}}$$

So, $n = 1\times 10^{21}$ photons/second

245. What is the wavelength (in m) of a particle of mass 6.62×10^{-29} g moving with a velocity of 10^3 ms^{-1}?

(a) 6.62×10^{-4} (b) 6.62×10^{-3}
(c) 10^{-5} (d) 10^{5}

JIPMER-2009

Ans. (c) : According to de–Broglie equation

$$\lambda = \frac{h}{mv}$$

$$\lambda = \frac{6.62\times 10^{-34}}{6.62\times 10^{-29}\times 10^{-3}\times 10^{3}}$$

$\lambda = 10^{-5}$ m.

246. Dual nature of particle was given by

(a) Bohr theory
(b) Thomson model
(c) Heisenberg principle
(d) de-Broglie equation

J&K CET (2010)
JIPMER-2005

Ans. (d): Dual nature of particle was given by de–Broglie in 1923.

De-Broglie equation relate the particle character with the wave character of matter.

247. Number of photons emitted by a 100 W (Js^{-1}) yellow lamp in 1.0 s. Take the wavelength of yellow light as 560 nm, and assume 100 percent efficiency.

(a) 1.6×10^{18} (b) 1.4×10^{18}
(c) 2.8×10^{20} (d) 2.1×10^{20}

JIPMER-2018

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Ans. (c): As per the Plank's quantum theory,

$$E = Nh\nu = N\frac{hc}{\lambda}$$

$$N=\frac{E\lambda}{hc} \quad \text{............(i)}$$

$E = 100\ w\ (Js^{-1})\times 1s = 100\ J$

Putting the value in equation (i), we get

$$N=\frac{100J\times 560\times 10^{-9}m}{6.626\times 10^{-34}Js\times 3\times 10^{8}ms^{-1}}$$

$= 2.82\times 10^{20}$.

248. With regard to photoelectric effect, identify the correct statement among the following.

(a) Energy of electron ejected increases with the increase in the intensity on incident light.

(b) Number of electron ejected increases with the increase in the frequency of incident light.

(c) Number of electron ejected increases with the increase in work function

(d) Number of electron ejected increases with the increase in the intensity of incident light.

Karnataka-CET-2020

Ans. (d) : The number of electron ejected increases with the increase in the intensity of incident light, an increase in the intensity of incident light means that the number of photons incident per unit surface area of the metal increase. (Provided the incident photons has its frequency more than threshold frequency).

The equation for the photoelectric effect is

$$h\nu = h\nu_0 + KE$$

Where, ν = frequency of the incident radiation

$h\nu_0$ = work function

It is clear that the number of electron elected does not depend of work function.

249. Two particle A and B are in motion. If the wavelength associated with 'A' is 33.33 nm, the wavelength associated with 'B' whose momentum is $\frac{1}{3}$rd of 'A' is

(a) 1.0×10^{-8} m (b) 2.5×10^{-8} m

(c) 1.25×10^{-7} m (d) 1.0×10^{-7} m

Karnataka-CET-2019

Ans. (d) : Given that,

$\lambda_A = 33.3$ nm or 33.33×10^{-9} m

$$P_B = \frac{1}{3}P_A$$

According to de-Broglie–

$$\lambda = \frac{h}{p}$$

$$\lambda_A = \frac{h}{P_A} \quad \text{......... (i)}$$

$$\lambda_B = \frac{h}{\frac{P_A}{3}} = \frac{3h}{P_A} \quad \text{......... (ii)}$$

From equation (i) and (ii), we get

$$\frac{\lambda_A}{\lambda_B} = \frac{1}{3} \Rightarrow \lambda_B = 33.33\times 10^{-9}\times 3 = 99.99\times 10^{-9}\,m$$

$= 1.0\times 10^{-7}$ m.

250. A body of mass x kg is moving with a velocity of 100 ms^{-1}. Its de-Broglie wavelength is 6.62 × 10^{-35} m. Hence, x is (h = 6.62 × 10^{-34} Js)

(a) 0.1 kg (b) 0.25 kg

(c) 0.15 kg (d) 0.2 kg

Karnataka-CET, 2009

Ans. (a): Given,

$h = 6.62\times 10^{-34}$ Js

$v = 100\ ms^{-1}$

$\lambda = 6.62\times 10^{-35}$

According to de-Broglie equation-

$$\lambda = \frac{h}{mv}$$

$$x = \frac{6.62\times 10^{-34}}{6.62\times 10^{-35}\times 100}$$

$$x = \frac{10^{-34}}{10^{-34}\times 10^{-1}\times 10^{2}} = \frac{1}{10}$$

= 0.1 kg

251. A body of mass 10 mg is moving with a velocity of 100 ms^{-1}. The wavelength of de-Broglie wave associated with it would be (h = 6.6. × 10^{-34} Js)

(a) 6.63×10^{-35} m (b) 6.63×10^{-34} m

(c) 6.63×10^{-31} m (d) 6.63×10^{-37} m

Karnataka-CET-2007

Ans. (c) : Given that,

$m = 10\ mg = 10 \times 10^{-6}$ kg

$\nu = 100\ ms^{-1}$

From de-Broglie equation,

$$\lambda = \frac{h}{mv}$$

$$\lambda = \frac{h}{mv} = \frac{6.63\times 10^{-34}}{10\times 10^{-6}\times 100}$$

$$= \frac{6.63\times 10^{-34}}{10^{-3}}$$

$m = 6.63 \times 10^{-31}$ m

252. The number of photons emitted per second by a 60 W source of monochromatic light of wavelength 663 nm is (h = 6.63 × 10^{-34} Js)

(a) 4× 10^{-20} (b) 1.5× 10^{20}

(c) 3× 10^{-20} (d) 2× 10^{20}

(e) 1× 10^{-20}

Kerala-CEE-2009

Ans. (d) : Given that,

$h = 6.63 \times 10^{-34}$ J sec.

$\lambda = 663\ nm = 663 \times 10^{-9}$ m

$c = 3 \times 10^{8}$ m/sec

n = ?

$E = 60\ W = 60\ J\ sec^{-1}$

∵ We know that,

$$E = \frac{nhc}{\lambda}$$

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$$\therefore \quad n = \frac{E\times\lambda}{hc}$$

$$= \frac{60\times 663\times 10^{-9}}{6.63\times 10^{-34}\times 3\times 10^{8}}$$

$$= \frac{6\times 663\times 10^{-8}}{3\times 663\times 10^{-28}}$$

$$= 2\times 10^{-8+28}$$

$$= 2\times 10^{20}$$

253. The relationship between the energy E_1 of the radiation with a wavelength 8000 Å and the energy E_2 of the radiation with a wavelength 16000 Å is:

(a) $E_1 = 6E_2$ (b) $E_1 = 2E_2$

(c) $E_1 = 4E_2$ (d) $E_1 = \frac{1}{2}E_2$

(e) $E_1 = E_2$

Kerala-CEE-2005

Ans. (b) : We know that,

$$E \propto \frac{1}{\lambda}$$

$$\frac{E_1}{E_2} = \frac{\lambda_2}{\lambda_1} = \frac{16000}{8000} \Rightarrow E_1 = 2E_2$$

254. The work function of a metal is 5 eV. What is the kinetic energy of the photoelectron ejected from the metal surface if the energy of the incident radiation is 6.2 eV? (1 eV = 1.6 × 10^{-19})

(a) 6.626 × 10^{-19} J (b) 8.10 × 10^{-19} J

(c) 1.92 × 10^{-18} J (d) 8.01 × 10^{-18} J

(e) 1.92 × 10^{-19} J

Kerala-CEE-2014

Ans. (e): Given that,

Work function ($h\nu_0$) = 5eV

Energy of incident radition ($h\nu$) = 6.2 eV

The kinetic energy of photoelectron:

$$K.E = h\nu - h\nu_0$$

= 6.2–5

= 1.2 eV

= $12\times1.6\times10^{-19}$ J= 1.92×10^{-19} J

255. A 250 W electric bulb of 80% efficiency emits a light of 6626 Å wavelength. The number of photons emitted per second by the lamp is (h = 6.636 × 10^{-34} Js)

(a) 1.42 × 10^{17} (b) 2.18 × 10^{16}

(c) 6.66 × 10^{20} (d) 2.83 × 10^{16}

(e) 4.25 × 10^{16}

Kerala-CEE-2014

Ans. (c) : Energy of one photon = $\frac{hc}{\lambda}$

$$\frac{6.626\times10^{-34}\times3\times10^{8}}{6626\times10^{-10}} = 3\times10^{-19}\,J$$

Energy emitted by bulb= $\frac{250\times80}{100} = 200J$

∴ $n\times3\times10^{-19}$= 200 (where n= no. of photons)

$$n = \frac{200}{3\times10^{-19}} = 6.66\times10^{20}$$

256. The de Broglie wavelength of the matter wave associated with an object dropped from a height x, when it reaches the ground is proportional to

(a) x^2 (b) $\frac{1}{\sqrt{x}}$

(c) $\sqrt{x}$ (d) $x^{3/2}$

(e) x

Kerala-CEE-2020

Ans. (b) : According to de-Broglie wavelength–

$$\lambda = \frac{h}{mv}$$

Since, an object dropped from a height x then,

$$v^2 = u^2 - 2gx$$

$$v = \sqrt{2gx}$$

So, $\lambda = \frac{h}{m\sqrt{2gx}}$

or $\lambda \propto \frac{1}{\sqrt{x}}$

257. Calculate the energy of photons having wavelength, 5 × 10^{-7} m falls on a metal surface of work function, 3.4 × 10^{-19} J :

(a) 3.97 × 10^{-19} J (b) 3.55 × 10^{-19} J

(c) 2.97 × 10^{-19} J (d) 2.57 × 10^{-19} J

Manipal-2016

Ans. (a) : Energy of photons, E= hν = $\frac{hc}{\lambda}$

Given that-

$$h = 6.626\times10^{-34}\,Js$$

$$c = 3\times10^{8}\,m/s$$

$$\lambda = 5\times10^{-7}\,m$$

So, $E = \frac{(6.626\times10^{-34}\,Js)\times(3\times10^{8}\,ms^{-1})}{5\times10^{-7}}$

= 3.975 ×10^{-19} J

258. Which one is the wrong statement?

(a) The uncertainty principle is $\Delta E\times\Delta t \ge \frac{h}{2\pi}$

(b) Half filled and fully filled orbital have greater stability due to greater exchange energy, greater symmetry and more balanced arrangement.

(c) The energy of 2s-orbital is less than the energy of 2p-orbital in case of hydrogen like atoms.

(d) de-Broglie's wavelength is given by $\lambda = \frac{h}{mv}$, where m = mass of the particle, v = group velocity of the particle

NEET-2017

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Ans. (c): (a) According to heisenberg uncertainity principle, the uncertainties of position (Δx) and momentum (p=mΔv) are related as

$$\Delta x \cdot \Delta p \ge \frac{h}{4\pi} \text{ or } \quad \Delta x \cdot m\Delta v \ge \frac{h}{4\pi}$$

$$\Delta x \cdot m \cdot \Delta a \cdot \Delta t \ge \frac{h}{h\pi} \qquad \left[\frac{\Delta v}{\Delta t} = \Delta a, a = \text{acceleration}\right]$$

Or, $$\Delta x \cdot F \cdot \Delta t \ge \frac{h}{h\pi} \qquad [\because F = m \cdot \Delta a]$$

$$\Delta E.\Delta t \ge \frac{h}{h\pi} \qquad [\because \Delta E = F.\Delta x, E = \text{energy}]$$

Thus, statement (a) is correct.

(b) The half filled and fully filled orbitals have greater stability due to greater exchange energy, greater symmetry and more balanced arrangement.

Thus, statement (b) is correct.

(c) For a single electronic species like H, energy depends on value of x and does not depend on l. Hence energy of 2s–orbital and 2p–orbital is equal in case of hydrogen like species.

Therefore, statement (c) is incorrect.

(d) According to de-Broglie equation,

Wavelength $(\lambda) = \frac{h}{mv}$

Where, h= Planck's constant

Thus, statement (d) is correct.

259. A 0.66 kg ball is moving with a speed of 100 m/s. The associated wavelength will be (h = 6.6 ×10^{-34}) Js)

(a) 6.6×10^{-32} m
(b) 6.6×10^{-34} m
(c) 1.0×10^{-35} m
(d) 1.0 × 10–32 m

NEET-Main 2010

Ans. (c): According to de-broglie equation-

$$\lambda = \frac{h}{mv}$$

$$= \frac{6.6 \times 10^{-34}}{0.66 \times 100} = 1 \times 10^{-35} \text{ m}$$

260. The frequency of radiation emitted when the electron falls from n = 4 to n = 1 in a hydrogen atom will be (Given ionization energy of H = 2.18 ×10^{-18} J atom^{-1} and h = 6.626 × 10^{-34}J s)

(a) 1.54×10^{15} s^{-1}
(b) 1.03×10^{15} s^{-1}
(c) 3.08×10^{15} s^{-1}
(d) 2.00×10^{15} s^{-1}

NEET-2004

Ans. (c): Hydrogen like atom–

$$E_n = -\frac{E_1}{n^2} = \frac{-2.18 \times 10^{-18}}{n^2} \text{J/atom}$$

$$E_1 = \frac{-2.18 \times 10^{-18}}{(1)^2} \text{J/atom}$$

$$E_4 = -\frac{2.18 \times 10^{-18}}{(4)^2} \text{J/atom}$$

On applying $\Delta E = E_1 - E_4$

$$= -2.18 \times 10^{-18} - \left[\frac{-2.18 \times 10^{-18}}{16}\right]$$

$$= -2.04 \times 10^{-18} \text{ J/atom}$$

On applying $\Delta E = hv$

$$-2.04 \times 10^{-18} = 6.626 \times 10^{-34} \times v$$

$$v = \frac{-2.04 \times 10^{-18}}{6.626 \times 10^{-34}}$$

$$v = 3.08 \times 10^{15} \text{ s}^{-1}$$

261. Based on equation E = -2178 × 10^{-15} J $\left(\frac{Z^2}{n^2}\right)$ certain conclusions are written. What of them is not correct?

(a) Equation can be used to calculate the change in energy when the electron changes orbit.

(b) For n=1, the electron has a more negative energy than it does for n = 6 which means that the electron is more loosely bound in the smallest allowed orbit.

(c) The negative sign in equation simply means that the energy of electron bound to the nucleus is lower than it would be if the electrons were at the infinite distance from the nucleus.

(d) Larger the value of n, the larger is the orbit radius.

NEET-2013

Ans. (b): For n=1 the electron has more negative energy than it does for n=6 which means that the electron is less loosely bound in the smallest allowed orbit.

We know that,

$$E = -R_H\left(\frac{Z^2}{n^2}\right)$$

If n = 1

$$E = -R_H\left(\frac{Z^2}{1}\right) = -2.178 \times 10^{-18} \text{J}$$

If n = 6

$$E = -R_H\left(\frac{Z^2}{6^2}\right) = \frac{-2.178}{36} \times 10^{-18} \text{J}$$

$$= -6.05 \times 10^{-20} \text{J}$$

$$E_{n=1} > E_{n=6}$$

262. Calculate the energy in joule corresponding to light of wavelenth 45 nm.
Planck'e constant, h = 6.63m × 10^{-34} J s, speed of light, c = 3 × 10^{8} m s^{-1})

(a) 6.67×10^{15}
(b) 6.67×10^{11}
(c) 4.42×10^{-15}
(d) 4.42×10^{-18}

NEET-2014

Ans. (d) : Using planck's quantum theory –

$$E = \frac{hc}{\lambda} = \frac{6.63 \times 10^{-34} \times 3 \times 10^8}{45 \times 10^{-9}}$$

$$= 4.42 \times 10^{-18} \text{ J}$$

263. The value of Planck's contant is 6.63 × 10^{-34} Js. Speed of light is 3 × 10^{17} nm s^{-1}. Which a value is closed to the wavelength in nanomter of a quantum of light with frequency of 6×10^{15} s^{-1}?

(a) 50
(b) 75
(c) 10
(d) 25

NEET-2013

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Ans. (a) : We know that –

$$c = \nu\lambda$$

$$\lambda = \frac{c}{\nu}$$

$$\lambda = \frac{3\times10^{17}}{6\times10^{15}} = 50\text{nm}$$

264. According to law of photochemical equivalence the energy absorbed (in ergs/mole) is given as ($h = 6.62 \times 10^{-27}$ ergs, $c = 3 \times 10^{10}$ cm s^{-1}, $N_A = 6.02 \times 10^{23}$ mol^{-1})

(a) $\frac{1.196\times10^{8}}{\lambda}$ (b) $\frac{2.859\times10^{5}}{\lambda}$

(c) $\frac{2.859\times10^{16}}{\lambda}$ (d) $\frac{1.196\times10^{16}}{\lambda}$

Karnataka NEET-2013

Ans. (a) : Given data,

$h = 6.62 \times 10^{-27}$ ergs

$c = 3 \times 10^{10}$ cm s^{-1}

$N_A = 6.02 \times 10^{23}$ mol^{-1}

$$E = \frac{hcN_A}{\lambda}$$

$$= \frac{6.62\times10^{-27}\times3\times10^{10}\times6.02\times10^{23}}{\lambda}$$

$$= \frac{1.196\times10^{8}}{\lambda}\text{ergs mol}^{-1}.$$

265. The energies E_1 and E_2 of two radiations are 25 eV and 50 eV respectively. The relation between their wavelengths i.e. λ_1 and λ_2 will be

(a) $\lambda_1 = \lambda_2$ (b) $\lambda_1 = 2\lambda_2$

(c) $\lambda_1 = 4\lambda_2$ (d) $\lambda_1 = \frac{1}{2}\lambda_2$

NEET-2011

Ans. (b) : Given, E_1= 25ev and E_2= 50 ev

$$E_1 = \frac{hc}{\lambda_1}, E_2 = \frac{hc}{\lambda_2}$$

By dividing E_1 and E_2

$$\Rightarrow \frac{25}{50} = \frac{\lambda_2}{\lambda_1}$$

$$\Rightarrow \frac{\lambda_2}{\lambda_1} = \frac{1}{2}$$

$$\Rightarrow \lambda_1 = 2\lambda_2$$

266. The value of Planck's constant is 6.63×10^{-34} Js. The velocity of light is 3.0×10^{8} ms^{-1}. Which value is closest to the wavelength in nanometers of a quantum of light with frequency of $8\times10^{15}s^{-1}$?

(a) 2×10^{-25} (b) 5×10^{-18}

(c) 4×10^{1} (d) 3×10^{7}

NEET-2003

Ans. (c): Given that –

$c = 3 \times 10^{8}$ m/s

$\lambda = 8 \times 10^{15}$ s^{-1}

We know that,

$$\lambda = \frac{c}{\upsilon}$$

$$\lambda = \frac{3\times10^{8}}{8\times10^{15}} = 0.375\times10^{-7}\text{m}$$

$$= 0.375\times10^{-7}\times10^{9}\text{ nm}$$

$$= 0.375\times10^{2}\text{ nm}$$

$$= 37.5\text{ nm}$$

$$\approx 4\times10^{1}\text{ nm}$$

267. For given energy, $E = 3.03 \times 10^{-19}$ Joules corresponding wavelength is ($h = 6.626 \times 10^{-34}$) J sec, $c = 3 \times 10^{8}$ m/sec

(a) 65.6 nm (b) 6.36 nm

(c) 3.4 nm (d) 656 nm

NEET-2000

Ans. (d) : We know that –

$$E = \frac{hc}{\lambda}$$

Given that –

$E = 3.03 \times 10^{-19}$J

$h = 6.626 \times 10^{-34}$ Js

$c = 3 \times 10^{8}$ m/s

$$\lambda = \frac{6.6\times10^{-34}\times3\times10^{8}}{3.03\times10^{-19}}$$

$$= 6.56\times10^{-7}\text{m} = 656\times10^{-9}\text{m} = 656\text{nm}$$

268. A particular station of All India Radio, New Delhi, broadcasts ona frequency of 1,368 kHz (kilohertz). The wavelength of the electromagnetic radiation emitted by the transmitter is [speed of light, $c = 3.0 \times 10^{8}$ m s^{-1}]

(a) 21.92 cm (b) 219.3 m

(c) 219.2 m (d) 2192 m

NEET-2021

Ans. (b) : We know that –

$$\text{Wave length }(\lambda) = \frac{c}{v}$$

$$\lambda = \frac{3\times10^{8}}{1368\times10^{3}} = 219.298\text{m} = 219.3\text{m}$$

269. What will be the wavelength of a photon having energy 1eV ($1eV=1.601\times10^{-19}J$)?

(a) 1.241×10^{-7}m (b) 12.41×10^{-9}m

(c) 12.41×10^{-7}m (d) 1.241×10^{-9}m

Tripura JEE-2019

Ans. (c): According to formula

$$E = \frac{hc}{\lambda}$$

$$\lambda = \frac{hc}{E} = \frac{6.626\times10^{-34}\times3\times10^{8}}{1.6\times10^{-19}}$$

$$\lambda = 12.41\times10^{-7}\text{ m.}$$

270. What is the wavelength (in m) of a particle of mass 6.62×10^{-29} g moving with a velocity of $10^{3}ms^{-1}$?

(a) 6.62×10^{-4} (b) 6.62×10^{-3}

(c) 10^{-5} (d) 10^{5}

UP CPMT-2008

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Ans. (c): According to de-Broglie equation

$$\lambda = \frac{h}{m\nu}$$

Given that –

$m = 6.62 \times 10^{-29}$g
$v = 10^3$ m/s
$h = 6.62 \times 10^{-34}$Js

putting these value in the equation.

$$\lambda = \frac{6.62\times10^{-34}}{6.62\times10^{-29}\times10^{3}\times10^{-3}} = 10^{-5}\text{m}$$

271. If the energy difference between the ground state and its excited state of an atom is 4.4×10^{-14}J. The wavelength of photon required to produce the transition:

(a) 2.26×10^{-12} m (b) 1.13×10^{-12} m
(c) 4.52×10^{-16} m (d) 4.52×10^{-12} m

UPTU/UPSEE-2006

Ans. (d) : We know that –

$$\Delta E = h\nu = \frac{hc}{\lambda}$$

$$\lambda = \frac{hc}{\Delta E} = \frac{6.62\times10^{-34}\times3\times10^{8}}{4.4\times10^{-14}}$$

$$\lambda = 4.52\times10^{-12}\text{m.}$$

272. What is the wavelength associated with a tennis ball of mass 10^3g and travelling at a velocity of 6.626 ms^{-1}? [$h=6.626\times10^{-34}Js^{-1}$]

(a) 10^{-34} m (b) 10^{-31} m
(c) 6.626m (d) 6.626×10^{-31}m

UPTU/UPSEE-2011

Ans. (a) : According to de-Broglie equation –

$$\lambda = \frac{h}{mv}$$

$$\lambda = \frac{6.626\times10^{-34}\,\text{Js}}{1\text{kg}\times6.626\,\text{ms}^{-1}} = 10^{-34}\text{ m}$$

273. Time period of a wave is 5×10^{-3} sec what is the frequency.

(a) 5×10^{-3} s^{-1} (b) 2×10^{2} s^{-1}
(c) 23×10^{3} s^{-1} (d) $5\times10^{2}s^{-1}$

UPTU/UPSEE-2008

Ans. (b) : Frequency (n) = $\frac{1}{\text{time period (T)}}$

Here, T= 5×10^{-3} s

$$n = \frac{1}{5\times10^{-3}} = 0.2\times10^{3}$$

$n = 2\times10^{2}$ s^{-1}

274. As per de-Broglie's formula a macroscopic particle of mass 100 g and moving at a velocity of 100 cm s^{-1} will have a wavelength of

(a) 6.6×10^{-29} cm (b) 6.6×10^{-30} cm
(c) 6.6×10^{-31} cm (d) 6.6×10^{-32} cm

WB-JEE-2014

Ans. (c) : According to de–Broglie wavelength,

$$\lambda = \frac{h}{mv}$$

Where, h = Planck's constant
m = Mass of particle
v = Velocity

Given, m= 100 g, v= 100 cm s^{-1}
$h=6.6\times10^{-34}$ Js= 6.6×10^{-27} ergs

$$\lambda = \frac{6.6\times10^{-27}}{100\times100}$$

$\lambda= 6.6\times10^{-31}$ cm

275. Which one of the following corresponds to a photon of highest energy?

(a) $\lambda = 300$ mm (b) $\nu = 3\times10^{8}s^{-1}$
(c) $\bar{\nu} = 30\text{ cm}^{-1}$ (d) $\varepsilon = 6.626\times10^{-27}$ J

WB-JEE-2017

Ans. (a) : $\therefore$ E= $h\nu = \frac{hc}{\lambda} = hc.\bar{v}\left(\because \frac{1}{\lambda} = \bar{v}\right)$

Where E= energy of photon
c = velocity of photon (=light)
λ = wavelength of photon
h= plank's constant.

For (a)
E= $6.63\times10^{-34} \times3\times10^{8}/300\times10^{-9}$
E= 1.98×10^{-25} J/300×10^{-9}

$$E = \frac{1.98\times10^{-25}\,J}{300\times10^{-9}\,m}$$

(a) → E = 6.6×10^{-19}J
For (b)
E= $h\nu = 6.63\times10^{-34}\times3\times10^{8}$
(b) → E= 1.98×10^{-25} J

For (c) $E = hc.\bar{v}\left(\because \frac{1}{\lambda} = \bar{v}\right)$

E= $6.63\times10^{-34}\times3\times10^{8}\times30\times10^{-2}$
(c) → E= 5.96×10^{-26}
For (d) → E= 6.62×10^{-27} J
Hence highest energy for photon is in (a).

4. Uncertainty Principle

276. If the work function of a metal is 6.63×10^{-19} J, the maximum wavelength of the photon required to remove a photoelectron from the metal is ——— nm. (Nearest integer) [Given : h = 6.63×10^{-34} Js, and c = 3×10^{8} m s^{-1}]

JEE Main-28.06.2022, Shift-I

Ans. (300) : Given,

Work function of metal = 6.63×10^{-19} J
Planck's constant = 6.63×10^{-34}Js
c(velocity) = 3×10^{8} m/s

As we know that–

$$\text{Work function} = \frac{hc}{\lambda}$$

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Then $\lambda = \dfrac{hc}{\text{work function}}$

$$\lambda = \frac{6.63\times10^{-34}\times3\times10^{8}}{6.63\times10^{-19}}$$

λ = 3000 nm

277. A fast moving particle of mass 6.63 × 10^{-28} g can be located with an accuracy of 1Å. The uncertainty in its velocity (in ms^{-1}) is about (h = 6.63 × 10^{-34} Js)

(a) 8 × 10^3 (b) 8 × 10^4
(c) 8 × 10^5 (d) 8 × 10^6
(e) 8 × 10^7

Kerala CEE -03.07.2022

Ans. (c) : Given that –

Mass of particle (m) = 6.63 × 10^{-28}g
= 6.63 × 10^{-31} kg

Planck's constant (h) = 6.63 × 10^{-34} Js

$\Delta x = 1A^{o} = 10^{-10}$ m

According to Heisenberg's uncertainty principle

$$\Delta x.\ \Delta p = \frac{h}{4\pi}$$

$$\Delta x.\ m\Delta v = \frac{h}{4\pi}$$

$$\Delta v = \frac{h}{4\pi\times m\times\Delta x}$$

$$\Delta v = \frac{6.63\times10^{-34}}{4\times3.14\times6.63\times10^{-31}\times10^{-10}}$$

$$\Delta v = \frac{10^{-34}\times10^{41}}{12.56}$$

$$\Delta v = \frac{10^{7}}{12.56}$$

$$\Delta v = \frac{100\times10^{5}}{12.56}$$

$$\Delta v = 8\times10^{5}$$

278. If the uncertainty in velocity and position of a minute particle in space are, 2.4 × 10^{-26} (m s^{-1}) and 10^{-7} (m) respectively. The mass of the particle in g is _____. (Nearest integer) (given : h = 6.626 × 10^{-34} Js)

JEE Main-27.06.2022, Shift-I

Ans. (29.89×10^{-3}) :

We know the uncertainty principle–

$$\Delta x.\ \Delta p = \frac{h}{4\pi}$$

$$\Delta x.\ m\Delta v \geq \frac{h}{4\pi} \because \Delta p = m\Delta v$$

$$m = \frac{h}{4\pi.\ \Delta x.\ \Delta v}$$

Given that –

$\Delta v = 2.4\times10^{-26}$

$\Delta x = 10^{-7}$

n = 6.626 × 10^{-34}

So,

$$m = \frac{6.626\times10^{-34}}{4\times3.14\times10^{-7}\times2.4\times10^{-26}}$$

$$m = \frac{6.626\times10^{-34}\times10^{33}}{4\times3.14\times2.4}$$

m = 21.89 × 10^{-3} g

279. The uncertainties in the velocities of two particles A and B are 0.05 and 0.02 ms^{-1} respectively. The mass of B is five times to that of A. What is the ratio of uncertainties $\left(\dfrac{\Delta x_A}{\Delta x_B}\right)$ their positions in :

(a) 2 (b) 0.25
(c) 4 (d) 1

AP-EAMCET-2006

Ans. (a) : Given, $\Delta v_A = 0.05\ ms^{-1}$ and m_A = m

$\Delta v_B = 0.02\ ms^{-1}$ m_B = 5 m

According to Heisenberg uncertainty principle–

$$\boxed{m\Delta v.\Delta x \geq \frac{h}{4\pi}}$$

Where, h = Planck's constant

Δx = Uncertainity in position

Δv = Uncertainity in velocity

m = Mass

For particle A :

$$m\times0.05\times\Delta x_A = \frac{h}{4\pi} \quad \text{.... (i)}$$

For particle B :

$$5\ m\times0.02\times\Delta x_B = \frac{h}{4\pi} \quad \text{.... (ii)}$$

Dividing equation (i) and (ii) we get :

$$\frac{m\times0.05\times\Delta x_A}{5m\times0.02\times\Delta x_B} = 1$$

$$\frac{\Delta x_A}{\Delta x_B} = \frac{0.02\times5}{0.05}$$

$$\boxed{\frac{\Delta x_A}{\Delta x_B} = 2}$$

280. If the uncertainty in velocity of a moving object is 1.0×10^{-6} ms^{-1} and the uncertainty in its position is 58 m, The mass of this object is approximately equal to that of (h = 6.626×10^{-34} Js)

(a) helium (b) deuterium
(c) lithium (d) electron

AP EAMCET (Medical) - 2013

Ans. (d) : Given-

Uncertainty in velocity $(\Delta v) = 1.0\times10^{-6}\ ms^{-1}$

Uncertainty in position (Δx) = 58 m

Mass (m) = ?

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Now, from the Heisenberg principle-

$$\Delta x.\Delta p \ge \frac{h}{4\pi}$$

where - Δx = uncertainty in position

Δp = uncertainty in momentum

$$\therefore \Delta x.\Delta v = \frac{h}{4\pi m}$$

or $$m = \frac{6.6\times10^{-34}}{4\times3.14\times58\times1.0\times10^{-6}}$$

or $$m = \frac{6.6}{728.48}\times10^{-34+6}$$

or $$m = 9.05\times10^{-28-3}$$

or $$m = 9.05\times10^{-31}$$

Thus, the mass of moving object is approximately equal to that of electron.

281. If a cricket ball of weight 0.1 kg has an uncertainty of 0.15 ms^{-1} in its velocity then the uncertainty in the position of the cricket balls is ________

(a) 3.5×10^{-33} m (b) 35×10^{-33}m

(c) 1.7×10^{-34} m (d) 1.7×10^{-33} m

AP EAPCET-6 Sep. 2021, Shift-II

Ans. (a) : According to Heisenberg's Uncertainty principle–

$$\Rightarrow \Delta p.\Delta x \ge \frac{h}{4\pi}$$

Where, h = Planck's constant (6.67×10^{-34} J-s)

$\because \Delta p = m\Delta v$

$$\Rightarrow m\Delta v\Delta x \ge \frac{h}{4\pi}$$

Given, m = 0.1kg, Δx=0.15m/sec

$$\Delta x = \frac{h}{4\pi m\Delta v}$$

$$= \frac{6.67\times10^{-34}}{4\times3.14\times0.1\times0.15}$$

$$= \frac{6.67}{0.1884}\times10^{-34}$$

$$\Rightarrow 35.40\times10^{-34}$$

$$\Rightarrow 3\cdot5\times10^{-33}\text{ m}$$

282. If the uncertainty in momentum and uncertainty in the position of a particle are equal. then the uncertaintiy in its velocity would be given by _______.

(a) $\Delta v \ge \sqrt{\frac{h}{2\pi}}$ (b) $\Delta v \ge \frac{1}{2m}\sqrt{\frac{h}{\pi}}$

(c) $\Delta v \ge \sqrt{\frac{h}{\pi}}$ (d) $\Delta v \ge \frac{1}{m}\sqrt{\frac{h}{\pi}}$

AP EAPCET 24.08.2021, Shift-I

CG PET -2019

Ans. (b) : Given –

Uncertainity in momentum = Uncertainity in position

i.e. $m\Delta v = \Delta x$ ... (1)

From equation of Heisenberg uncertainity principle –

$$\Delta x.\Delta v \ge \frac{h}{4\pi m}$$

Where, h = Planck's constant

Δx = Uncertainity in position

Δv = Uncertainity in velocity

From equation (1) we get

$$m\Delta v^2 \ge \frac{h}{4\pi m}$$

$$\Delta v^2 \ge \frac{h}{4\pi m^2}$$

$$\Delta v \ge \sqrt{\frac{h}{4\pi m^2}}$$

$$\Delta v \ge \frac{1}{2m}\sqrt{\frac{h}{\pi}}$$

283. Find the uncertainlity in the position of an electron which is moving with a velocity of 2.99 × 10^4 $cm.s^{-1}$. accurate up to 0.0016%. (Given, $m_e = 9.1\times10^{-28}$ g. h = 6.626×10^{-27} erg.s)

(a) 1.211 mm (b) 2.99×10^{-10} mm

(c) 0.121 mm (d) 12.11 mm

AP EAPCET 24.08.2021, Shift-I

Ans. (d) : Given –

$\Delta v = 2.99\times10^4$ cm s^{-1}, $m_e = 9.1\times10^{-28}$ gm,

h = 6.626×10^{-27} g cm^2 s^{-2}

Hence,

$$\Delta v = 2.99\times10^4 \text{ cm s}^{-1}\times\frac{0.0016}{100}$$

$$\Delta v = 0.478 \text{ cm s}^{-1}$$

From equation of Heisenberg uncertainity principle –

$$\Delta x.\Delta v \ge \frac{h}{4\pi m}$$

Where, h = Planck's constant

Δx = Uncertainity in position

Δv = Uncertainity in velocity

m = Mass

π = 3.14

or $$\Delta x = \frac{6.626\times10^{-27}\left(\text{g cm}^2\text{s}^{-2}\right)\cdot\text{s}}{4\times3.14\times0.478(\text{cm s}^{-1})\times9.1\times10^{-28}(\text{gm})}$$

Δx = 1.21 cm = 12.1 mm

284. If a proton is accelerated to a velocity of 3 × 10^7 $m.s^{-1}$ which is accurate up to ± 0.5%, then the uncertainty in its position will be ____ [mass of proton = 1.66×10^{-27} kg, h =6.6×10^{-34} J.s]

(a) 1.55×10^{-12} m (b) 3.24×10^{-13} m

(c) 1.58×10^{-13} m (d) 2.11×10^{-13} m

AP EAPCET 24.08.2021, Shift-I

Ans. (d): Given –

$\Delta v = 3\times10^7$ m s^{-1}

Δx = ?

m = 1.66×10^{-27} kg

h = 6.626×10^{-34} J-s

It is given that velocity have the ± 0.5% So, the velocity will be –

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$$\Delta v = 3 \times 10^7\ ms^{-1} \times \frac{0.5}{100}$$

$$\Delta v = 3 \times 5 \times 10^4\ ms^{-1}$$

From the Heisenberg uncertainity principle –

$$\Delta x.\Delta v \geq \frac{h}{4\pi m}$$

or $$\Delta x = \frac{h}{4\pi m \cdot \Delta v}$$

$$\Delta x = \frac{6.6\times10^{-34}\left(kgm^2s^{-1}\right)}{4\times3.14\times1.66\times10^{-27}\left(kg\right)\times1.5\times10^5\left(ms^{-1}\right)}$$

$$= \frac{6.6\times10^{-12}}{31.2744}$$

$\Delta x = 2.11 \times 10^{-13}$ m

285. In an atom, an electron is moving with a speed of 600 m/s with an accuracy of 0.005%. Certainty with which position of the electron can be located is
(h= 6.6 ×10^{-34} kg m^2 s^{-1}, mass of electron e_m=9.1 ×10^{-31} kg)

(a) 1.52× 10^{-4} m (b) 5.10× 10^{-3} m
(c) 1.92× 10^{-3} m (d) 3.84× 10^{-3} m

COMEDK-2017

Ans. (c) : Given: velocity of electron, $v = 600\,ms^{-1}$

Accuracy of velocity= 0.005%

$$\therefore \Delta v = \frac{600\times0.005}{100} = 0.03 m/s$$

According to Heisenberg's uncertainty principle,

$$\Delta x.m\Delta v \geq \frac{h}{4\pi}$$

$$\Delta x = \frac{h}{4\pi m\Delta v}$$

Where, h = Planck's constant
Δx = Uncertainity in position
Δv = Uncertainity in velocity
m = Mass

$$\Rightarrow \Delta x = \frac{6.6\times10^{-34}}{4\times3.14\times9.1\times10^{-31}\times0.03} = 1.92\times10^{-3}m$$

286. A ball weighing 10 g is moving with a velocity of 90 ms^{-1}. If the uncertainty in its velocity is 5%, then the uncertainty in its position is ______ ×10^{-33} m. (Rounded off to the nearest integer) [Given: h=6.63×10^{-34} Js]

JEE Main 26.02.2021,Shift-II

Ans. (1) : Given that,
m= 10gm =10×10^{-3}=10^{-2} kg
v = 90 m/sec.

$$\Delta v = 90\times\frac{5}{100} = 4.5 m/sec$$

According to Heisenberg's principle

$$m.\ \Delta v.\Delta x \geq \frac{h}{4\pi}$$

Where, h = Planck's constant
Δx = Uncertainity in position
Δv = Uncertainity in velocity
m = Mass
π = 3.14

$$10^{-2}\times4.5\times\Delta x \geq \frac{6.63\times10^{-34}}{4\times3.14}$$

$$\Delta x \geq \frac{6.63\times10^{-34}}{4\times3.14\times10^{-2}\times4.5}$$

$$\Delta x \geq 1.17\times10^{-33}$$

So, x= 1.17 ≈ 1.

287. Both the position and exact velocity of an electron in an atom cannot be determined simultaneously and accurately. This is known as

(a) De Broglie principle
(b) Hamiltonian law
(c) Heisenberg uncertainty principle
(d) Bohr theory of hydrogen atom

TS-EAMCET 09.08.2021, Shift-I

Ans. (c) : Heisenberg uncertainty principle– It is impossible to determine the exact position and the exact momentum of the particle simultaneously.

According to Heisenberg uncertainty principle–

$$\boxed{\Delta x.\ \Delta p \geq \frac{h}{4\pi}}$$

Thus, lesser the error in the momentum more will be the error in the position of the particle.

288. A microscope using appropriate photons is engaged to track an electron in an atom within distance of 0.001 nm. What will be the uncertainty involved in measuring its velocity?

(a) 5.79 × 10^7 m/s (b) 5.79 × 10^6 m/s
(c) 4.79 × 10^7 m/s (d) 3.7 × 10^6 m/s

TS EAMCET 05.08.2021, Shift-I

Ans. (a):

According to heisenberg's uncertainty principle-

$$\Delta v \geq \frac{h}{4\pi m\Delta x}$$

Where, h = Planck's constant
Δx = Uncertainity in position
Δv = Uncertainity in velocity
m = Mass

$$\Delta v \geq \frac{6.626\times10^{-34}}{4\times3.14\times9.11\times10^{-31}\times0.01\times10^{-10}}$$

Δv ≥ 0.0579 × 10^9 m/s

Δv ≥ 5.79 × 10^7 m/s

289. Heisenberg's uncertainty principle is in general significant to

(a) Planets
(b) Cricket bal of 500 g
(c) Cars
(d) Micro particles having a very high speed

TS EAMCET 04.08.2021, Shift-I

Ans. (d) : According to Heisenberg's uncertainty principle we cannot simultaneously determine both the precise velocity and position of a particle. It is general significant to micro particles having a very high speed.

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The mathematical expression of law is given below :

$$\Delta x \times \Delta y \geq \frac{h}{4\pi}$$

Δx = Change in position of the particle.
Δy = Change in momentum of particle.
h = Planck's constant.

290. A proton and a Li^{3+} nucleus are accelerated by the same potential. If λ_{Li} and λ_P denote the de Broglie wavelengths of Li^{3+} and proton respectively, then the value of $\frac{\lambda_{Li}}{\lambda_p}$ is $x \times 10^{-1}$.

The value of x is _____(Rounded off to the nearest integer)
[Mass of Li^{3+} = 8.3 mass of proton]

JEE Main 24.02.2021, Shift-I

Ans. (2) : Given –

Potential of proton = $e_p^- V$

Potential of $Li^{3+} = 3e_p^- V$

and $\frac{\lambda_{Li}}{\lambda_p} = x \times 10^{-1}$

According to de-Broglie equation

Now, $\lambda = \frac{h}{\sqrt{2M(K.E)}}$

Where, h = Planck's constant
m = Mass
K.E. = Kinetic energy

$$\therefore \quad \frac{\lambda_{Li}}{\lambda_p} = \frac{h}{\sqrt{2M_{Li^{3+}}(3e_p^- V)}} \times \frac{\sqrt{2M_p(e_p^- V)}}{h}$$

$$\therefore \quad x \times 10^{-1} = \sqrt{\frac{M_p(e_p^- V)}{M_{Li^{3+}}(3e_p^- V)}}$$

$$\left[M_{Li^{3+}} = 8.3M_p \Rightarrow \frac{M_p}{M_{Li^{3+}}} = \frac{1}{8.3}\right]$$

$$x \times 10^{-1} = \sqrt{\frac{1}{8.3 \times 3}} \Rightarrow \boxed{x = 2}$$

291. Assertion: It is impossible to determine the exact position and exact momentum of an electron simultaneously.
Reason: The path of an electron in an atom is clearly defined.

(a) If both Assertion and Reason are correct and the Reason is the correct explanation of Assertion
(b) If both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.
(c) If Assertion is correct but Reason is incorrect.
(d) If both the Assertion and Reason are incorrect.

AIIMS-2016

Ans. (c): According to Heisenberg's uncertainty principle, we cannot determine the exact position and exact momentum of an electron simultaneously. So assertion is correct but reason is not correct.

292. The uncertainties in the velocities of two particles, A and B are 0.05 and 0.02 ms^{-1} respectively. The mass of B is five times to that of the mass of A. What is the ratio of uncertainties $\frac{\Delta x_A}{\Delta x_B}$ in their positions?

(a) 2
(b) 0.25
(c) 4
(d) 1

AIIMS-2008

Ans. (a): According to Heisenberg's uncertainty principle,

$$\Delta x \times m\Delta v = \frac{h}{4\pi}$$

Where, h = Planck's constant
Δx = Uncertainity in position
Δv = Uncertainity in velocity
m = Mass
$\pi = 3.14$

For particle A, $\Delta x = \Delta x_A$
M=m, Δv=0.05

So, $\Delta x_A \times m \times 0.05 = \frac{h}{4\pi}$ ………. (i)

For particle B, $\Delta x = \Delta x_B$ m = 5m, Δv = 0.02

So, $\Delta x_B \times 5m \times 0.02 = \frac{h}{4\pi}$ ………..(ii)

So, $\frac{\Delta x_A}{\Delta x_B} = \frac{5 \times 0.02}{0.05}$
$= 2$

293. The product of uncertainty in velocity and uncertainty in position of a micro particle of mass 'm' is not less than in which of the following?

(a) $h \times \frac{3\pi}{m}$
(b) $\frac{h}{3\pi} \times m$
(c) $\frac{h}{4\pi} \times \frac{1}{m}$
(d) $\frac{h}{4\pi} \times m$

AP-EAMCET – 2016

Ans. (c) : According to uncertainty principle

$$\Delta p.\Delta x \geq \frac{h}{4\pi} \quad \text{(i)}$$

Where, Δp = Uncertainty in momentum
Δx = Uncertainity in position
h = Planck's constant

$\therefore \quad \Delta p = m \cdot \Delta v$

Putting the value of Δp in equation (i) we get -

$$m \cdot \Delta v \cdot \Delta x \geq \frac{h}{4\pi}$$

$$\boxed{\Delta x \cdot \Delta v \geq \frac{h}{4\pi} \times \frac{1}{m}}$$

294. The exact path of electron in any orbital cannot be determined. The above statement is based on ______

(a) Hund's Rule
(b) Bohr's Rule
(c) Uncertainty Principal
(d) Aufbau Principal

AP- EAPCET- 07-09-2021, Shift-I

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Ans. (c) : According to Heisenberg uncertainty principle, the position and the velocity of an object cannot both be measured exactly at the same time.

Hund's Rule- Every orbitals in a subshell is singly occupied with one electron before any one orbital is doubly occupied,

Aufbau Principle- Electrons fill lower energy atomic orbitals before filling higher energy ones.

295. The uncertainty in position and velocity of a particle are 10^{-10}m and 5.27 × 10^{-24} ms^{-1} respectively. Calculate the mass of the particle is ($h = 6.625 \times 10^{-34}$ Js) –

(a) 0.099 kg (b) 0.99 kg
(c) 0.92 kg (d) None

VITEEE 2019

Ans. (a): Given,

$$\Delta n = 10^{-10}\text{ m}$$
$$\Delta v = 5.27\times10^{-24}\text{ m.s}^{-1}$$
$$h = 6.625\times10^{-34}\text{ J-s}$$

According to Heisenberg's uncertainty principle–

$$\Delta x.m\Delta v \ge \frac{h}{4\pi} \qquad [\therefore p = m\Delta v]$$

$$m = \frac{h}{4\pi.\Delta x\times\Delta v}$$

$$m = \frac{6.625\times10^{-34}\text{ J sec}}{4\times3.14\times10^{-10}\times5.27\times10^{-24}}$$

$$m = 0.099\text{ kg.}$$

296. Which of the following pairs is not correctly matched?

(a) Hund's rule	In orbitals of equivalent energy electron spins remain unpaired if possible.
(b) Pauli's exclusion principle	No two electrons can have all the four quantum number identical.
(c) Zeeman effect	the effect of magnetic field on the atomic spectra.
(d) Uncertainty principle	It is impossible to determine the position of an electron.

J & K CET-(2013)

Ans. (d) : According to uncertainty principle, it is impossible to measure simultaneously the position and momentum of an electron with absolute accuracy.

297. The Heisenberg uncertainty principle may be stated as

(a) $\Delta x.\Delta v = h$ (b) $\Delta x.\Delta v = h/4\pi m$
(c) $\Delta x.\Delta v \ge h/4\pi m$ (d) $\Delta x.\Delta v = h/4\pi$

WB-JEE-2012, AMU-2004

Ans. (c) : According to Heisenberg's uncertainty principle : "It is impossible to determine simultaneously both the position and momentum (or velocity) of a microscopic particle with absolute accuracy.

Mathematically. $\Delta x \times \Delta v \ge \dfrac{h}{4\pi m}$

Or $\Delta x.m\Delta v \ge \dfrac{h}{4\pi}$

Δx = Uncertainty in position
Δv = Uncertainty in velocity
m = Mass of particle
h = Planck's constant

298. The measurement of the electron position if associated with an uncertainty in momentum, which is equal to 1 × 10^{-18}g cm s^{-1}. The uncertainty in electron velocity is, (mass of an electron is 9 × 10^{-28} g)

(a) 1 × 10^{9} cm s^{-1} (b) 1 × 10^{6} cm s^{-1}
(c) 1 × 10^{5} cm s^{-1} (d) 1 × 10^{11} cm s^{-1}

BITSAT 2007

Ans. (a) : Momentum, $\Delta p = m\Delta v$

Substituting the given values of Δx and m, we get

$$1\times10^{-18}\text{g cm s}^{-1} = 9\times10^{-28}\text{g}\times\Delta v$$

$$\text{or } \Delta v = \frac{1\times10^{-18}}{9\times10^{-28}}$$

$$= 1.1\times10^{9}\text{cm s}^{-1} = 1\times10^{9}\text{cm s}^{-1}$$

299. A stream of electrons from a heated filament was passed between two charged plates kept at a potential difference V esu. If e and m are charge and mass of an electron, respectively, then the value of h/λ (where, λ is wavelength associated with electron wave) is given by

(a) 2 meV (b) $\sqrt{\text{meV}}$
(c) $\sqrt{2\text{meV}}$ (d) meV

[JEE Main-2016]

Ans. (c): Wavelength, $\lambda = \dfrac{h}{mv} = \dfrac{h}{\sqrt{2m(KE)}}$

$$\therefore \frac{h}{\lambda} = \sqrt{2meV}$$

300. The de Broglie wavelength of an electron in the 4th Bohr orbit is

(a) $6\pi a_0$ (b) $2\pi a_0$
(c) $8\pi a_0$ (d) $4\pi a_0$

[JEE Main 2020, 9 Jan Shift-I]

Ans. (c) : De–Broglie wavelength of an electron

$$2\pi r = n\lambda$$

Where, r = Radius of orbit
n = no. of orbit

$$2\pi\times\frac{n^2}{z}a_0 = n\cdot\lambda$$

$$2\pi\times\frac{n}{z}a_0 = \lambda$$

$$2\pi\times\frac{4}{1}a_0 = \lambda \Rightarrow 8\pi a_0$$

301. A ball weighing 10 g is moving with a velocity of 90 ms^{-1}. If the uncertainty in its position is 5%, then the uncertainty in its position is ....×10^{-33} m(Rounded off to the nearest integer). [Given, $h = 6.63\times10^{-34}$ J-s]

[JEE Main 2021, 26 Feb Shift-II]

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Ans. : According to Heisenberg uncertainty principle

$$\Delta x\Delta p \ge \frac{h}{4\pi}$$

$$\Delta x = \frac{h}{4\pi m\Delta v}\ (\Delta p = m\Delta v)$$

$$\Rightarrow \frac{6.63\times10^{-34}\text{ Js}}{4\times3.14\times10\times10^{-3}\text{ kg}\times90\text{ ms}^{-1}\times0.05}$$

$$\Rightarrow 1.173\times10^{-33}\text{ m}$$

$$\Rightarrow 1\times10^{-33}\text{ m}$$

302. A proton and a Li^{3+} nucleus are accelerated by the same potential. If λ_{Li} and λ_P denote the de-Broglie wavelengths of Li^{3+} and proton respectively, then the value of $\frac{\lambda_{Li}}{\lambda_P}$ is $x\times10^{-1}$. The value of x is..........(Rounded off to the nearest integer)

Mass of Li^{3+} = 8.3 mass of proton)

[JEE Main 2021, 24 Feb Shift-I]

Ans. $\lambda = \frac{h}{\sqrt{2mqV}}$

$$\frac{\lambda_{Li}}{\lambda_p} = \sqrt{\frac{m_p(e)(V)}{m_{Li}(3e)(V)}}, m_{Li} = 8.3$$

$$m_p = \frac{\lambda_{Li}}{\lambda_p} = \sqrt{\frac{1}{8.3\times3}} = \frac{1}{5} = 2\times10^{-1}$$

x = 2

303. An accelerated electron has a speed of 5×10^6 ms^{-1} with an uncertainty of 0.02%. The uncertainty in finding its location while in motion is $x\times10^{-9}$m. The value of x is ....(Nearest integer)

[Use mass of electron = 9.1×10^{-31} kg, h = 6.63×10^{-34} Js, $\pi = 3.14$]

[JEE Main 2021, 25 July Shift-II]

Ans. Given, $\Delta v = \frac{0.02}{100}\times5\times10^6 = 10^3\text{ m/sec}$

According to Heisenberg's uncertainty principle

$$\Delta x.\Delta v \ge \frac{h}{4\pi m}$$

$$x\times10^{-9}\times10^3 = \frac{6.63\times10^{-34}}{4\times3.14\times9.1\times10^{-31}}$$

$$x\times10^{-9}\times10^3 = 0.058\times10^{-3}$$

$$x = \frac{0.058\times10^{-6}}{10^{-9}} = 58$$

x = 58

304. The energy of a photon is 3×10^{-12} erg. What is its wavelength in nm?

(h = 6.62×10^{-27} erg-s; c = 3×10^{10} cm/s)

(a) 662
(b) 1324
(c) 66.2
(d) 6.62

JCECE - 2009

Ans. (a): $\therefore$ Energy, $E = \frac{hc}{\lambda}$

$$3\times10^{-12} = \frac{6.62\times10^{-27}\times3\times10^{10}}{\lambda}$$

$$\lambda = \frac{6.62\times10^{-27}\times3\times10^{10}}{3\times10^{-12}}$$

$$\Rightarrow 6.62\times10^{-5}\text{ cm} \Rightarrow 662\times10^{-9}\text{ m}$$

$$\Rightarrow 662\times10^{-7}\text{ cm} \Rightarrow 662\text{ nm}$$

305. A dust particle has mass equal to 10^{-11} g, diameter 10^{-4} cm and velocity 10^{-4} cm/s. The error in measurement of velocity is 0.1%. What will be the uncertainty in its position?

(a) 0.527×10^{10} cm
(b) 5.27×10^{9} cm
(c) 0.527×10^{-15} cm
(d) 0.527×10^{-9} cm

JCECE - 2014

Ans. (d) : $v = 10^{-4}\text{ cm s}^{-1}$

$$\therefore \quad \Delta v = \frac{0.1\times10^{-4}}{100}(\text{due to 1\% error})$$

$$= 1\times10^{-7}\text{ cm s}^{-1}$$

According to Heisenberg's uncertainty principle –

Now, $\Delta v.\Delta x \ge \frac{h}{4\pi m}$

Where, h = Planck's constant
m = Mass of particle
π = 3.14

$$\Delta x = \frac{6.626\times10^{-27}}{4\times3.14\times10^{-11}\times10^{-7}}$$

$$= 0.527\times10^{-9}\text{ cm}$$

306. In an atom, an electron is moving with a speed of 600 m/s with an accuracy of 0.005%. Certainty with which the position of the electron can be located is

(Given, h= 6.6×10^{-34} kg m^2s^{-1}, mass of electron e_m=9.1×10^{-31} kg)

(a) 2.15×10^{-3} m
(b) 2.78×10^{-3} m
(c) 1.92×10^{-3} m
(d) 3.24×10^{-3} m

JIPMER-2015

Ans. (c) : Given that velocity of electron, v= 600 m/s

Accuracy of velocity = 0.005 %

$$\Delta v = \frac{600\times0.005}{100} \Rightarrow 0.03$$

According to Heisenberg's uncertainty principle -

$$\Delta x.m\Delta v \ge \frac{h}{4\pi}$$

$$\Delta x = \frac{6.6\times10^{-34}}{4\times3.14\times9.1\times10^{-31}\times0.03}$$

$$= 1.92\times10^{-3}\text{ m}$$

307. The de-Broglie wavelength of a particle with mass 1 kg and velocity 100 m/s is

(a) 6.6×10^{-33} m
(b) 6.6×10^{-36} m
(c) $3.3\times10^{+33}$ m
(d) 3.3×10^{-36} m

JIPMER-2008, JCECE - 2007
AP-EAMCET (Engg.) 1997, 1996
AP – EAMCET - (Medical)-1997
NEET-1999

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Ans. (b) : de-Broglie equation–

$$\lambda = \frac{h}{mv}$$

Where, h = Planck's constant
m = Mass
v = Velocity

$$= \frac{6.62\times10^{-34}\,\text{kg}\,\text{m}^2\text{s}^{-1}}{1\,\text{kg}\times100\,\text{ms}^{-1}}$$

$$\Rightarrow 6.62\times10^{-36}\,\text{m}$$

308. Heisenberg uncertainty principle can be explained as

(a) $\Delta x \geq \frac{\Delta P\times h}{4\pi}$
(b) $\Delta x\times\Delta P \geq \frac{h}{4\pi}$
(c) $\Delta x\times\Delta P \geq \frac{h}{\pi}$
(d) $\Delta P \geq \frac{\pi h}{\Delta x}$

JIPMER-2008
JCECE - 2007
BCECE-2005

Ans. (b) : According to Heisenberg's uncertainty principle.

$$\Delta x.\Delta p \geq \frac{h}{4\pi} \quad \text{or} \quad \Delta x.(m.\Delta v) \geq \frac{h}{4\pi}$$

309. A golf-ball weigh 40.0g. If it is moving with a velocity of 20.0 ms^{-1}, it's de-Broglie wave length is

(a) 1.66×10^{-34} nm
(b) 8.28×10^{-32}nm
(c) 8.28×10^{-25} nm
(d) 1.66×10^{-24}nm

JIPMER-2004

Ans. (c) : From de-Broglie equation–

$$\lambda = \frac{h}{mv}$$

Where, h = Planck's constant
m = Mass of Golf-ball
v = Velocity

$$\lambda = \frac{6.626\times10^{-34}\,\text{J.s}}{40\times10^{-3}\,\text{kg}\times200\,\text{ms}^{-1}}$$

$$\Rightarrow 8.28\times10^{-34}\ \text{m}$$

$$\Rightarrow 8.28\times10^{-34}\times10^{9}\text{nm}$$

$$\Rightarrow 8.28\times10^{-25}\ \text{nm}$$

310. The minimum values of uncertainties involved in the determination of both the position and velocity of a particle respectively are 1× 10^{-10} m and 1 × 10^{-10}ms^{-1}. Then, the mass (in kg) of the particle is

(a) 5.270×10^{-15}
(b) 5.270×10^{-20}
(c) 5.270×10^{-16}
(d) 5.270×10^{-10}
(e) 5.270×10^{-14}

Kerala-CEE-2015

Ans. (a) : According to Heisenberg uncertainty principle -

$$\Delta x.\Delta p= \frac{h}{4\pi}$$

$$\Rightarrow \Delta x.m\Delta v = \frac{h}{4\pi} \Rightarrow m = \frac{h}{4\pi\Delta x.\Delta v}$$

Given $\therefore$ $\Delta x=1\times10^{-10}$ m, $\Delta v=1\times10^{-10}\text{ms}^{-1}$

$$m = \frac{6.626\times10^{-34}}{4\times3.14\times10^{-10}\times10^{-10}}$$

$$\Rightarrow 5.270\times10^{-15}\ \text{kg}$$

311. Uncertainty principle is valid for

(a) Proton
(b) Methane
(c) Both (a) and (b)
(d) 1 μm sized platinum particles
(e) 1 μm sized NaCl particles

Kerala-CEE-2017

Ans. (a) : Uncertainty Principle states that the position and momentum for a subatomic particle is uncertain to find simultaneously. Thus, the uncertainty principle is valid for protons (subatomic particle).

312. Maximum number of photons emitted by a bulb capable of producing monochromatic light of wavelength 550 nm is ———, if 100 V and 1A is supplied for one hour.

(a) 1×10^{24}
(b) 5×10^{24}
(c) 1×10^{23}
(d) 5×10^{23}
(e) 5×10^{22}

Kerala-CEE-2019

Ans. (a) : Given that,

$\lambda = 550\ \text{nm} = 550\times10^{-9}\ \text{m}$
$i = 1\text{A},\ V = 100\text{V}$

$$\therefore E = \frac{hc}{\lambda} = \frac{6.626\times10^{-34}\times3.0\times10^{8}}{550\times10^{-9}} = 0.036\times10^{-17}$$

So, each proton carries energy, $E = 0.036\times10^{-17}$

$$\text{No. of photons} = \frac{\text{total energy output in one second}}{\text{energy carried per photon}}$$

$$n = \frac{100\times3600}{0.036\times10^{-17}}$$

$$n = 1\times10^{24}$$

313. The ratio of de-Broglie wavelengths for electrons accelerated through 200 V and 50 V is :

(a) 1 : 2
(b) 2 : 1
(c) 3 : 10
(d) 10 : 3

Manipal-2020

Ans. (a) : As we know,

$$eV = \frac{1}{2}mv^2$$

So, $$v = \sqrt{\frac{2eV}{m}}$$

Ans, $$mv = \sqrt{2meV}$$

According to de Broglie equation–

$$\lambda = \frac{h}{mv}$$

or $$\lambda = \frac{h}{\sqrt{2meV}}$$

When it is accelerated through 200 volt

$$\lambda_1 = \frac{h}{\sqrt{2meV}.\sqrt{200}} \qquad \text{.......(i)}$$

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When it is accelerated through 50 volt

$$\lambda_2 = \frac{h}{\sqrt{2meV}.\sqrt{50}} \quad ....(ii)$$

On solving equation (i) and (ii), we get

$$\frac{\lambda_1}{\lambda_2} = \frac{\sqrt{50}}{\sqrt{200}} = \frac{1}{2}$$

314. If uncertainty in position and velocity are equal, then uncertainty in momentum will be :

(a) $\frac{1}{2}\sqrt{\frac{mh}{\pi}}$ (b) $\frac{1}{2}\sqrt{\frac{h}{\pi m}}$

(c) $\frac{h}{4\pi m}$ (d) $\frac{mh}{4\pi}$

Manipal-2018

Ans. (a) Given, $\Delta x = \Delta v$

According to Heisenberg Uncertainity Principle–

$$\Delta x \times \Delta p \geq \frac{h}{4\pi}$$

Where, Δx = Change in position

Δp = Change in momentum

$$\Delta x \times m\Delta v = \frac{h}{4\pi} \quad (\because \Delta p = m\Delta v)$$

$$(\Delta v^2) = \frac{h}{4\pi m} \quad [\because \Delta x = \Delta v]$$

$$\Delta p = m\Delta v = m\sqrt{\frac{h}{4\pi m}} \Rightarrow \sqrt{\frac{mh}{4\pi}}$$

$$\Delta p = \frac{1}{2}\sqrt{\frac{mh}{\pi}}$$

315. Uncertainty in the position of an electron (mass = 9.1×10^{-31} kg) moving with a velocity 300 ms^{-1} accurate upon 0.001% will be (h = 6.63×10^{-34} J-s)

(a) 19.2×10^{-2} m (b) 5.76×10^{-2} m

(c) 1.92×10^{-2} m (d) 3.84×10^{-2} m

MHT CET-2011

Ans. (c) : $\Delta v = \frac{0.001}{100} \times 300\,ms^{-1} = 3\times10^{-3}\,ms^{-1}$

$$\Delta x.m\Delta v = \frac{h}{4\pi}$$

$$\Delta x = \frac{h}{4\pi m\Delta v}$$

$$\Rightarrow \frac{6.63\times10^{-34}\,kg\,m^2s^{-1}}{4\times3.14\times9.1\times10^{-31}kg\times3\times10^{-3}ms^{-1}}$$

$= 0.019336$

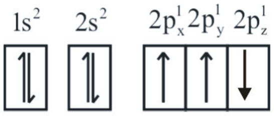
$\Delta x \simeq 1.933\times10^{-2}$ m.

316. Which one is a wrong statement?

(a) Total orbital angular momentum of electron in s-orbital is equal to zero.

(b) An orbital is designated by three quantum numbers while an electron in an atom is designed by four quantum numbers.

(c) The electronic configuration of N atom is



(d) The value of m for d_z^2 is zero.

NEET-2018

Ans. (c) : While filling electron to the orbitals, direction of spin cannot change unless the orbital is half–filled.

317. If uncertainty in position and momentum are equal, then uncertainty in velocity is

(a) $\frac{1}{m}\sqrt{\frac{h}{\pi}}$ (b) $\sqrt{\frac{h}{\pi}}$

(c) $\frac{1}{2m}\sqrt{\frac{h}{\pi}}$ (d) $\sqrt{\frac{h}{2\pi}}$

NEET-2008

Ans. (c) : According to Heisenberg,

Uncertainty Principle - $\Delta x.\Delta p = \frac{h}{4\pi}$

$$(\Delta p)^2 = \frac{h}{4\pi} \quad [\therefore \Delta x = \Delta p]$$

$$(m.\Delta v)^2 = \frac{h}{4\pi}$$

$$m^2.\Delta v^2 = \frac{h}{4\pi}$$

$$\Delta v = \sqrt{\frac{h}{4\pi m^2}} = \frac{1}{2m}\sqrt{\frac{h}{\pi}}$$

318. The measurement of the electron position is associated with uncertainty in momentum, which is equal to 1 × 10^{-18} g cm s^{-1}. The uncertainty in election velocity is (mass of an electron is 9 × 10^{-28}g)

(a) 1 × 10^9 cm s^{-1} (b) 1 × 10^6 cm s^{-1}

(c) 1 × 10^5 cm s^{-1} (d) 1 × 10^{11} cm s^{-1}

NEET-2008

Ans. (a) : Momentum, $\Delta p = m\Delta v$

1×10^{-18} g cm s^{-1} = 9×10^{-28}g $\times\Delta v$

$\therefore \Delta v = 1\times10^9$ cms^{-1}

319. Given : The mass of electron is 9.11 × 10^{-31} kg. Planck constant is 6.626×10^{-34}Js, the uncertainty involved in the measurement of velocity within a distance of 0.1 Å is

(a) 5.79 × 10^5 m s^{-1} (b) 5.79 × 10^6 m s^{-1}

(c) 5.79 × 10^7 m s^{-1} (d) 5.79× 10^8 m s^{-1}

NEET-2006

Ans. (b) : According to Heisenberg's uncertainty principle, $\Delta x\Delta v = \frac{h}{4\pi m}$,

or $\quad \Delta v = \frac{h}{4\pi m\Delta x}$

Where Δx is uncertainty involved in the measurement of position Δv is uncertainty involved in the measurement of velocity h is planck's constant m is mass of the electron

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∵ Given $\Delta x = 0.1\ \mathring{A}$

$= (0.1\times10^{-10})$

$= 10^{-11}$ m

$m = 9.11 \times10^{-31}$ kg

$h= 6.626 \times10^{-34}$ Js

On substituting the values–

$$\Delta v = \frac{6.626\times10^{-34}}{4\times3.14\times9.11\times10^{-31}\times10^{-11}}$$

$= 0.0579 \times 10^{8}\ ms^{-1} = 5.79 \times 10^{6}\ ms^{-1}$

320. The uncertainty in momentum of an electron is 1×10^{-5} kg m/s. The uncertainty in its position will be ($h = 6.62 \times 10^{-34}$ kg m^2/s)

(a) 5.27×10^{-30} m (b) 1.05×10^{-26} m

(c) 1.05×10^{-28} m (d) 5.25×10^{-28} m

NEET-1998

Ans. (a) : The uncertainty in the position of an electron is : $\Delta x= \frac{h}{4\pi\Delta p}$

Where, Δx = The position of the particle

Δp = The momentum of the particle

h = Planck's constant

$$\Delta x = \frac{6.626\times10^{-34}}{4\times3.146\times10^{-5}}$$

$= 5.27\times10^{-30}$ m

321. The position of both, an electron and a helium atom is known within 1.0 nm. Further the momentum of the electron is known within 5.0×10^{-26} kg m s^{-1}. The minimum uncertainty in the measurement of the momentum of the helium stone is

(a) 8.0×10^{-26} kg m s^{-1} (b) 80 kg m s^{-1}

(c) 50 kg m s^{-1} (d) 5.0×10^{-26} kg m s^{-1}

NEET-1998

Ans. (d) : Uncertainty principle state that the product of uncertainty position and uncertainty in momentum is constant for a particle

$$\Delta x, \Delta p = \frac{h}{4\pi}$$

Here, given Δx = 1.0nm for both electron and helium atom, so Δp charge of momentum is also same for both the particle

Therefore uncertainty in momentum of the helium stone is also 5.0×10^{-26} kg ms^{-1}

322. Uncertainty in position of an electron (mass = 9.1×10^{-28} g) moving with a velocity of 3×10^{4} cm/s accurate upto 0.001% will be

(use $h/(4\pi)$ in uncertainity expression where h = 6.626×10^{-27} erg second)

(a) 5.76 cm (b) 7.68 cm

(c) 1.93 cm (d) 3.84 cm

NEET-1995

Ans. (c) : According to Heisenberg's uncertainty principle $\Delta x \times \Delta v = \frac{h}{4\pi m}$

Where, Δx = Uncertainty in position or change in position

Δv = uncertainty in velocity

h = Planck's constant $(6.626\times10^{-27}\ Js)$

m = mass of electron $(9.1\times10^{-28}\ kg)$

Here, Δv = 0.001% of 3×10^{4}

$= \frac{0.001}{100}\times3\times10^{4} = 0.3$ cm/s

$$\therefore \Delta x = \frac{h}{4\pi m\Delta v}$$

$$= \frac{6.626\times10^{-27}}{4\times3.14\times9.1\times10^{-28}\times0.3} = 1.93\text{cm}$$

323. If E_e, E_α and E_p represent the kinetic energies of an electron, α-particle and a proton respectively each moving with same de-Broglie wavelength then

(a) $E_e = E_\alpha = E_p$ (b) $E_e > E_\alpha > E_p$

(c) $E_\alpha > E_p > E_e$ (d) $E_e > E_p > E_\alpha$

UP CPMT-2011

Ans. (d) : De-Broglie wavelength,

$$\lambda = \frac{h}{mv}$$

$$v = \frac{h}{m.\lambda} \qquad \text{..... (i)}$$

$$K.E = \frac{1}{2}mv^2 \qquad \text{..... (ii)}$$

Now, put the value of *v* in Eq. (ii)

$$K.E = \frac{1}{2}m\left(\frac{h}{m.\lambda}\right)^2$$

$$K.E = \frac{1}{2}\left(\frac{h^2}{m\times\lambda^2}\right)$$

Hence, $K.E \propto \frac{1}{m}$ (If λ and h-constant)

and the order of K.E is as–

$E_e > E_p > E_\alpha$

5. Schrodinger Wave Equation

324. When an electron in an excited hydrogen atom jumps from an energy level for which n = 5 to level for which n = 2, the spectral line is observed in the which series of the hydrogen spectrum?

(a) Lyman (b) Balmer

(c) Paschen (d) pfund

AP-EAMCET-1991

Ans. (b): In Balmer series, hydrogen spectrum $n_1 = 2$ and $n_2 = 3, 4$ .....

- An electron in an excited hydrogen atom (n = 2) jump to n = 5 energy level, then the spectral line is observed is Balmer series.

Electron transitions for the Hydrogen atom

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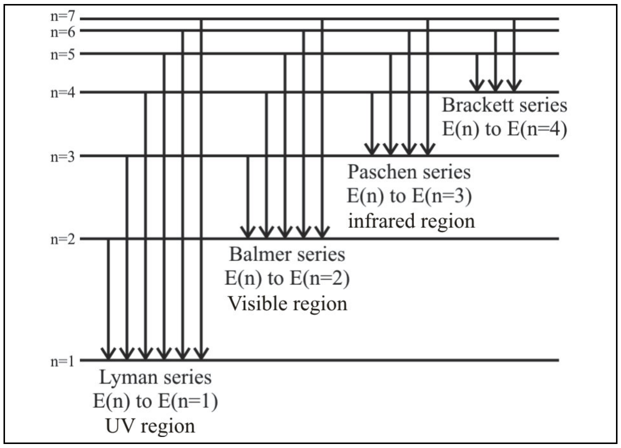


325. Which one of the following series of lines is found in the UV region of atomic spectrum of hydrogen?

(a) Balmer (b) Paschen
(c) Brackett (d) Lyman

AP-EAMCET-1991

Ans. (d) : Lyman series of hydrogen spectrum lies in UV region.

- Balmer series lies in visible region.
- Paschen series lies in infrared region.
- Brackett series lies in infrared region.

Hence, Lyman series lies in UV region and Paschen series lies in IR region of spectrum.

326. Among the first lines of Lyman, Balmer, Paschen and Brackett series in hydrogen atomic spectra, which has the highest energy?

(a) Lyman (b) Balmer
(c) Paschen (d) Brackett

AP-EAMCET-1999

Ans. (a) : Energy, $\Delta E = 13.6\left(\frac{1}{n_1^2}-\frac{1}{n_2^2}\right)\text{eV}$

For the first line of Lyman series,

$n_1 = 1, n_2 = 2$

$$\Delta E = 13.6\left(\frac{1}{1^2}-\frac{1}{2^2}\right)\text{eV} = 10.2\,\text{eV}$$

and energy decreases as we move on to the next series.

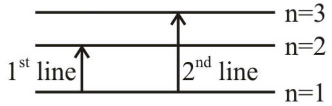
327. What are the values of n_1 and n_2 for the 2nd line in the Lyman series of hydrogen atomic spectrum ?

(a) 3 and 5 (b) 2 and 3
(c) 1 and 3 (d) 2 and 4

AP-EAMCET-2000

Ans. (c) : 2nd line (H_β line) is formed when electron jumps from 3rd orbit to 1st orbit in Lyman series.

$\therefore$ $n_1 = 1, n_2 = 3$



328. The wavelength of spectral line emitted by hydrogen atom in the Lyman series is $\frac{16}{15R}$ cm. What is the value of n_2? (R=Rydberg constant)

(a) 2 (b) 3
(c) 4 (d) 1

AP-EAMCET-2007

Ans. (c) : Given, $\lambda = \frac{16}{15R}\text{cm}, n_2 = ?$

For Lyman series–

$$\frac{1}{\lambda} = R\left[\frac{1}{n_1^2}-\frac{1}{n_2^2}\right]$$

$$\frac{15R}{16} = R\left[\frac{1}{1^2}-\frac{1}{n_2^2}\right]$$

or $$\frac{15R}{16R} = 1-\frac{1}{n_2^2}$$

or $$\frac{1}{n_2^2} = 1-\frac{15}{16} = \frac{1}{16}$$

or $$\frac{1}{n_2} = \frac{1}{4}$$

or $$\boxed{n_2 = 4}$$

329. An electronic transition in hydrogen atom results in the formation of H_α line of hydrogen in Lyman series, the energies associated with the electron in each of the orbits involved in the transition (in kcal mol^{-1}) are :

(a) –313.6, –34.84 (b) –313.6, –78.4
(c) –78.4, –34.84 (d) –78.4, –19.6

AP-EAMCET-2008

Ans. (b) : Energy of electron in nth orbit–

$$E_n = \frac{2\pi^2 Z^2 e^4}{n^2 h^2} a$$

Putting the value of h, e and π, we get

$$E_n = \frac{-1311.8Z^2}{n^2}\text{kJ/mole}$$

$$E_n = \frac{-313.52Z^2}{n^2}\text{kcal/mole}$$

$$(\because 1\,\text{kcal} = 4.184\,\text{kJ})$$

For H atom, Z = 1 and Lyman series have the value of $n_1 = 1, n_2 = 2$.

$n_1=1, n_2=2$

Since, Energy of electron in n_1 orbit

$$= \frac{-313.52\times(1)^2}{(1)^2}$$

= – 313.6 kcal/mole

and energy of electron in n_2 orbit

$$= \frac{-313.52\times(1)^2}{(2)^2}$$

= – 78.38 kcal/mole

330. The ratio of the highest to the lowest wavelength of Lyman series is

(a) 4 : 3 (b) 9 : 8
(c) 27 : 5 (d) 16 : 5

TS-EAMCET (Engg.), 05.08.2021 Shift-II

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Ans. (a) : The equation of Lyman series wavelength for hydrogen atom is

$$\frac{1}{\lambda}=R_H\left(1-\frac{1}{n^2}\right)$$

Where, λ = Lyman series wavelength for hydrogen atom

R_H = Rydberg Constant

For lowest wavelength, n = ∞

$$\therefore\ \frac{1}{\lambda_L}=R_H\left(1-\frac{1}{\infty^2}\right)$$

$$\text{or}\qquad \frac{1}{\lambda_L}=R_H \qquad ..... (1)$$

For highest wavelength, n = 2

$$\therefore\ \frac{1}{\lambda_H}=R_H\left(1-\frac{1}{4}\right)=\frac{3R_H}{4} \qquad ..... (2)$$

From equation (1) and (2)

$$\frac{\lambda_H}{\lambda_L}=\frac{4}{3}\Rightarrow 4:3$$

331. Which one of the following is extracted through alloy formation ?

(a) Manganese (b) Silver
(c) Nickel (d) Lead

SCRA - 2009

Ans. (b) : Silver is the metal extracted through alloy formation.

Note-Alloys are made by mixing two or more elements, at least one of which is a metal.

332. Which among the following represents Schrodinger wave equation ?

(a) $\frac{d^2\psi}{dx^2}+\frac{d^2\psi}{dy^2}+\frac{d^2\psi}{dz^2}+\frac{4\pi m}{h}(E-v)\psi=0$

(b) $\hat{H}=\frac{h}{4\pi^2 m}\left(\frac{d^2}{dx^2}+\frac{d^2}{dy^2}+\frac{d^2}{dz^2}\right)+V$

(c) $\hat{H}=\frac{-h^2}{8\pi^2 m}\left(\frac{d^2}{dx^2}+\frac{d^2}{dy^2}+\frac{d^2}{dz^2}\right)+P$

(d) $\frac{d^2\psi}{dx^2}+\frac{d^2\psi}{dy^2}+\frac{d^2\psi}{dz^2}+\frac{8\pi^2 m}{h^2}(E-v)\psi=0$

AP EAMCET (Engg.) 18.9.2020 Shift-I
GUJCET-2008

Ans. (d) : The Schrondinger wave equation is

$$\frac{d^2\psi}{dx^2}+\frac{d^2\psi}{dy^2}+\frac{d^2\psi}{dz^2}+\frac{8\pi^2 m}{h^2}(E-v)\psi=0$$

Where, ψ = Wave function
m = Mass of electron,
h = Planck's constant
E = Total energy of electron
V = Potential energy of electron

333. The spectrum of Helium is expected to be similar to that of——

(a) Li^+ (b) H
(c) Na (d) He^+

AP EAPCET 19-08-2021 Shift-I
NEET-1998

Ans. (a) : The spectrum of any element depends upon the no. of electron in outer shell.

Electronic configuration of He = $_1s^2$

Reason:- Li^+ has the same electronic configuration like as He atom i.e.

$Li^+ = 1s^2, 2s^1$ (Removing of one electron form outer shell)

$Li^+ = 1s^2$

i.e $Li^+ = 2$

334. Which of the following electron transitions in the H-atom will release the largest amount of energy?

(a) n=3 to n=2 (b) n=2 to n=1
(c) n=5 to n=2 (d) n=6 to n=2

COMEDK-2012

Ans. (b) : As we know,

$$E=\frac{hc}{\lambda}\text{ and }\frac{1}{\lambda}=R\left[\frac{1}{n_1^2}-\frac{1}{n_2^2}\right]$$

So, we can say–

$$E\propto\left\{\frac{1}{n_1^2}-\frac{1}{n_2^2}\right\}$$

Energy released when electron jumps from

(a) For, n= 3 to n=2

$$\left(\frac{1}{2^2}-\frac{1}{3^2}\right)=\left(\frac{1}{4}-\frac{1}{9}\right)=\frac{5}{36}$$

(b) For, n = 2 to n=1

$$\left(\frac{1}{1^2}-\frac{1}{2^2}\right)=\left(\frac{1}{1}-\frac{1}{4}\right)=\frac{3}{4}$$

(c) For, n = 5 to n=2

$$\left(\frac{1}{2^2}-\frac{1}{5^2}\right)=\left(\frac{1}{4}-\frac{1}{2^5}\right)=\frac{21}{100}$$

(d) For, n = 6 to n = 2

$$\left(\frac{1}{2^2}-\frac{1}{6^2}\right)=\left(\frac{1}{4}-\frac{1}{36}\right)=\frac{8}{36}$$

$$\frac{3}{4}>\frac{21}{100}>\frac{8}{36}>\frac{5}{36}$$

Hence, largest amount of energy is released when electron jumps from n=2 to n=1.

335. A body of mass 10 mg is moving with a velocity of 100 m s^{-1}. The wavelength of de Broglie wave associated with it would be ($h=6.63\times10^{-34}$ J s)

(a) 6.63×10^{-35} m (b) 6.63×10^{-34} m
(c) 6.63×10^{-31}m (d) 6.63×10^{-37} m

COMEDK-2019

Ans. (c) Given, Mass, m = 10 mg = 10×10^{-3} g

= 10×10^{-6} kg= 10^{-5} kg

$v=100\,m\,s^{-1}$, de Broglie, λ = ?

h = 6.63×10^{-34} J s

de Broglie relation, $\lambda=\frac{h}{mv}$

$$\lambda=\frac{6.63\times10^{-34}}{10^{-5}\times100}=\frac{6.63\times10^{-34}}{10^{-3}}=6.63\times10^{-31}\text{m}$$

336. The first emission line on hydrogen atomic spectrum in the Balmer series appears at (R = Rydberg constant):

@apna_pdf

(a) $\frac{5R}{36}cm^{-1}$ (b) $\frac{3R}{4}cm^{-1}$

(c) $\frac{7R}{144}cm^{-1}$ (d) $\frac{9R}{400}cm^{-1}$

AP-EAMCET (Medical), 2006
AP EAMCET (Medical) -1998
AP-EAMCET (Engg.) -1998

Ans. (a) : The first emission line on hydrogen atomic spectrum in Balmer series contains the following values-

$n_1 = 2$ and $n_2 = 3$

now, $\bar{\nu} = R\left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right)Cm^{-1}$

where $- \bar{\nu}$ = wave number

R = Rydberg constant

$\therefore \quad \bar{\nu} = R\left(\frac{1}{4} - \frac{1}{9}\right)$

$\bar{\nu} = R\left(\frac{9-4}{36}\right)Cm^{-1}$

or $\bar{\nu} = \frac{5R}{36}Cm^{-1}$

337. What are the values of n_1 and n_2 respectively for H_β line in the Lyman series of hydrogen atomic spectrum?

(a) 3 and 5 (b) 2 and 3

(c) 1 and 3 (d) 2 and 4

AP-EAMCET (Medical), 2006

Ans. (c) : The Lyman series of lines are the lines in the hydrogen spectrum which appear in the ultraviolet region. The value of n_1 and n_2 is given as follows–

$n_1 = 1$

$n_2 = 2,3….$

338. The radial probability distribution curve obtained for an orbital wave function (ψ) has 3 peaks and 2 radial nodes. The valence electron of which one of the following metals does this wave function (ψ) correspond to ?

(a) Cu (b) Li

(c) K (d) Na

AP- EAMCET(Medical) -2010

Ans. (d): The radial probability distribution curve obtained for an orbital wave function has 3 peaks and 2 radial nodes i.e. n =3 and l= 0 (for radial node =2)

Hence, the valence electron of the metal must present in 3s-orbital. The electronic configuration of the given metal is –

$_{29}Cu = [Ar]3d^{10}, 4s^1$

$_3Li = [He]2s^1$

$_{19}K = [Ar]4s^1$

$_{11}Na = [Ne]3s^1$

Thus, the given wave function corresponds to the valence electrons of the sodium metal.

339. Which one of the following conditions is incorrect for a well behaved wave function (ψ)?

(a) ψ must be finite

(b) ψ must be single valued

(c) ψ must be infinite

(d) ψ must be continuous

AP-EAMCET- (Engg.) - 2010

Ans. (c) : For a well behaved wave function (ψ) is defined as the wave function (ψ) must be finite, single valued and continuous.

340. Assertion (A) : The probability of finding an electron in a small volume around a point (x, y, z) at a distance 'r' from the nucleus is proportional to ψ^2.

Reason (R) : Subatomic particles have both wave and particle nature.

The correct answer is

(a) Both (A) and (R) are true and (R) is the correct explanation of (A)

(b) Both (A) and (R) are true but (R) is not the correct explanation of (A)

(c) Only (A) is true but (R) is not true

(d) (A) is not true but (R) is true

AP - EAMCET(MEDICAL) - 2009

Ans. (b) : The square of the wave function, ψ^2 is called probability density and is always positive. The probability of finding an electron at a distance 'r' from the nucleus is expressed by following relation–

$\text{Probability} = 4\pi r^2 dr \cdot \psi^2$

$\therefore \quad \text{Probability} \propto \psi^2$

The de-Broglie explains any particle shows the both nature i.e. particle and wave nature. Both (A) and (R) are true but (R) is not the correct explanation of (A).

341. Wave number of spectral line for a given transition is x cm^{-1} for He^+, then its value for Be^{3+} (isoelectronic of He^+) for same transition is–

(a) $\frac{x}{4}cm^{-1}$ (b) x cm^{-1}

(c) 4x cm^{-1} (d) 16x cm^{-1}

BCECE-2013

Ans. (c) : The spectral lines of the transitions are directly proportional to square of atomic number i.e. z^2.

$\bar{\nu} \propto z^2$

Given, $\bar{\nu}_1 = x$

Now, $\frac{\bar{\nu}_1}{\bar{\nu}_2} = \frac{z_1^2}{z_2^2}$

For, $He^+, z_1 = 2$

For, $Be^{3+}, z_2 = 4$

$\frac{x}{\bar{\nu}_2} = \frac{(4)^2}{(2)^2}$

$\bar{\nu}_2 = 4x\ cm^{-1}$

342. What is effective nuclear charge and the periphery of nitrogen atom when an extra electron is added in the formation of an anion?

(a) 1.20 (b) 2.45

(c) 3.55 (d) 5.95

BCECE-2013

@apna_pdf

Ans. (c) : As an extra electron is added in nitrogen atom then added electron will be screened by five electrons in second orbit ($2s^22p^3$) and two electrons in first orbit ($1s^2$)

Now screening constant–

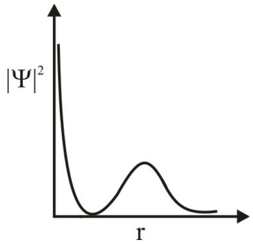
$\sigma = 5\times0.35$ in n^{th} orbit $+ 2\times0.85$ in $(n-1)^{th}$ orbit

$\Rightarrow \quad 1.75 + 1.70 \Rightarrow 3.45$

$\therefore$ Effective nuclear charge

$\Rightarrow \quad 7 - 3.45 = 3.55$

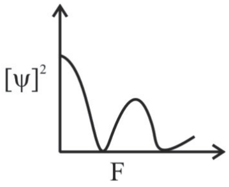
343. The graph between $|\psi|^2$ and r (radial distance) is shown below. This represents.



(a) 1s-orbital
(b) 2p-orbital
(c) 3s-orbital
(d) 2s-orbital

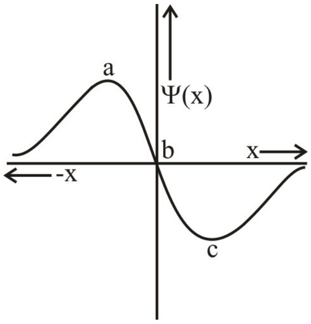
[JEE Main 2019, 10 April Shift-I]

Ans. (d) : The given probability density curve is for 2s orbital because it has only one radial node. Among other given orbitals, 1s and 2p do not have any radial node and 3s has two radial nodes.



2s

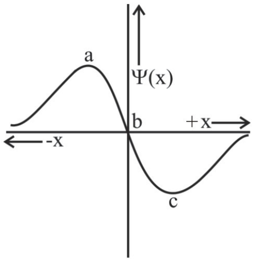
344. The electrons are more likely to be found



(a) in the region a and c
(b) in the region a and b
(c) only in the region a
(d) only in the region c

[JEE Main 2019, 12 April Shift-I]

Ans. (a) : The electrons are more likely to be found in the region a and c as shown in figure. At b, wave function becomes zero and is called radial nodal surface or simple node.



The graph between wave function ψ and distance (r) from the nucleus helps in determining the shape of orbital.

345. The frequency of light emitted for the transition n = 4 to n = 2 of He^+ is equal to the transition in H atom corresponding to which of the following?

(a) n = 3 to n = 1
(b) n = 2 to n = 1
(c) n = 3 to n = 2
(d) n = 4 to n = 3

AIEEE-2011

Ans. (b) : For He^+

$$\bar{v} = \frac{1}{\lambda} = R_H 2^2\left(\frac{1}{2^2}-\frac{1}{4^2}\right)$$

For H

$$\bar{v} = \frac{1}{\lambda} = R_H \times 1^2\left(\frac{1}{n_1^2}-\frac{1}{n_2^2}\right)$$

For same frequency–

$$2^2\left(\frac{1}{2^2}-\frac{1}{4^2}\right) = \left(\frac{1}{n_1^2}-\frac{1}{n_2^2}\right)$$

$$\Rightarrow \quad \frac{1}{n_1^2}-\frac{1}{n_2^2} = \frac{1}{1^2}-\frac{1}{2^2}$$

$$\Rightarrow \quad n_1 = 1 \text{ and } n_2 = 2$$

346. Energy of an electron is given by E = –2.178 × 10^{-18} J $\left(\frac{Z^2}{n^2}\right)$. Wavelength of light required to excite an electron in an hydrogen atom from level n = 1 to n = 2 will be (h = 6.62 × 10^{-34}) Js and c = 3.0 ×10^8 ms^{-1})

(a) 1.214×10^{-7} m
(b) 2.816×10^{-7} m
(c) 6.500×10^{-7} m
(d) 8.500×10^{-7} m

[JEE Main 2013]

Ans. (a) : Energy change–

$$\Delta E = 2.178\times10^{-18}\left(\frac{1}{1^2}-\frac{1}{2^2}\right) = \frac{hc}{\lambda}$$

$$= 2.178\times10^{-18}\left(\frac{1}{1^2}-\frac{1}{2^2}\right) = \frac{6.62\times10^{-34}\times3.0\times10^8}{\lambda}$$

$$\therefore \lambda = 1.214\times10^{-7} \text{ m}$$

347. For any given series of spectral lines of atomic hydrogen, let $\Delta\bar{v} = \bar{v}_{max} - \bar{v}_{min}$ be the difference in maximum and minimum frequencies in cm^{-1}. The ratio $\Delta\bar{v}_{Lyman}/\Delta\bar{v}_{Balmer}$ is

(a) 27 : 5
(b) 5 : 4
(c) 9 : 4
(d) 4 : 1

[JEE Main 2019, 9 April Shift-I]

@apna_pdf

Ans. (c) : For Lyman series–

$$\Delta\overline{V} = \overline{V}\max - \overline{V}_{\min} = R\left(\frac{1}{1^2} - \frac{1}{\infty^2}\right) - R\left(\frac{1}{1^2} - \frac{1}{2^2}\right)$$

$$\Rightarrow R - \frac{3R}{4} = \frac{R}{4}$$

For Balmer series

$$\Delta\overline{V} = \overline{V}_{\max} - \overline{V}_{\min} = R\left(\frac{1}{2^2} - \frac{1}{\infty^2}\right) - R\left(\frac{1}{2^2} - \frac{1}{3^2}\right)$$

$$\Rightarrow \frac{R}{4} - \frac{5R}{36} = \frac{4R}{36}$$

$$\therefore \frac{\Delta\overline{V}\text{Lyman}}{\Delta\overline{V}\text{Balmer}} = \frac{\frac{R}{4}}{\frac{4R}{36}} = \frac{36}{16} = 9:4$$

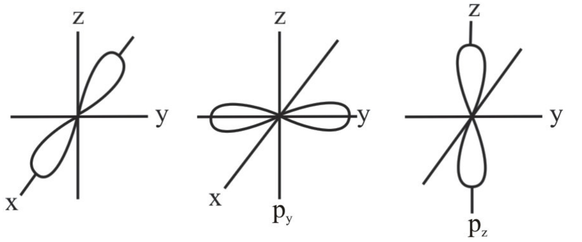
348. Which of the following orbitals will have zero probability of finding the electron in the yz plane?

(a) p_x (b) p_y

(c) p_z (d) d_{yz}

WB-JEE-2010

Ans. (a) : px orbital lies along x–axis. Hence, the probability of finding an electron is zero in the yz plane.



6. Electronic Configuration and Shape of Orbital's.

349. Identity the incorrect statement from the following

(a) All the five 4d orbitals have shapes similar to the respective 3d orbitals.

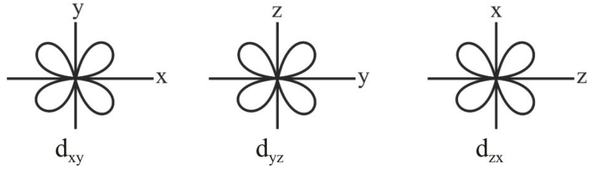
(b) In an atom, all the five 3d orbitals are equal in energy in free state.

(c) The shapes of d_{xy} , d_{yz} and d_{xz} orbitals are similar to each other; and $d_{x^2-y^2}$ and d_{z^2} are similar to each other.

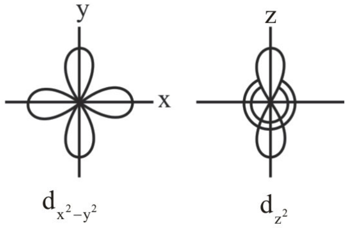
(d) All the five 5d orbitals are different in size when compared to the respective 4d orbitals.

NEET-17.07.2022

Ans. (c) : The size of orbital depends on the principle quantum number and the shape of orbital's depends on the azimuthal quantum number (*l*). In all the five 3d orbital are equal in energy in free state and the shape of d_{xy}, d_{yz} and d_{zx} are similar.



and the shape of $d_{x^2-y^2}$ and d_{z^2} are different



350. The electronic configuration of Pt (atomic number 78) is:

(a) $[Xe]\ 4f^{14}\ 5d^9\ 6s^1$ (b) $[Kr]\ 4f^{14}\ 5d^{10}$

(c) $[Xe]\ 4f^{14}\ 5d^{10}$ (d) $[Xe]\ 4f^{14}\ 5d^8\ 6s^2$

JEE Main-29.06.2022, Shift-I

Ans. (a) : Sub-electronic configuration of Pt (atomic number 78) is–

$_{78}Pt = {}_{54}[Xe]\ 4f^{14}\ 5d^9\ 6s^1$

351. Which of the following statements are correct?

(a) The electronic configuration of Cr is (Ar) $3d^5\ 4s^1$

(b) The magnetic quantum number may have a negative value

(c) In the ground state of an atom, the orbitals are filled in order of their increasing energies

(d) The total number of nodes are given by n–2

Choose the most appropriate answer from the options given below:

(a) (a), (c) and (d) only (b) (a) and (b) only

(c) (a) and (c) only (d) (a), (b) and (c) only

JEE Main-29.06.2022, Shift-I

Ans. (c) : Statements –

(a) Electronic configuration of Cr

$_{24}Cr = [Ar]\ 3d^5\ 4s^1$

(d) Total number of nodes are (n–1)

So, option (c) is correct

352. Element "E" belongs to the period 4 and group 16 of the periodic table. The valence shell electron configuration of the element, which is just above "E" in the group is

(a) $3s^2$, $3p^4$ (b) $3d^{10}$, $4s^2$, $4p^4$

(c) $4d^{10}$, $5s^2$, $5p^4$ (d) $2s^2$, $2p^4$

JEE Main-28.06.2022, Shift-I

Ans. (a) : Element "E" belong to the period 4 and group 16 of the periodic table.

Then, element is $_{34}Se = [Ar]\ 3d^{10}\ 4s^2\ 4p^4$. [4 period, 16 group]

So, "E" is sulphur because "E" is above the 'Se'. Therefore, electronic configuration is $3s^2$, $3p^4$.

353. The number of nodal planes present in *s antibonding orbitals is :

(a) 1 (b) 2

(c) 0 (d) 3

Karnataka-CET, 2008

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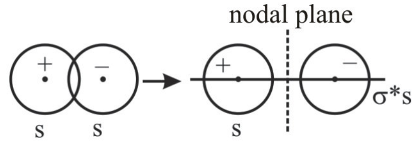
Ans. (a) : In an antibonding molecular orbital, most of the electron density is located away from the space between the nuclei, as a result of which there is a nodal plane between the nuclei.

Note- A plane at which the electron density is zero.



354. Mg^{2+} is isoelectronic with

(a) Cu^{2+} (b) Zn^{2+}
(c) Na^{+} (d) Ca^{2+}

Karnataka-CET-2007

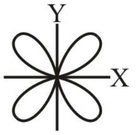
Ans. (c) : Isoelectronic species have same number of electron. Mg^{2+} and Na^{+} both have 10 electrons hence, they are isolectronic species.

355. Which of the following atomic orbitals is not directed along the axis?

(a) p_x (b) $d_{x^2-y^2}$
(c) d_{xy} (d) d_{z^2}

AP-EAMCET (Med.)-1999

Ans. (C) : The lobe of the of three orbital i.e. d_{xy}, d_{y^2}, d_{x^2} exists in between the axis and the lobe of $d_{x^2-y^2}$ and d_{z^2} exist in along the axis.



356. How many electrons are present in the M shell of the atom of an element with atomic number 24?

(a) 5 (b) 6
(c) 12 (d) 13

AP-EAMCET (Med.)-1999

Ans. (d) : The electronic configuration of atomic number 24 is $1s^2$, $2s^2$, $2p^6$, $3s^2$, $3p^6$, $4s^1$, $3d^5$. The name of the element is Chromium.

$$_{24}Cr = 2, 8, 13, 1$$
$$\begin{array}{cccc} K & L & M & N \end{array}$$

So, M shell contains 13 electrons.

357. The symbol of the element 'Tungeston' is:

(a) Ta (b) W
(c) Tl (d) Tc

NDA (II)-2015

Ans : (b) The symbol of the element 'Tungsten' is W and atomic number is 74. It is the rarest and toughest metal found in nature.

- It have 5 stable and 21 unstable isotopes.
- It have highest melting point and tensile strength.

358. Which one of the following orbitals has the highest energy?

(a) 5d (b) 5f
(c) 6s (d) 6p

SCRA-2015

Ans. (b): According to **Aufbau principle** electron are first occupy those orbitals whose energy is lowest.

Hence the electronic configuration is–

1s, 2s, 2p, 3s, 3p, 4s, 3d, 4p, 5s, 4d, 5p, 6s, 4f, 5d, 6p, 7s 5f, 6d, 7p.

359. The correct electronic configuration of potassium is

(a) $1s^2,2s^2,2p^6,3s^1$
(b) $1s^2,2s^2,2p^6,3s^2,3p^6,4s^2$
(c) $1s^2,2s^2,2p^6,3s^2,3p^5,4s^2$
(d) $1s^2,2s^2,2p^6,3s^2,3p^6,4s^1$

AP EAMCET- 1992

Ans. (d) : The electronic configuration of Potassium is-

$_{19}K = 1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^1$

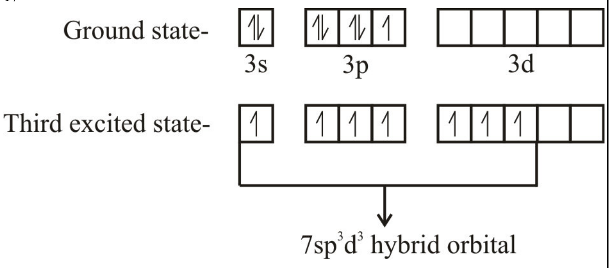
360. Chlorine atom, in its third excited state, reacts with fluorine to form a compound X. The formula and shape of X are

(a) ClF_5, pentagonal
(b) ClF_4, tetrahedral
(c) ClF_4, pentagonal bipyramidal
(d) ClF_7, pentagonal bipyramidal

AP EAMCET- 2003

Ans. (d) : The electronic configuration of $_{17}Cl$ is given below-

$_{17}Cl = 1s^2 2s^2 2p^6 3s^2 3p^5 3d^0$



Hence, it forms the ClF_7 compound and have the pentagonal bipyramidal geometry.

361. The electronic configuration of curium (Z = 96) is

(a) $[Rn]\ 5f^8\ 6d^0\ 7s^2$ (b) $[Rn]\ 5f^7\ 6d^1\ 7s^2$
(c) $[Rn]\ 5f^3\ 6d^5\ 7s^2$ (d) $[Rn]\ 5f^6\ 6d^2\ 7s^2$

JHARKHAND – 2019

Ans. (b) : The electronic configuration of Curium (Z = 96)

$_{96}Cm = [Rn]\ 5f^7\ 6d^1\ 7s^2$

Curium (Cm) is a synthetic chemical element of the actinoid series in the periodic table.

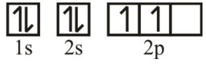
362. The number of unpaired electrons in carbon atom is

(a) one (b) Two
(c) Three (d) Four

MPPET- 2009

Ans. (b) : The electronic configuration of carbon is–

$_6C = 1s^2, 2s^2, 2p^2$



Hence, the number of unpaired electron in carbon atom is 2.

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363. In the change of NO^+ to NO, the electron is added to a

(a) σ orbital (b) π orbital
(c) σ* orbital (d) π* orbital

SCRA 2010

Ans. (d) : According to molecular orbital diagram–electronic configuration of.

$$NO^+(14e) - \sigma 1s^2, \sigma^* 1s^2, \sigma 2s^2, \sigma^* 2s^2, \pi 2p_x^2 = \pi 2p_y^2, \sigma 2p_z^2,$$
$$\pi^* 2p_x = \pi^* 2p_y$$

$$NO(15e^-) - \sigma 1s^2, \sigma^* 1s^2, \sigma 2s^2, \sigma^* 2s^2\ \sigma 2p_z^2, \pi 2p_x^2 = \pi 2p_y^2, \pi^* 2p_x^1 = \pi^* 2p_y$$

The last electron into $\pi^* 2p_x$ orbital i.e. π^* orbital.

364. For the iso-electronic series, which among the following species requires the least energy to remove an outer electron?

(a) K^+ (b) Ag
(c) Cl^- (d) S^{2-}

SCRA-2014

Ans. (d) : The isoeletronic species are K^+, Cl^- and S^{2-}. The electronic configuration are–

$${}_{19}K^+ = 1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^0$$
$${}_{17}Cl^- = 1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^0$$
$${}_{16}S^{2-} = 1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^0$$

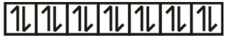
The S^{2-} ion has more in size than K^+ and Cl^- because 16 proton of the nuclear pull on 18 electron. So, the energy required to removing the electron from outer orbital is less in quantity.

365. The maximum number of electrons that can be accommodated in all the orbitals for which *l* = 3, is :

(a) 15 (b) 14
(c) 10 (d) 6

AP-EAMCET-1991

Ans. (b) : For $l = 3$, orbital is f.



f-orbital

Hence, maximum number of electron is 14.

366. The rule that explains the reason for chromium to have [Ar] $3d^5$, $4s^1$ configuration instead of [Ar] $3d^4$, $4s^2$, is :

(a) Pauli's exclusion principle
(b) Aufbau principle
(c) Hund's rule
(d) Heisenberg principle

AP-EAMCET-1996

Ans. (c) : Hund's rule, state that electrons do not pair up in the orbitals unless all the degenerated orbital have got one electron each to get stability.
Hence, to get more stability chromium has [Ar] $3d^5$, $4s^1$ configuration instead of [Ar] $3d^4\ 4s^2$.

367. The electronic configuration of sodium is :

(a) [Ne] $3s^2$ (b) [Ne] $3s^1$
(c) [Ar] $4s^1$ (d) [Ar] $4s^2$

AP-EAMCET-1999

Ans. (b) : Electronic configuration of sodium is

$${}_{11}Na = 1s^2\ 2s^2\ 2p^6\ 3s^1$$
or $${}_{11}Na = [Ne]\ 3s^1.$$

Hence, the correct option is (b).

368. In the ground state, an element has 13 electrons in M shell. The element is :

(a) Copper (b) Chromium
(c) Nickel (d) Iron

AP-EAMCET-2001

Ans. (b) : Given that :
In the ground state an element has 13 electron in M shell is Chromium.

$${}_{24}Cr = 1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^1\ 3d^5 = \overset{K}{2}\ \overset{L}{8}\ \overset{M}{13}\ \overset{N}{1}$$

No. of electron in M shell = 2 + 6 + 5 = 13.

369. X litre of carbon monoxide is present at STP. It is completely oxidised to CO_2. The volume of CO_2 formed is 11.207 L. What is the value of X in litres ?

(a) 22.414 (b) 11.207
(c) 5.6035 (d) 44.828

AP-EAMCET-2002

Ans. (b) : $$\underset{\substack{22.4L \\ xL}}{CO} + \frac{1}{2}O_2 \rightarrow \underset{\substack{22.4L \\ 11.207L}}{CO_2}$$

For STP,
22.4 L of CO, oxidize to CO_2 = 22.4 L

$$1\text{ L of CO, oxidize to } CO_2 = \frac{22.4}{22.4}L = 1$$

$$11.207\text{ L of CO, oxidize to } CO_2 = \frac{22.4}{22.4} \times 11.207$$
$$= 11.207\text{ L}$$

370. If the electron of a hydrogen atom is present in the first orbit, the total energy of the electron is:

(a) $\frac{-e^2}{r}$ (b) $\frac{-e^2}{r^2}$
(c) $\frac{-e^2}{2r}$ (d) $\frac{-e^2}{2r^2}$

AP-EAMCET-2003

Ans. (c) : We know that :

$$\text{Kinetic energy, K.E.} = \frac{1}{2}mv^2$$

$$\text{Potential energy} = \frac{-e^2}{r}$$

$$\text{or}\quad \text{K.E.} = \frac{1}{2}\frac{e^2}{r}\ \left(\because mv^2 = \frac{e^2}{r}\right)$$

$$\therefore \quad \text{Total energy} = \text{K.E.} + \text{PE}$$
$$= \frac{1}{2}\frac{e^2}{r} - \frac{e^2}{r}$$
$$= \frac{e^2}{r}\left(\frac{1}{2} - 1\right)$$
$$= \frac{e^2}{r}\left(\frac{-1}{2}\right)$$
$$= \frac{-e^2}{2r}$$

@apna_pdf

371. Which of the following elements have least number of electrons in its M shell ?

(a) K (b) Mn
(c) Ni (d) Sc

AP-EAMCET-2004

Ans. (a) : Potassium (K) elements has least number of electrons in it's M shell.

$$_{19}K = \underbrace{1s^2}_{K}\underbrace{2s^2 2p^6}_{L}\underbrace{3s^2 3p^6}_{M}\underbrace{4s^1}_{N}$$

Number of electrons in M shell (n = 3) = 8

Similarly,

		K	L	M	N
$_{25}Mn$	=	2	8	13	2
$_{28}Ni$	=	2	8	16	2
$_{21}Sc$	=	2	8	9	2

Hence, the correct option is (a).

372. The atomic numbers of elements X, Y and Z are 19, 21 and 25 respectively. The number of electrons present in the M shell of these elements follow the order :

(a) Z > X > Y (b) X > Y > Z
(c) Z > Y > X (d) Y > Z > X

AP-EAMCET-2005

Ans. (c) : Given atomic number of element :

Configuration, $_{19}X = \underbrace{1s^2}_{K}\underbrace{2s^2 2p^6}_{L}\underbrace{3s^2 3p^6}_{M}\underbrace{4s^1}_{N}$

$$_{21}Y = \underbrace{1s^2}_{K}\underbrace{2s^2 2p^6}_{L}\underbrace{3s^2 3p^6}_{M}\underbrace{4s^2}_{N}\underbrace{3d^1}_{M}$$

$$_{25}Z = \underbrace{1s^2}_{K}\underbrace{2s^2 2p^6}_{L}\underbrace{3s^2 3p^6}_{M}\underbrace{4s^2}_{N}\underbrace{3d^5}_{M}$$

For the order of number of electrons in M shell is :

Z > Y > X

373. The maximum number of sub-levels, orbitals and electrons in N shell of an atom are respectively :

(a) 4, 12, 32 (b) 4, 16, 30
(c) 4, 16, 32 (d) 4, 32, 64

AP-EAMCET-2007

Ans. (c) : For N shell :

(i) Number of shell (n) = 4
(ii) The number of sub-shell (l) = 4
(iii) Number of orbital = $n^2 = 4^2 = 16$
(iv) Number of electron = $2n^2$
$= 2 \times 4^2$
$= 32$

374. Which orbital among the following has zero radial nodes and 2 angular nodes?

(a) 4s (b) 3d
(c) 2p (d) 5s

AP EAPCET 23-08-2021 Shift-I

Ans. (b) : Radial node = $n - \ell - 1$

Where, n = Principle quantum number
ℓ = Azimuthal quantum number

Angular node = ℓ

ℓ value for s = 0 , p = 1, d = 2, f = 3

(i) 4s $\begin{cases}\text{Radial node} = 4-0-1 = 3\\ \text{Angular node} = 0\end{cases}$

(ii) 3d $\begin{cases}\text{Radial node} = 3-2-1 = 0\\ \text{Angular node} = 2\end{cases}$

(iii) 2p $\begin{cases}\text{Radial node} = 2-1-1 = 0\\ \text{Angular node} = 1\end{cases}$

(iv) 5s $\begin{cases}\text{Radial node} = 5-0-1 = 4\\ \text{Angular node} = 0\end{cases}$

So, the option (b) is correct.

375. In which of the following pair are the ions isoelectronic ?

(a) Mg^{2+}, Ar (b) Na^-, O^{2-}
(c) Al^{3+}, Cl^- (d) K^+, Ne

NDA (I)-2019

Ans : (b) Isoelectronic species have the same number of electrons but different in atomic number. In the given option, Na^+ and O^{2-} are isoelectronic species having 10 electron.

Electronic configuration of Na^+ and O^{2-};

$Na^+ = 1s^2\ 2s^2\ 2p^6$
$O^{2-} = 1s^2\ 2s^2\ 2p^6$

376. Assertion (A) : Atoms with completely filled and half-filled subshells are stable.

Reason (R) : Completely filled and half-filled subshells have symmetrical distribution of electrons and have maximum exchange energy.

The correct answer is

(a) (A) and (R) are correct, (R) is the correct explanation of (A)
(b) (A) and (R) are correct, (R) is not the correct explanation of (A)
(c) (A) is correct, but (R) is not correct
(d) (A) is not correct, but (R) is correct

TS-EAMCET-2016

Ans. (a) : Atoms with completely filled and half filled subshells have symmetrical distribution of electrons and have maximum exchange energy and the electrons are more stable in the atom.

377. The element with the electronic configuration $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^1$ is

(a) Cu (b) Ca
(c) Cr (d) Co

TS-EAMCET-2016

Ans. (a) : The element with electronic configuration $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^1$ is Copper and Copper has atomic number is 29.

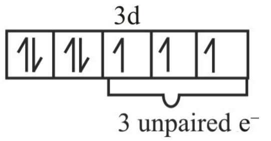
378. The number of unpaired electrons in Co^{2+}, is

(a) 2 (b) 3
(c) 4 (d) 5

TS-EAMCET (Engg.), 07.08.2021 Shift-II

Ans. (b) : The electronic configuration of Co^{2+} is $1s^2\ 2s^2\ 2p^6\ 3p^6\ 3d^7$.

or $Co^{2+} = [Ar]3d^7$



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379. [Ar]$3d^{10}4s^1$ electronic configuration belongs to

(a) Ti (b) Tl

(c) Cu (d) V

MPPET-2008

Ans. (c) : The electronic configuration of [Ar] $3d^{10}$ 45^1 is belong to Cu.

It is in 4th period and IB group.

380. The electronic configuration of Cs is

(a) $[Kr]5s^1$ (b) $[Xe]6s^1$

(c) $[Rn]7s^1$ (d) $[Ar]4s^1$

AP EAMCET (Engg.) 21.09.2020, Shift-II

Ans. (b) : Caesium atomic number is 55.

Thus, electron configuration of Caesium is $1s^22s^22p^63s^2$ $3p^64s^23d^{10}4p^65s^24d^{10}5p^66s^1$ or [Xe] $6s^1$.

Hence, correct option is (b).

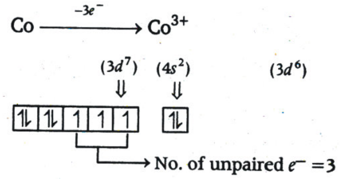
381. How many unpaired electrons will be present in the ground state of an atom which has valence electronic configuration $3d^6$ in its +3 oxidation state ?

(a) 1 (b) 3

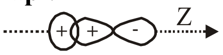
(c) 4 (d) 7

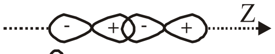
AP EAMCET (Engg.) 18.9.2020 Shift-I

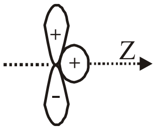
Ans. (b) : Ground state electronic configuration of the element (Co, z = 27) will be [Ar] $3d^7$ $4s^2$.

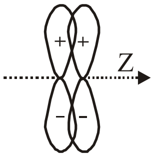


382. Which among the following represents zero overlap ?

(a) 

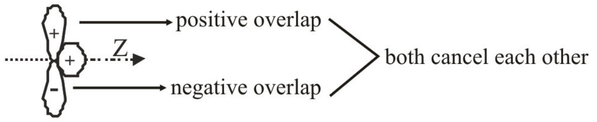
(b) 

(c) 

(d) 

AP EAPCET 24.08.2021 Shift-II

Ans. (c): Both orbitals p and s are aligned to different axis so their total overlap become zero.



383. To which orbital among the following may an electron having zero angular momentum belong?

(a) 3s (b) 3p

(c) 3d (d) 4f

AP EAPCET 24.08.2021 Shift-II

Ans. (a) Angular momentum, $\mu = \sqrt{l(l+1)}\frac{h}{2\pi}$

Where l = Azimuthal quantum number for orbital

Azimuthal quantum no. (l)

s	0
p	1
d	2
f	3

So, for 3s orbital an electron having zero angular momentum.

384. To which group of the periodic table does an element having electronic configuration [Ar] $3d^54s^2$ belong?

(a) Second (b) Fourth

(c) Seventh (d) Third

AP EAPCET 19-08-2021 Shift-I

Ans. (c) : The given electronic configuration–

${}_{18}$[Ar], $3d^5$, $4s^2$

Which is the electronic configuration of Mn and Mn element belongs to the 7th group of periodic table.

385. The element with atomic number 12 belongs to .... group and .... period

(a) IA, third (b) III A, third

(c) II A, third (d) II A, second

AP EAMCET (Engg.) 2001

Ans. (c): The element with atomic number 12 is magnesium.

The electronic configuration for Mg = $1s^2$, $2s^2$, $2p^6$ $3s^2$. There are 2 electron in the outermost shell so it belongs to the II A group. Mg has an outermost shell, n=3 therefore, the third period.

386. The maximum number of sub-level, orbitals and electrons in N shell of an atom are respectively

(a) 4, 12, 32 (b) 4, 16, 30

(c) 4, 16, 32 (d) 4, 32, 64

AP EAMCET (Engg.) -2007

Ans. (c) : For 'N' shell

$\because$ The number of shell (n) = 4

$\therefore$ The number of sublevels or subshell (l) = 4

The number of orbitals = $n^2 = 4^2 = 16$

and the number of electrons = $2n^2 = 2\times4^2 = 32$

387. Electronic configuration of X is $1s^2$ $2s^2$ $2p^6$ $3s^2$ $3p^1$. It belongs to

(a) third group and third period

(b) thirteenth group and third period

(c) first group and third period

(d) third group and first period.

COMEDK-2017

Ans. (b) : $1s^2$ $2s^2$ $2p^6$ $3s^2$ $3p^1$

i.e., n=3, third period

And group number for p-block elements = 10+number of electrons in s and p orbitals = 10+2+1=13

388. Elements A, B, C, D and E have the following electronic configuration:

(a) $1s^2$ $2s^2$ $2p^2$ **(b) $1s^2$ $2s^2$ $2p^6$ $3s^2$**

(c) $1s^2$ $2s^2$ $2p^5$ **(d) $1s^2$ $2s^2$ $2p^6$ $3s^2$ $3p^2$**

(e) $1s^2$ $2s^2$ $2p^6$ $3s^2$ $3p^6$

@apna_pdf

Which of these will belong to the same group in the periodic table?

(a) A and B (b) A and C
(c) A and D (d) A and E

COMEDK-2018

Ans. (c) : A and D belongs to same group because in same group. Number of valence electrons is same.
A: $1s^2\ 2s^2\ 2p^2$
D: $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^2$

389. An orbital with n=3, l=1 is designated as

(a) 1s (b) 3s
(c) 3p (d) 3d

COMEDK-2014

Ans. (c) : For 3p-orbital, n=3 and l =1.

390. The total number of orbitals in the fifth energy …….is:

(a) 5 (b) 10
(c) 18 (d) 25

AP-EAMCET (Medical), 2006

Ans. (d) : Given:- n = 5
Total number of orbital's in the fifth energy level
$= n^2$
$= 5^2$
$= 25.$

391. The atomic number of an element is 35. What is the total number of electrons present in all the p-orbitals of the ground state atom of that element?

(a) 6 (b) 11
(c) 17 (d) 23

AP-EAMCET (Medical), 2003

Ans. (c) : The atomic number of element is 35. The name of the element is bromine. The electronic configuration of Br is $1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 4s^2, 3d^{10}, 4p^5$.
Electrons present in p- orbital is 17.

392. The total number of electrons present in all the 's' orbitals, all the 'p' orbitals and all the 'd' orbitals of cesium ion are respectively:

(a) 8, 26, 10 (b) 10, 24, 20
(c) 8, 22, 24 (d) 12, 20, 22

AP-EAMCET (Medical), 2003

Ans. (b) : According to the Aufbau Principle-the electronic configuration of Cs^+ is $1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 4s^2, 3d^{10}, 4p^6, 5s^2, 4d^{10}, 5p^6$
Total electron in s-orbital = 10
Total electron in p-orbital = 24
Total electron in d- orbital = 20

393. The electronic configuration of four different elements is given below, identify the group XIV element among these:

(a) $[He]2s^1$ (b) $[Ne]3s^2$
(c) $[Ne]3s^2 3p^2$ (d) $[Ne]3s^2 3p5$

AP-EAMCET (Medical), 2001

Ans. (c) : The element of group XIV belongs to the p-block elements. As we know, outer configuration of p-block goes to the $ns^2\ np^2$. The XIV group elements contains the four electron in outer shell. Hence, the correct option is C.

394. Which of the following is correct for number of electron, number of orbitals and type of orbitals respectively in N orbit?

(a) 4, 4 and 8 (b) 4, 8 and 16
(c) 32, 16 and 4 (d) 4, 16 and 32

GUJCET-2011

Ans. (c):

Orbits	K	L	M	N
No of electrons	2	8	18	32
No. of orbitals	s	s,p	s,p,d,	s,p,d,f
	2	4	9	16

∴ For N orbit, No. of e^- = 32, No. of orbital = 16 and type of orbital = 4

395. In which of the following pairs, the outer most electronic configuration will be the same?

(a) Fe^{2+} and Co^+ (b) Cr^+ and Mn^{2+}
(c) Ni^{2+} and Cu^+ (d) V^{2+} and Cr^+

JEE Main 25-02-2021, Shift-I

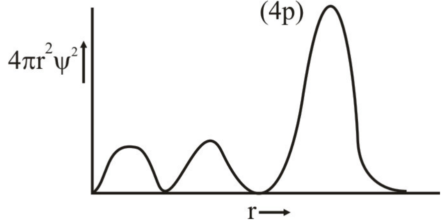
Ans. (b) :
(a) Fe^{2+} : $[Ar]\ 3d^6$ Co^+ : $[Ar]\ 3d^7\ 4s^1$
(b) Cr^+ : $[Ar]\ 3d^5$ Mn^{2+} : $[Ar]\ 3d^5$
(c) Ni^{2+} : $[Ar]3d^8$ Cu^{2+} : $[Ar]\ 3d^9$
(d) V^{2+} : $[Ar]\ 3d^3$ Cr^+ : $[Ar]\ 3d^5$
So, (b) option is correct.

396. An orbital with one angular node shows three maxima in its radial probability distribution curve, the orbital?

(a) 3s (b) 4p
(c) 5d (d) 3p

TS EAMCET 05.08.2021, Shift-I

Ans. (b) : The atomic orbital with one angular node shows 3 maxima, the number of radial nodes must be 2. The 3s, 5d and 4p orbital's have two radial nodes. However, only the 4p orbital's have one angular node.



397. Assertion: Yb^{+2} is more stable in comparison to Gd^{+2}
Reason: The electronic configuration of Gd is $[Xe]\ 4f^7\ 5d^2\ 6s^2$.

(a) If both Assertion and Reason are correct and Reason is the correct explanation of Assertion.
(b) If both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.
(c) If Assertion is correct but Reason is incorrect.
(d) If both the Assertion and Reason are incorrect.

AIIMS 25 May 2019 (Morning)

Ans. (c): The electronic configuration of Yb^{2+} and Gd^{2+} are:
Yb^{2+}: $[Xe]\ 4f^{14}\ 5d^0\ 6s^0$
Gd^{2+}: $[Xe]\ 4f^7\ 5d^1\ 6s^0$
Thus, the given electronic configuration of Gd^{2+} is not correct.

@apna_pdf

398. Assertion: Helium and beryllium having similar outer electronic configuration of types ns^2. Reason: Both are chemically inert.

(a) If both Assertion and Reason are true and the Reason is a correct explanation of the Assertion.
(b) If both Assertion and Reason are true but Reason is not a correct explanation of the Assertion.
(c) If Assertion is true but the Reason is false
(d) If both Assertion ad Reason are false

AIIMS-1994

Ans. (c): Although He and Be have similar outer electronic configuration of the type ns^2, only He (s^2) has inert gas configuration and hence is chemically inert but Be ($1s^2$, $2s^2$) close not have inert gas configuration and hence is not chemically inert.

399. Assertion: d^5 configuration is more stable than d^4
Reason: d^5 has more exchange energy as compared to d^4 because 10 & 6 exchanges are possible in d^5 & d^4 respectively.

(a) If both Assertion and Reason are correct and Reason is the correct explanation of Assertion.
(b) If both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.
(c) If Assertion is correct but Reason is incorrect.
(d) If both the Assertion and Reason are incorrect.

AIIMS 26 May 2019 (Morning)

Ans.(a): d^5 configuration has exactly haif–filled configuration so has more exchange energy. While d^4 has only four such (unpaired) electron these has less exchange energy. Maximum exchange energy leads to the stabilization of the atoms.
Therefore, d^5 configuration is more stable them that of d^4 configuration.

400. Spectrum of Li^{2+} is similar to that of

(a) H (b) Be
(c) He (d) Ne

AIIMS-2002

Ans. (a): Electronic configuration of Li is $1s^2$ $2s^1$ and of Li^{2+} is $1s^1$. That is similar to the electronic configuration of H ($1s^1$) Which has only one electronic in its valance shell, thus it has spectrum similar to that of H.

401. Which of the following element is represented by electronic configuration

$1s^2 2s^2 2p_x^1 2p_y^1 2p_z^1$

(a) Nitrogen (b) oxygen
(c) fluorine (d) sulphur

AIIMS-2001

Ans. (a): 7^N– $1s^2$, $2s^2$ $2px^1$ $2py^1$ $2pz^1$
This element contains 7 electrons

402. The outermost configuration of most electronegative element is

(a) ns^2 np^5 (b) ns^2 np^6
(c) ns^2 np^4 (d) ns^2 np^3

AIIMS-2000

Ans. (a): The outermost electronic configuration of the most electronegative element is ns^2 np^5. It represents a halogen atom. In a period, halogens have the highest electro negativity due to the small size and high effective number charge.

403. The configuration $1s^2, 2s^2 2p^5, 3s^1$ shows:

(a) excited state of O_2^-
(b) excited state of neon atom
(c) excited state of fluorine atom
(d) ground state of fluorine atom

AIIMS-1997

Ans. (b): The ground state of neon is $1s^2$ $2s^2$ $2p^6$ on excitation an electron from 2p jumps to 3s orbital. The excited neon configuration is $1s^2$ $2s^2$ $2p^5$ $3s^1$.

404. The element with outer electronic configuration $(n – 1)d^2ns^2$. where n = 4. would belong to ___.

(a) 2nd period. 2nd group (b) 4th period. 4th group
(c) 4th period. 2nd group (d) 2nd period. 4th group

AP EAPCET 19-08-2021, Shift-II

Ans. (b) : Given,
Outer electronic configuration = $(n - 1)d^2$ ns^2 where n = 4
$\therefore$ $= (4 – 1)d^2, 4s^2$
$= 3d^2, 4s^2$
This is the outer electronic configuration of titanium which is belongs to the 4th period and 4th group.

405. Transition metal elements exhibit general electronic configuration ________

(a) ns^{1-2} nd^{1-10} (b) ns^{1-2} $(n – 1)$ d^{1-10}
(c) $ns^2(n –1)d^{10}$ (d) ns^2 $(n – 1)d^0$

AP- EAPCET- 07-09-2021, Shift-I

Ans. (b) : Transition metal element exibit general electronic configuration is $ns^{1-2}(n – 1)$ d^{1-10}.

406. If an element with atomic number Z = 115 has been discovered today in which of the following family would it had been placed and identify its electronic configuration.

(a) Boron Family : [Ar] $4f^{14}5d^{10}6s^2 6p^3$
(b) Carbon Family : [Kr] $5f^{14}6d^{10}7s^2 7p^3$
(c) Nitrogen Family : [Rn] $5f^{14}$ $6d^{10}$ $7s^2 7p^3$
(d) Oxygen Family : [Xe] $4f^{14}5d^{10}6s^2 6p^3$

AP- EAPCET- 07-09-2021, Shift-I

Ans. (c) : Atomic number Z = 115 is Moscovium (Mc) is a synthetic chemical element and an extremely radioactive element. It belongs to nitrogen family and electronic configuration is
115^{Mc} =[Rn] $5f^{14}$ $6d^{10}$ 75^2 $7p^3$

407. The atomic number of an element 'M' is 26. How many electrons are present in the M-shell of the element in its M^{3+} state?

(a) 11 (b) 15
(c) 14 (d) 13

AP - EAMCET (Medical) - 2007

Ans. (d) : The atomic number of element (M) is 26.
According to **Aufbau principle**, the electronic configuration of $_{26}M$ will be $1s^2$, $2s^2$, $2p^6$, $3s^2$, $3p^6$, $3d^6$, $4s^2$.

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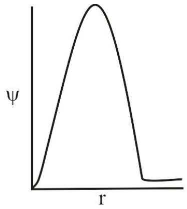
For $_{26}M^{3+} = 1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 3d^5$
or $_{26}M^{3+} = 2, 8, 13$
K L M
Hence, the electrons are present in M shell is 13.

408. Which of the following graph represents variation of 2p-orbital wave function with distance from the nucleus?

(a)


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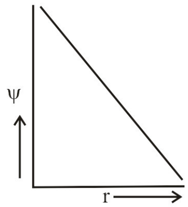
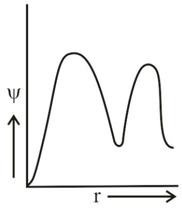
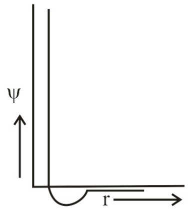


(c)


(d)


VITEEE-2016

Ans. (a) : In option (a) show the variation of 2p–orbitals wave function with distance from the nucleus. It has one maxima and passes through origin.

409. The orbital angular momentum of an electron in 2p orbital is
(a) h/4 π
(b) zero
(c) h/2 π
(d) $\sqrt{2}$ h/2 π

Assam CEE-2019

Ans. (d) : Angular momentum in an orbital

$$= \frac{h}{2\pi}\sqrt{\ell(\ell+1)}, \quad (\ell = 1)$$

$$= \left(\frac{\sqrt{2}h}{2\pi}\right)$$

410. The orbital angular momentum of a p-electron given as
(a) $\frac{h}{\sqrt{2}\pi}$
(b) $\sqrt{3}\frac{h}{\sqrt{2}\pi}$
(c) $\sqrt{\frac{3}{2}}\frac{h}{\pi}$
(d) $\sqrt{6}\frac{h}{2\pi}$

NEET-Mains 2012

Ans. (a) : Orbital angular momentum (m)

$$= \sqrt{\ell(\ell+1)}\frac{h}{2\pi}$$

For P electrons; ℓ=1

$$\text{Thus, } m = \sqrt{\ell(\ell+1)}\frac{h}{2\pi} = \frac{\sqrt{2}h}{2\pi} = \frac{h}{\sqrt{2}\pi}$$

411. Orbital having 3 angular nodes and 3 total nodes to
(a) 5p
(b) 3d
(c) 4f
(d) 6d

Odisha NEET-2019

Ans. (c) : Give that,
Angular node (ℓ) = 3
Total node = 3
Total node = Radial node + Angular node
$3 = n - \ell - 1 + \ell$
$3 = n - 1$
$n = 4$
Subshell nl = 4f

412. The number of radial nodes of 3s and 2p orbitals are respectively
(a) 2, 0
(b) 0, 2
(c) 1, 2
(d) 2, 2

BITSAT-2017

Ans. (a) : For a given orbital with principal quantum number (n) and azimuthal quantum number (l)
number of radial nodes = $(n - l - 1)$
for 3s orbital: n = 3 and l = 0
therefore, number of radial nodes
$= 3 - 0 - 1 = 2$
for 2p orbital; n = 2 and l = 1
therefore, number of radial nodes
$= 2 - 1 - 1 = 0$

413. According to Bohr's theory, the angular momentum for an electron in 5th orbit is
(a) 2.5 h / π
(b) 5 h / π
(c) 25 h / π
(d) 5 π / 2h

UPTU/UPSEE-2010

Ans. (a) : The angular momentum (ℓ) of an electron in a Bohr's orbit is given as $L = \frac{nh}{2\pi}$

It is an integral multiple of $\frac{h}{2\pi}$

In the fifth Bohr orbit, the angular momentum of electron is $(L) = \frac{5h}{2\pi}$

$$L = \frac{2.5h}{\pi}$$

$= 2.5$ h\π

414. Which one of the following decides the shapes of orbitals in an energy shell?
(a) Magnetic quantum number
(b) Principle quantum number
(c) Azimuthal quantum number
(d) Spin quantum number

AMU-2013

Ans. (c) : Principal quantum number tells the principal energy level or shell to which the electron belongs or the average distance of the electron from the nucleus.
Azimuthal quantum number tells, the shape of the various subshells present within the same principal shell.
Magnetic quantum number determines the number of preferred orientations of the electrons present in subshell. Spin quantum number helps to explain state of each electron in an orbital.

@apna_pdf

415. The electrons indentified by quantum numbers n and *l* (i) n = 4, *l* = 1; (ii) n = 4, *l* =0; (iii) n = 3, *l* = 2; (iv) n = 3, *l* = 1 can be placed in order of increasing energy from the lowest to highest as

(a) (iv) < (ii) < (iii) < (i)
(b) (ii) < (iv) < (i) < (iii)
(c) (i) < (iii) < (ii) < (iv)
(d) (iii) < (i) < (iv) < (ii)

AMU-2011

Ans. (a) : The greater is the value of (n+1), the greater si the energy of orbitals.
(i) n=4, l=1 = 4p orbital
(ii) n=4, l=0 = 4s orbital
(iii) n=3, l=2 = 3d orbital
(iv) n=3, l=1 = 3p orbital
According to the Aufbau principle, energies of above–mentioned orbitals are in the order of –
The increasing order of energy
(iv) 3p < (ii) 4s< (iii) 3s< (i) 4p

416. The element whose electronic configuration is $1s^2\ 2s^2\ 2p^6\ 3s^2$ is a

(a) metoalloid (b) metal
(c) noble gas (d) non-metal

AMU-2004

Ans. (b) : $1s^2\ 2s^2\ 2p^6\ 3s^2$ is electronic configuration of alkaline earth metal.

417. The electronic configuration of P in $H_3\ PO_4$

(a) $1s^2 2s^2, 2p^6, 3s^2 3p^6$ (b) $1s^2, 2s^2, 2p^6, 3s^2$
(c) $1s^2 2s^2 2p^6$ (d) $1s^2, 2s^2, 2p^6, 3s^2 3p^6, 4s^1$

CG PET- 2011

Ans. (a) : The electronic configuration of pin H_3PO_4 is $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6$
P atom has 5 valance electron it shares 3 with 3–OH groups to form 3P–OH bonds it shares 2 with one O atom to form p=O bond.

418. The pair having the similar shape is

(a) BF_3 and NF_3 (b) BF_4^- and NH_4^+
(c) $SiC1_4$ and $SC1_4$ (d) CH_3^+ and N_3O^+

CG PET- 2011

Ans. (b) : Both BF_4^- and NH_4^+ ion are tetrahedral.

419. Quantum numbers ℓ = 2and m = 0 represent the orbital

(a) d_{xy} (b) $d_{x^2-y^2}$
(c) d_{z^2} (d) d_{xz}

CG PET- 2016

Ans. (c) : Quantum number ℓ= 2 and m=0

Respresent dz^2 orbital.

Note– For s, p, d and f orbitals, the value of the azmithual quantum number 'ℓ' is 0, 1, 2, 3.

When ℓ=2, m can have values

–2, –1, 0, +1 +2.

A d–subshell can be have five different orientations and orbitals
Corresponding to these orientations are

d_{xy}, d_{xz}, d_{yz}, $d_{x^2-y^2}, d_{z^2}$.

420. The electronic configuration of an element is
$1s^2, 2s^2 2p^6, 3s^2 3p^6 3d^{10}, 4s^2 4p^3$
Its properties would be similar to which of the following elements?

(a) Boron (b) Oxygen
(c) Nitrogen (d) Chlorine

CG PET -2004

Ans. (c) : The valence shell electronic configuration is $4s^2\ 4p^3$ similar to nitrogen $2s^2, 2p^3$.

421. Out of the following electronic configurations the one of a transition element is

(a) $1s^2, 2s^2 2p^2, 3s^2 3p^6 3d^{10}, 4s^2 4p^6$
(b) $1s^2, 2s^2 2p^6, 3s^2 3p^6 3d^2, 4s^2$
(c) $1s^2, 2s^2 2p^6, 3s^2 p^6, 4s^2$
(d) $1s^2, 2s^2 2p^6, 3s^2 3p^6 3d^{10}, 4s^2 4p^1$

CG PET -2004

Ans. (b) : $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^2\ 4s^2$ is a transition element the last electron here enters the 3d sub shell.

422. Aufbau principle is not satisfied by

(a) Cr and Cl (b) Cu and Ag
(c) Cr and Mg (d) Cu and Na

CG PET -2004

Ans. (b) : The correct option is Cu and Ag. Cu as we know should have the configuration $3d^9\ 4s^2$ But it does not obey the Aufbau Principal and has a configuration of $3d^{10}\ 4s^1$.
Similarly Ag lies below Cu in the periodic table [same group] and thus disobeys.
aufbau principal.

423. Which of the following can be represented by the configuration $[Kr]5s^2$?

(a) Ca (b) Sr
(c) Ba (d) Ra

CG PET -2004

Ans. (b) : Electronic configuration of strontium is $[Kr]5s^2$

424. Which of the following describes the shape of orbital?

(a) Principal quantum number
(b) Azimuthal quantum number
(c) Magnetic quantum number
(d) Spin quantum number

CG PET -2006

Ans. (b) : Principal quantum number represents the principal energy shell where the electron is revolving
Azimuthal quantum describe the slope of an orbital
Magnetic quantum number describes the orientation of the orbital in space.

425. Electronic configuration of H^+ is

(a) $1s^0$ (b) $1s^1$
(c) $1s^2$ (d) $1s^1, 2s^1$

CG PET- 2010

Ans. (a) : Electronic configuration
$H^+ = 1s^0$
$H^- = 1s^2$
$He^+ = 1s^1$

@apna_pdf

426. The ion which does not have configuration of argon (Ar) is:

(a) I^- (b) K^+
(c) Cl^- (d) Ca^{2+}

HP CET-2018

Ans. (a) : Argon has 18 electrons Cl^-, K^+, Ca^{2+} have 18 electrons I^- have 54 electron so I^- does not have electronic configuration with Ar.

427. Match List-I with List-II.

List-I (Electronic configuration of elements)		List-II (Δ_i in kJ mol^{-1})	
A.	**$1s^22s^2$**	**(i)**	**801**
B.	**$1s^22s^22p^4$**	**(ii)**	**899**
C.	**$1s^22s^22p^3$**	**(iii)**	**1314**
D.	**$1s^22s^22p^1$**	**(iv)**	**1402**

Choose the most appropriate answer from the options given below.

Codes

	A	B	C	D
(a)	(ii)	(iii)	(iv)	(i)
(b)	(i)	(iv)	(iii)	(ii)
(c)	(i)	(iii)	(iv)	(ii)
(d)	(iv)	(i)	(ii)	(iii)

(JEE Main 2021, 26 Feb Shift-I)

Ans. (a) : The correct option is A (a) -(ii), (b) -(iii), C(iv), d-(i)

$1s^2\ 2s^2 \rightarrow Be$
$1s^2\ 2s^22p^4 \rightarrow O$
$1s^2\ 2s^22p^3 \rightarrow N$
$1s^2\ 2s^22p^1 \rightarrow B$

The ionization enthalpy order is B < Be < O < N. Be has more I.E compared to B due to extra state fully filled 2s orbital N has more I.E Compared to O due to extra stable half filled 2p orbital.

Hence,

N→1402 kJ /mol
O→1314 kJ/mol
B→801 kJ/mol
Be→899 kJ /mol

428. The electronic configuration of bivalent europium and trivalent cerium are (atomic number : Xe = 54, Ce = 58, Eu = 63)

(a) $[Xe]4f^7$ and $[Xe]4f^1$
(b) $[Xe]4f^7\ 6s^2$ and $[Xe]4f^26s^2$
(c) $[Xe]4f^2$ and $[Xe]4f^7$
(d) $[Xe]4f^4$ and $[Xe]4f^9$

(JEE Main 2020, 9 Jan Shift-I)

Ans. (a) : The electronic configuration of europium and cerium in the ground state is–

$Eu(63) \Rightarrow [Xe]4f^76s^2$
$Ce(58) \Rightarrow [Xe]4f^15d^16s^2$

Bivalent means it lost two electrons and trivalent means it lost three electrons

$Eu^{2+} \Rightarrow [Xe]4f^7$
$Ce^{3+} \Rightarrow [Xe]4f^1$

429. The correct electronic configuration and spin-only magnetic moment (BM) of Gd^{3+} (Z=64), respectively, are

(a) $[Xe]4f^7$ and 7.9 (b) $[Xe]5f^7$ and 7.9
(c) $[Xe]5f^7$ and 8.9 (d) $[Xe]4f^7$ and 8.9

(JEE Main 2020, 5 Sep Shift-I)

Ans. (a) : Given, $[Gd]^{3+}$

To find electronic configuration and magnetic moment of $[Gd]^{3+}$ -

Electronic configuration of $[Gd]^{3+}$:$[Xe]4f^7\ 5d^06s^0$

Hence number of unpaired electron n=7

Hence magnetic moment $\sqrt{n(n+2)} = \sqrt{63} = 7.9\ BM$

Hence electronic configuration is $[Xe]4f^7$

Magnetic moment is 7.9 BM

430. In the sixth period, the orbitals that are filled are

(a) 6s, 5f, 6d, 6p (b) 6s, 4f, 5d, 6p
(c) 6s, 5d, 5f, 6p (d) 6s, 6p, 6d, 6f

(JEE Main 2020, 5 Sep Shift-I)

Ans. (b) : As per (n+*l*) rule in 6th period, order of orbital filling is 6s, 4f, 5d, 6p.

431. Outermost electronic configuration of a group-13 element E is $4s^2\ 4p^1$. The electronic configuration of an element of p-block period-five placed diagonally to element, E is

(a) $[Kr]3d^{10}4s^24p^2$ (b) $[Ar]3d^{10}4s^24p^2$
(c) $[Xe]5d^{10}6s^26p^2$ (d) $[Kr]4d^{10}5s^25p^2$

(JEE Main 2021, 20 July Shift-II)

Ans. (d) : $[Kr]4d^{10}\ 5s^2\ 5p^2$

The element E is Ga and the digonal element of 5th period is $_{50}Sn$ having outer electronic configuration will be $[Kr]4d^{10}\ 5s^2\ 5p^2$.

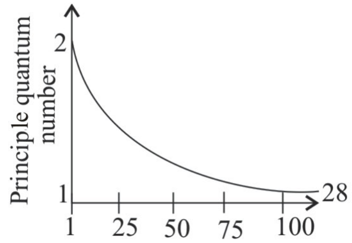
432. Among the following, the energy of 2s-orbital is lowest in

(a) K (b) H
(c) Li (d) Na

[JEE Main 2019, 12 April Shift-II]

Ans. (a) : The energy of 2s-orbital is lowest in K (potassium). An orbital gets larger as the principle quantum number n increases.

Correspondingly the energy of the electron in such an orbital become less negative, meaning that the electron is less strongly bound and has less energy. The graph of principle quantum number with atomic number is



433. Ge (Z = 32) in its ground state electronic configuration has x completely filled orbitals with $m_\ell = 0$. The value of x is

[JEE Main 2021, 31 Aug Shift-I]

@apna_pdf

Ans. (7) : $_{32}Ge : 1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^{10}\ 4s^2\ 4p^2$

7 orbitals are fully filled with $m_\ell = 0$.

The value of x is 7.

434. A certain orbital has n = 4 and m_ℓ = –3. The number of radial nodes in this orbital is........(Round off to the nearest integer).

[JEE Main 2021, 17 March Shift-I]

Ans. (0) : n = 4, m_ℓ = –3 so ℓ = 3

Number of radial nodes = n – ℓ – 1

= 4 – 3 – 1

= 0

435. The number of orbitals with n = 5, m_1 = +2 is ....(Round off to the nearest integer).

[JEE Main 2021, 16 March Shift-II]

Ans. (3) : For, n = 5

ℓ = 0, 1, 2, 3, 4

For, ℓ = 2, m = –2, –1, 0, 1, 2

For, ℓ = 3, m = –3, –2, –1, 0, 1, 2, 3

For, ℓ = 4, m = –4, –3, –2, –1, 0, 1, 2, 3, 4

Hence, the number of orbitals with n = 5, m_ℓ = +2 is 3.

436. Which of the following atoms in its ground state has the highest number of unpaired electrons?

(a) Chromium (24)
(b) Iron (26)
(c) Manganese (25)
(d) Vanadium (23)

J & K CET-(2016)

Ans. (a) : The electronic configuration of the give element is–

Chromium (24): $(3d^5 4s^1)$ – 6 unpaired electron.
Iron (26) : $(3d^6 4s^2)$ – 4 unpaired electron.
Manganese (25) : $(3d^5 4s^2)$ – 5 unpaired electron.
Vanadium (23) : $(3d^3 3s^2)$ – 3 unpaired electron.
So, $_{24}$Cr has the highest number of unpaired electrons.

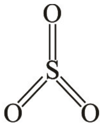
437. The sulphur compound in which the sulphur atom has octet configuration in its valence shell among the following is

(a) Sulphur trioxide
(b) Sulphur hexafluoride
(c) Slphur dichloride
(d) Sulphur dioxide

J & K CET-(2016)

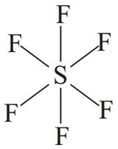
Ans. (c) : Octet rule dictates that atoms are most stable when their valence shells are filled with eight electrons. The moleculer of the halogens, oxygen, nitrogen and carbon are known to obey the octet rule.

SO_3:



(Extended octet)

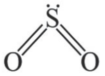
SF_6 :



(Extended octet)

SCl_2 : Cl – S – Cl (complete octet)

SO_2:



(Extended octet)

438. Which electronic configuration will show the highest first ionization potential?

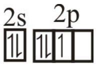
(a) $1s^2 2s^2 2p^1$
(b) $1s^2 2s^2 2p^5$
(c) $1s^2 2s^2 2p^3$
(d) $1s^2 2s^2$

J & K CET-(2018)

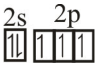
Ans. (b) : $1s^2 2s^2 2p^1$=B
$1s^2 2s^2 2p^5$=F
$1s^2 2s^2 2p^3$=N
$1s^2 2s^2$=Be
The order of first ionization potential is F > N > Be > B.

439. The orbital diagram in which Aufbau principle is violated is

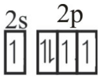
(a)



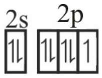
(b)



(c)



(d)



J & K CET-(2013)

Ans. (c) : According to Aufbau principle in the ground state of the atoms the electron fill subshells of the lowest available energy, then they fill subshells of higher energy. So, in option (c) 2s subshell should filled before the 2p subshell is occupied while in (a) Hund's rule is violated.

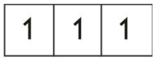
440. What is the total number of electrons that can have the values n = 2, *l* = 1, s = ½ in the electronic configuration $1s^2 2s^2 2p^3$?

(a) 1
(b) 3
(c) 5
(d) 7

J & K CET-(2013)

Ans. (b) The given electronic configuration is $1s^2 2s^2 2p^3$

2p



Then, n=2, *l*=1 i.e. 2p
Hence, the total number of electron is 3.

441. According to Aufbau principle, the correct order of energy of 3d, 4s and 4p orbitals is

(a) 4p < 3d < 4s
(b) 4s < 4p < 3d
(c) 4s < 3d < 4p
(d) 3d < 4s < 4p

J & K CET-(2006)

Ans. (c) : According to Aufbau principle the increasing order of the energies of the orbital's is
1s < 2s < 2p < 3s < 3p < 4s < 3d < 4p < 5s…..

442. Electronic configuration of deuterium atom is

(a) $1s^1$
(b) $2s^2$
(c) $2\ s^1$
(d) $1s^2$

J & K CET-(2005)

Ans. (a) : Deuterium is an isotope of hydrogen its atomic number is one
Hence, its electronic configuration is as $_1D^2$: $1s^1$

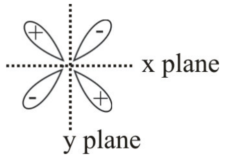
443. Two nodal planes are present in

(a) $\pi^* 2p_x$
(b) $\sigma\ 2p_z$
(c) $\pi\ 2p_x$
(d) $\pi\ 2p_y$

J & K CET-(2004)

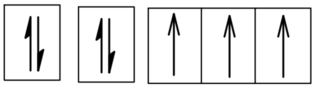
@apna_pdf

Ans. (a) : π^*2p_x has two nodal planes perpendicular to each other

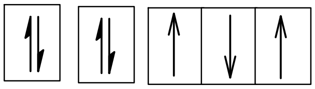


444. Ground state electronic configuration of nitrogen atom can be represented as

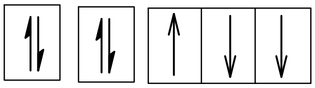
(a)



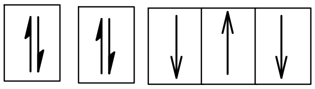
(b)



(c)

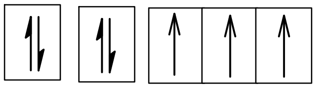


(d)



J & K CET-(2003)

Ans. (a) : Nitrogen (N) atomic number = 7
Electronic configuration ($_7$N) = $1s^2$, $2s^2$, $2p^3$
Hence,



445. A 3p-orbital has
(a) two non-spherical nodes
(b) two spherical nodes
(c) one spherical and one non-spherical node
(d) one spherical and two non-spherical nodes

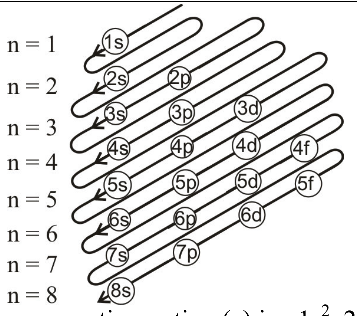
J & K CET-(1998)

Ans. (c) : Given 3p orbital
In 3p orbital, n = 3 and l =1
We know,
Spherical Node = $n - l - 1 = 3 - 1 - 1 = 1$
Non spherical Node = $l = 1$
Hence, one spherical Node and one non spherical Node.

446. Impossible configuration is:
(a) $1s^2$, $2s^2$, $2p^2$, 3 s^2
(b) $1s^2$, $2s^2$
(c) $1s^2$, $2s^2$, $2p^6$
(d) none of these

JCECE - 2003

Ans. (a): Aufbau Principal: it state that electron are filled in the atomic orbitals in the increasing order of orbital energy level It means the available atomic orbitals with the lowest energy levels are occupied before those with higher energy levels.



From the above equation option (a) i.e. $1s^2$, $2s^2$ $2p^{2,}$ $3s^2$ does not follow Aufbau Rule.

447. The element with the electronic configuration as [Ar] $3d^{10}4s^24p^3$ represents a
(a) metal
(b) non-metal
(c) metalloid
(d) transition element

JCECE - 2010

Ans. (c) : Electronic configuration shows that the p-orbital of the element is not complete. That is why, it is a p-block element. Moreover, the atomic number of the element is 33(As). Therefore, it is a metalloid.

448. The electronic configuration of element with atomic number 24 is
(a) $1s^2$, $2s^22p^6$, $3s^23p^63d^4$, $4s^2$
(b) $1s^2$, $2s^22p^6$, $3s^23p^63d^{10}$
(c) $1s^2$, $2s^22p^6$, $3s^23p^63d^6$
(d) $1s^2$, $2s^22p^6$, $3s^23p^63d^5$, $4s^1$

JCECE - 2010

Ans. (d) : The electronic configuration of element with atomic number 24 is
$1s^2$, $2s^2$, $2p^6$, $3s^2$, $3p^6$, $4s^1$, $3d^5$
($\because$ Exactly half-filled orbitals are more stable than nearly half-filled orbitals.)

449. Which of the following is correct for number of electrons, number of orbitals and type of orbitals respectively in N-orbit?
(a) 4, 4 and 8
(b) 4, 8 and 16
(c) 32, 16 and 4
(d) 4, 16 and 32

JCECE - 2013

Ans. (c) : For N shell, types of orbitals = 4s, 4p, 4d, 4f
Number of orbitals = 1+ 3 + 5 + 7 = 16
number of electrons = 32

450. The outermost electronic configuration of the most electronegative element is
(a) ns^2np^3
(b) ns^2np^4
(c) ns^2np^5
(d) ns^2np^6

JCECE - 2014

Ans. (c) : ns^2np^5 configuration shows the most electronegative element as after gaining one electron it becomes more stable (inert gas configuration) [electronegativity is the tendency of attracting electron].

451. If n=6, the correct sequence for filling of electrons will be.
(a) ns →(n-1) d→(n-2) f→np
(b) ns →(n-2) f→np→(n-1)d
(c) ns → np→(n-1) d→(n-2)f
(d) ns →(n-2) f→(n-1)d→np

JIPMER-2014

@apna_pdf

Ans. (d) : If n=6, then the correct sequence for filling of electrons will be
ns→(n–2)f→ (n–1)d→np.
It will be
6s→4f→ 5d→6p.
The energy of 4f and 5d orbitals are in between the energies of 4s and 6p orbitals.
Note:– Higher is the (n+ ℓ), higher will be the energy of the orbital.
For n=6
6s= 6+0=6
6p=6+1=7
5d=5+2=7
4f=4+3=7
Hence, the correct order is:
ns→(n–2)f→(n–1)d→np

452. The total number of orbitals in the fifth energy level is

(a) 5 (b) 10
(c) 18 (d) 25

JIPMER-2009
UP CPMT-2008

Ans. (d) : For fifth energy level
The value of n will be 5
Therefore, the total number of orbitals is given by $n^2 = 5^2 = 25$

453. The last element of the p-block in 6th period is represented by the outer most electronic configuration

(a) $7s^2, 7p^6$ (b) $5f^{14}, 6d^{10}, 7s^2, 7p^5$
(c) $4f^{14}, 5d^{10}, 6s^2, 6p^4$ (d) $4f^{14}, 5d^{10}, 6s^2, 6p^6$

Karnataka-CET-2020

Ans. (d) : As we know form periodic table, the last element of the p-block in 6th period is Radon ($_{86}$Rn).
The electronic configuration of $_{86}$Rn
$_{86}Rn = 1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 3d^{10}, 4s^2, 4p^6, 4d^{10}, 5s^2, 4f^{14}, 5d^{10}, 6s^2, 6p^6$
Or it can be also written as $[Xe]\ 4f^{14}, 5d^{10}, 6s^2, 6p^6$

454. The orbital nearest to the nucleus is

(a) 4f (b) 5d
(c) 4s (d) 7p

Karnataka-CET-2018

Ans. (c) : In general orbitals with lower energy are present near to the nucleus. This can be calculate by (n+1) rule.
(i) Lower be the sum of (n+1) value, nearest the orbital to the nucleus.
(ii) And for the same sum, if the value of n will be lower, then its energy will also be low and it will be nearest to the nucleus.
Therefore, from the given options-

(a) 4f→ (ℓ =3) ∴ n+ ℓ = 4+3=7
(b) 5d→ (ℓ =2) ∴ n+ ℓ = 5+2=7
(c) 4s→ (ℓ =0) ∴ n+ ℓ = 4+0=4
(d) 7p→ (ℓ =1) ∴ n+ ℓ = 7+1=8

455. Among the elements form atomic number 1 to 36, the number of elements which have an unpaired electron in their s subshell is

(a) 2 (b) 7
(c) 6 (d) 9

Karnataka-CET-2014

Ans. (c) : Key elements among 1 to 36 atomic number which have one-unpaired electron in their s-subshell-
∵ The alkali metals have 1 electron in s-subshell-
$H = 1 \rightarrow 1s^1$
$Li = 3 \rightarrow 1s^2\ 2s^2$
$Na = 11 \rightarrow 1s^2\ 2s^2\ 2p^6\ 3s^1$
$K = 19 \rightarrow [Ar]\ 4s^1$
$Cr = 24 \rightarrow [Ar]\ 4s^1\ 3d^5$
$Cu = 29 \rightarrow [Ar]\ 4s^1\ 3d^{10}$
Therefore, there are total 6 elements between atomic number 1 to 36 which have one electron in their outer most s-subshell.

456. Impossible orbital among the following is

(a) 3f (b) 2p
(c) 4d (d) 2s

Karnataka-CET-2012

Ans. (a) : According to Bohr Bury's scheme maximum number of e^- in 3rd orbital $2n^2=2(3)^2=18$
Maximum number of e^- in s-subshell =2, p-subshell =6, d-subshell =10 and f-subshell =14 therefore, 18 e^- present in 3rd orbital enter in s, p and d subshell.
There after there is no e^- available for f-subshell that is why 3f subshell is not possible.
Thus, the value of magnetic quantum number is $-l$ to $+l$, then –2 to +2, i.e –2–1, 0,+1, +2

457. The number of naturally occurring p-block elements that are diamagnetic is

(a) 18 (b) 6
(c) 5 (d) 7

Karnataka-CET-2011

Ans. (a) : The group 18 elements have completely filled subshells, therefore, they are diamagnetic. They are He, Ne, Ar, Kr and Xe.

458. Which one of the following is not correct in respect of hybridization of orbitals?

(a) The orbitals present in the valence shell only are hybridized
(b) The orbitals undergoing hybridization have almost equal energy
(c) Promotion of electron is not essential condition for hybridization
(d) It is not always that only partially filled orbitals participate in hybridization in some cases even filled orbitals in valence shell take part
(e) Pure atomic orbitals are more effective in forming stable bonds than hybrid orbitals

Kerala-CEE-2013

Ans. (e) : Pure atomic orbitals are less effective in forming stable bonds than hybrid orbitals.

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459. Which of the following are isoelectronic species?

(i) NH_3 **(ii)** CH_3^+

(iii) NH_2^- **(iv)** NH_4^+

Choose the correct answer from the codes given below.

(a) (i), (ii), (iii) (b) (ii), (iii), (iv)
(c) (i), (ii), (iv) (d) (i), (iii), (iv)
(e) (ii), (iii)

Kerala-CEE-2014

Ans. (d) :

Species	Number of electrons
(1) NH_3	$7+1\times3=10$
(2) CH_3^+	$6+1\times3-1=8$
(3) NH_2^-	$7+1\times2+1=10$
(4) NH_4^+	$7+1\times4-1=10$

Since,
(i) (iii) and (iv) have the equal number of electrons therefore these are called as isoelectronic species.

460. Electronic configuration of only one p-block element is exceptional. One molecule of that element consists of how many atoms of it?

(a) One (b) Two
(c) Three (d) Four

MHT CET-2015

Ans. (a) : Helium is the element with exceptional configuration in p-block with only 2 electrons in outermost shell Helium is monoatomic hence it consists of only 1 atom.
Electronic configuration of helium (He) = $1s^2$

461. The number of spherical nodes in 3p orbitals are/is

(a) one (b) three
(c) none (d) two

NEET-1988

Ans. (a) : Given, 3p orbital
In 3p orbital, n = 3 and l = 1
We know,
Spherical Node = $n-l-1=1$

462. The orientation of an atomic orbital is governed by

(a) principle quantum number
(b) azimuthal quantum number
(c) spin quantum number
(d) magnetic quantum number

NEET-2006

Ans. (d) : Magnetic Quantum number represents the orientation of an orbital around the nucleus. It is represented by m_l.

463. The total number of atomic orbitals in fourth energy level of an atom is

(a) 8 (b) 16
(c) 32 (d) 4

NEET-2011
UPTU/UPSEE-2004

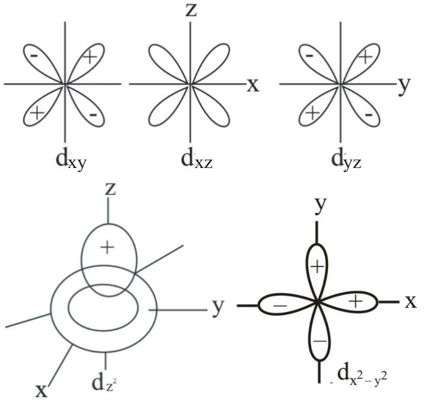
Ans. (b) : According to question.
n=4
Now,
Number of atomic orbital in particular energy level is given by formula $=n^2$
Number of orbital's in fourth energy level $\Rightarrow 4^2 \Rightarrow 16$ orbital's.

464. Which of the following pairs of d-orbital's will have electron density along the axes?

(a) d_{z^2}, d_{xy} (b) d_{xy}, d_{yz}
(c) $d_{z^2}, d_{x^2-y^2}$ (d) $d_{xy}, d_{x^2-y^2}$

NEET-II 2016

Ans. (c) : The shapes of various d-orbitals are as follow



So, the pairs of d-orbitals having electron density along the axis are dz^2 and dx^2-y^2.

465. 4d, 5p, 5f and 6p orbital's are arranged in the order of decreasing energy. The correct option is

(a) 5f > 6p> 4d > 5p (b) 5f > 6p > 5p > 4d
(c) 6p > 5f > 5P > 4d (d) 6p > 5f > 4d > 5p

NEET-2009

Ans. (b) : As we know, Greater the (n+1) values greater is the energy (n+1) values for,
4d=4+2=6
5p=5+1=6
5f=5+3=8
6p=6+1=7
Order of energy would be 5f > 6p > 5p > 4d

466. The stable electronic configuration of chromium is

(a) $3d^6\ 4S^1$ (b) $3d^5\ 4S^2$
(c) $3d^5\ 4S^1$ (d) $3d^6\ 4S^o$

J & K CET-(2007)

Ans. (c) : The electronic configuration of ${}_{24}Cr$ is $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^5\ 4s^1$

467. Which one of the following electronic arrangements is absurd?

(a) n=3,l=1,m= –1 (b) n=3, l =0, m= 0
(c) n=2, l =0, m= –1 (d) n=2, l =1, m= 0

WB-JEE-2019

Ans. (c) : The value of magnetic quantum number m depends upon aziamuthal quantum number l m varies form $-l$ to $+l$
So, if the value of l. is O then value of m will also be O.

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468. The ground state term symbol for an electronic state is governed by:
(a) Heisenberg's principle
(b) Hund's rule
(c) Aufbau principle
(d) Pauli exclusion principle

UPTU/UPSEE-2004

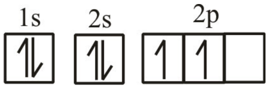
Ans. (b) : The ground state term symbol for an electronic state is governed by Hund's Rule.

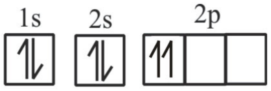
469. The compound in which cation is isoelectronic with anion is:
(a) NaC*l* (b) CsF
(c) NaI (d) K_2S

UPTU/UPSEE-2004

Ans. (d) : NaCl: No of e^- in Na^+ = 11–1=10
No of e^- in Cl^- = 17+1=18
CsF No of e^- in Cs^+ = 55–1=54
No of e^- in F^- = 9+1=10
NaI No of e^- in Na^+ ⇒11–1=10
No of e^- in I^- ⇒53+1=54
K_2S No of e^- in K^+ =19–1=18
No of e^- in S^{2-} =16+2=18
So, K_2S anion has isoelectronic with cation

470. Which of the following will violate Pauli's exclusion principle?

(a)


(b)


(c) Both (a) and (b)
(d) None of the above

UPTU/UPSEE-2014

Ans. (b) : Pauli's exclusion principle states that in a single atom no two electrons will have an identical set or the same quantum numbers. It means orbital must have opposite spins or it should be anti parallel.

471. The electronic configuration of the oxide ion is much most similar to the electron configuration of the
(a) sulphide ion (b) nitride ion
(c) oxygen atom (d) nitrogen atom

UPTU/UPSEE-2009

Ans. (b) : Sulphide ion (S^{2-})=No of electrons =16+2=18
Nitride ion (N^{3-})=No of electrons =7+3=10
Oxide ion (O^{2-})=No of electrons =8+2=10
No of electros in oxygen atom =8
No of electrons in nitrogen atom=7
Electronic configuration of O^{2-} or N^{3-} (10)
$1s^2\ 2s^2\ 2p^6$

472. The electronic configuration $1s^22s^22p^63s^23p^63d^9$ represents a
(a) Metal atom (b) Non metal atom
(c) Non metallic anion (d) Metallic cation

WB-JEE-2008

Ans. (d) : The given configuration represents the electron configuration of Cu^{2+} i.e a metallic cation.

473. An element belongs to group 15 and third period of the periodic table, Its electronic configuration will be
(a) $1s^2\ 2s^2\ 2p^3$ (b) $1s^2\ 2s^2\ 2p^4$
(c) $1s^2\ 2s^22p^6\ 3s^2\ 3p^3$ (d) $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3P^2$

WB-JEE-2011

Ans. (c) : The element belongs to group 15 and third period is phosphorus ($_{15}P$).
Electronic configuration of phosphorus.
$_{15}P = 1s^2, 2s^2, 2p^6, 3s^2, 3p^3$

474. The representation of the ground state electronic configuration of He by box-diagram as $\boxed{\uparrow\uparrow}$ is wrong because it violates
(a) Heisenberg's uncertainty principle
(b) Bohr's quantization theory of angular momenta
(c) Pauli's exclusion principle
(d) Hund's rule

WB-JEE-2011

Ans. (c) : According to Pauli Exclusion principle, in any orbital, maximum two electrons can exist, having opposite spin.

475. Which of the following electronic configuration is not possible?
(a) n=3, *l* = 0, m=0 (b) n=3, *l* = 1, m= –1
(c) n=2, *l* = 0, m= –1 (d) n=2, *l* = 1, m= 0

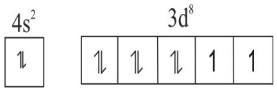
WB-JEE-2018

Ans. (c) : When l=0, m will also be zero.
Hence electronic configuration is not possible.

476. The number of unpaired electrons in Ni (atomic number = 28) are
(a) 0 (b) 2
(c) 4 (d) 8

WB-JEE-2018

Ans. (b) $_{28}Ni$ has electronic configuration = $[Ar]3d^8,4s^2$



∴ No of unpaired electron =2

7. Quantum Number

477. Consider the following pairs of electrons

(A) (a) n=3, *l*=1, m_l=1, $m_s = +\frac{1}{2}$
(b) n=3, *l* =2, m_l=1, $m_s = +\frac{1}{2}$
(B) (a) n=3, *l* =2, m_l= –2, $m_s = -\frac{1}{2}$
(b) n=3, *l* =2, m_l= –1, $m_s = -\frac{1}{2}$
(C) (a) n=4, *l* =2, m_l= 2, $m_s = +\frac{1}{2}$
(b) n=3, *l* =2, m_l= 2, $m_s = +\frac{1}{2}$

@apna_pdf

The pairs of electrons present in degenerate orbitals is/are:

(a) Only (A)   (b) Only (B)
(c) Only (C)   (d) (B) and (C)

JEE Main-24.06.2022, Shift-I

Ans. (b) :
(A) (a) n = 3, $l = 1$ ⇒ 3p
(b) n = 3, $l = 2$ ⇒ 3d
(B) (a) n = 3, $l = 2$ ⇒ 3d
(b) n = 3, $l = 2$ ⇒ 3d
(C) (a) n = 4, $l = 2$ ⇒ 4d
(b) n = 3, $l = 2$ ⇒ 3d

478. The number of radial and angular nodes in 4d orbital are, respectively

(a) 1 and 2   (b) 3 and 2
(c) 1 and 0   (d) 2 and 1

JEE Main-26.06.2022, Shift-II

Ans. (a) : We know that,
Radial nodes = $n-l-1$
Angular node = l
Where, n = Principle quantum number
l = Azimuthal quantum number
For 4d, n = 4, $l = 2$
∴ Radial node = 4–2–1 = 1
And angular node = 2

479. Consider the following set of quantum numbers.
The number of correct sets of quantum numbers is _____.

	n	l	m_l		n	l	m_l
(a)	3	3	–3	(b)	3	2	–2
(c)	2	1	+1	(d)	2	2	+2

JEE Main-27.06.2022, Shift-II

Ans. (2) : The value of azimuthal quantum number
s = 0, p = 1, d = 2, f = 3.
For n = 2, l = 0, 1, m_l = +1, 0, –1
For n = 3, l = 0, 1, 2, m_l = +2, +1, 0, –1, –2
Therefore, the correct set of quantum number in option (b) and (c).
Hence, The number of correct sets of quantum number is 2.

480. Consider the following statement :

(A) The principle quantum number 'n' is a positive integer with values of 'n' = 1, 2, 3,....
(B) The azimuthal quantum number 'I' For a given 'n' (principle quantum number) can have values as 'l' = 0, 1, 2, …n
(C) Magnetic orbital quantum number 'm_l' for a particular 'l' (azimuthal quantum number) has (2I+1) values.
(D) ±1/2 are the two possible orientations of electron spin.
(E) For l =5, there will be a total of 9 orbital Which of the above statement are correct?

(a) (A), (B) and (C)
(b) (A), (C), (D) and (E)
(c) (A), (C) and (D)
(d) (A), (B), (C) and (D)

JEE Main-28.06.2022, Shift-II

Ans. (c) : Here, statements (A), (C) and (D) are correct.
And statements (B) and (E) are incorrect.
The correct form of statements (B) and (E)–
(B) The azimuthal quantum number 'l' for a given 'n' (principle quantum number) can have values as 'l' = 0, 1, 2 ……..(n – 1)
(E) for l = 5, the total number of orbital
$= (2l + 1) = 11$

481. For n=3 energy level the number of possible orbitals (all kinds) are

(a) 1   (b) 3
(c) 4   (d) 9

CG PET -2005

Ans. (d) : Given, n = 3
and we know,
Number of orbitals $= n^2$
$= (3)^2 = 9$

482. The number of radial nodes for 4p is

(a) 4   (b) 3
(c) 2   (d) 1

SCRA-2015

Ans. (c): Radial node = $n - l - 1$
Where, n = principle quantum number
l = Azimuthal quantum number
For 4p orbital
n = 4, $l = 1$
∴ Radial node = 4–1–1 = 2

483. Which of the following sets of quantum numbers is restricted:

(a) n = 3, 1 = 1, m = + 2
(b) n = 3, 1 = 2, m = –2
(c) n = 3, 1 = 1, m = + 1
(d) n = 3, l = 1, m = –1

MPPET - 2012

Ans. (a) : If n = 3
Where, n = Principle Quantum No.
Then, l (Azimuthal Quantum No.)

$$\begin{array}{lccc} & l = 0, & 1, & 2 \\ & \downarrow & \downarrow & \downarrow \\ \text{and} & m = 0. & \overbrace{-1, 0, +1}, & \overbrace{-2, -1, 0, +1, +2} \end{array}$$

484. The magnetic quantum number m for the outermost electron in the Na atom, is :

(a) 1   (b) 2
(c) 3   (d) 0

AP-EAMCET-1991

Ans. (d) : The electronic configuration of sodium atom is :

$${}_{11}\text{Na} = \underbrace{1s^2}_{K}\,\underbrace{2s^2\,2p^6}_{L}\,\underbrace{3s^1}_{M}$$

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For $3s^1$
Principle quantum number (n) = 3
Azimuthal quantum number (l) = 0
Magnetic quantum number (m) = 0

485. Which one of the following sets of the quantum numbers is not possible for a 4p electron ?

(a) $n = 4, l = 1, m = +1, s = +\frac{1}{2}$

(b) $n = 4, l = 1, m = 0, s = +\frac{1}{2}$

(c) $n = 4, l = 1, m = 2, s = +\frac{1}{2}$

(d) $n = 4, l = 1, m = -1, s = -\frac{1}{2}$

AP-EAMCET-1998

Ans. (c) : For 4p electron,

$$n = 4, l = 1, m = +1, 0, -1,\ S = \pm\frac{1}{2}$$

Hence the option (c) is not correct.

486. Based on the Bohr's theory of hydrogen atom, the speed of the electron, energy of the electron, and the radius of its orbit varies with the principal quantum number, respectively as

(a) n, n^2, n^2
(b) $\frac{1}{n^2}, \frac{1}{n}, n$
(c) $\frac{1}{n}, \frac{1}{n}, n^2$
(d) $\frac{1}{n}, \frac{1}{n^2}, n^2$

TS-EAMCET (Engg.), 07.08.2021 Shift-II

Ans. (d) :

Speed of electron (V) = $\frac{Z}{n} \times 2.188 \times 10^8\ \text{cm/sec}$

or $V \propto \frac{1}{n}$ [Where n is energy level]

Energy of e^- (E) = $-13.6\ \frac{Z^2}{n^2}$ eV [Z is atomic number]

or $E \propto \frac{1}{n^2}$

Radius of orbital (r_n)= $0.529 \times \frac{n^2}{Z}$ Å

or $r_n \propto n^2$

Hence, $V : E : r_n = \frac{1}{n} : \frac{1}{n^2} : n^2$

487. Find the exact orbital from the following for which n = 4 and l = 1.

(a) 4s
(b) 3d
(c) 4d
(d) 4p

AP EAMCET (Engg.) 17.09.2020, Shift-II

Ans. (d) : For, n (principal quantum number) = 4 an ℓ (azimuthal quantum number) = 1
The orbital is 4p.
For, $4s \rightarrow n = 4, \ell = 0$

$3d \rightarrow n = 3, \ell = 2$

$4d \rightarrow n = 4, \ell = 2$

488. Choose the correct option regarding:
Assertiion : Energy of the orbital decreases with increase of 'n'.
Reason : Energy is required in shifting away the negatively charged electron from positively charged nucleus

(a) Assertion and Reasoning are correct statements and Reason is the correct explanation for Assertion
(b) Assertion and Reasoning are correct statements and Reason is not the explanation for Assertion
(c) Assertion is correct, Reason is wrong
(d) Assertion is wrong, Reason is correct

AP EAMCET (Engg.) 21.09.2020, Shift-I

Ans. (d) : As we move away from the nucleus, in atom the potential energy of electron increases, as the distance for nucleus increases, the value of n increases. Consequently the kinetic energy of the electron decreases, but total energy as a whole increases. Thus, the Assertion is incorrect but Reason is correct. Hence, the correct option is (d).

489. The four quantum numbers of the valence electron of potassium are:

	n	l	m	s
1	4	0	0	1/2
2	4	1	0	1/2
3	4	0	1	1/2
4	4	1	1	1/2

(a) $4, 0, 1, \frac{1}{2}$
(b) $4, 1, 0, \frac{1}{2}$
(c) $4, 0, 0, \frac{1}{2}$
(d) $4, 1, 1, \frac{1}{2}$

AP EAMCET (Medical) -1998

Ans. (c): The electronic configuration of potassium is $1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 4s^1$. We find the four quantum of 4s– shell–
Principal quantum number (n) = 4
Azimuthal quantum number (ℓ) = 0
Magnetic quantum number (m) = 0
Spin quantum numbers (s) $= +\frac{1}{2}$

490. "No two electrons in an atom can have the same set of all four quantum numbers". This principle of called

(a) Zeeman effect
(b) Pauli's exclusion principle
(c) Stark effect
(d) Heisenberg principle

AP EAMCET (Engg.) 18.09.2020, Shift-I

Ans. (b) : Pauli's exclusion principle is, "No two electrons in an atom can have the same set of all four quantum numbers".
e.g. for $4s^2$ configuration, its

	n	ℓ	m	s
1st e^- =	4	0	0	+1/2
2nd e^- =	4	0	0	–1/2

@apna_pdf

491. How many emission spectral lines are possible when hydrogen atom is excited to nth energy level ?

(a) $\frac{n(n+1)}{2}$ (b) $\frac{(n+1)}{2}$

(c) $\frac{(n-1)n}{2}$ (d) $\frac{n^2}{4}$

TS EAMCET-2017

Ans. (c) : Number of spectral lines $=\frac{n(n-1)}{2}$

Where, n is the orbital of electron.

492. A subshell n = 3, *l* = 2 can accommodate maximum of______

(a) 10 electrons (b) 6 electrons

(c) 18 electrons (d) 16 electrons

AP EAPCET 20.08.2021 Shift-II

Ans. (a): Given that subshell n = 3, *l* = 2

So,

l = 0 (s = subshell)
l = 1 (p = subshell)
l = 2 (d = subshell)
l = 3 (f = subshell)

In n = 3 and *l* = 2 maximum no. of electron is 10.

493. The quantum number which explains the line spectra observed as doublets in case hydrogen and alkali metals and doublets are triplets in case of alkaline earth metals is

(a) spin (b) azimuthal

(c) magnetic (d) principal

AP EAMCET (Engg.) 2012

Ans. (a) : Spin quantum number explains the line spectra observed as doublets in case of hydrogen and alkali metals and doublets and triplets in case of alkaline earth metal.

494. The number of angular and radial nodes of 4d orbital respectively are

(a) 3, 1 (b) 1, 2

(c) 3, 0 (d) 2, 1

AP EAMCET (Engg.) -2014

Ans. (d) : For 4d subshell, n=4, *l* = 2

No. of angular nodes =*l* = 2

Number of radial nodes = n–*l* – 1⇒ 4–2–1=1

496. An electron having spin quantum number, s = –1/2 and magnetic quantum number, m=+3 can be present in

(a) both s-orbital and p-orbital

(b) p-orbital only

(c) f-orbital only

(d) both d-orbital and f-orbital

COMEDK-2012

Ans. (c) : For f-orbital, *l*=3; m= –*l* to +*l*

i.e., –3 to +3

497. Which one of the following sets of quantum numbers represents the highest energy level in an atom?

(a) n=4, *l*=0, m=0, $s=+\frac{1}{2}$

(b) n=3, *l*=1, m=1, $s=+\frac{1}{2}$

(c) n=3, *l*=2, m= –2, $s=+\frac{1}{2}$

(d) n=3, *l*=0, m=0, $s=+\frac{1}{2}$

COMEDK 2018, Assam CEE-2018
JIPMER-2012
Karnataka-CET-2011
NEET-1994

Ans. (c) : The orbital with highest (n+*l*) value will have the highest energy. In the given sets n=3, l=2, m =–2, s =+1/2 have n+*l* =5 i.e., 3d-orbital has the highest energy.

498. Four different sets of quantum numbers for four electrons are given below:

$e_1 = 4, 0, 0, -\frac{1}{2}; e_2 = 3, 1, 1, -\frac{1}{2}$

$e_3 = 3, 2, 2, +\frac{1}{2}; e_4 = 3, 0, 0, +\frac{1}{2}$

The order of energy of e_1, e_2, e_3 and e_4 is

(a) $e_1 > e_2 > e_3 > e_4$ (b) $e_4 > e_3 > e_2 > e_1$

(c) $e_3 > e_1 > e_2 > e_4$ (d) $e_2 > e_3 > e_4 > e_1$

COMEDK-2018

Ans. (c) : Higher (n+l) value, higher is the energy and for same (n+l) value higher n, higher will be the energy.

Thus, $e_3 > e_1 > e_2 > e_4$

499. Which one of the following expressions represent the electron probability function (D)?

(a) $4\,\pi r\,dr\,\psi^2$ (b) $4\,\pi r^2\,dr\,\psi$

(c) $4\,\pi r^2\,dr\,\psi^2$ (d) $4\,\pi r\,dr\,\psi$

AP-EAMCET (Medical), 2003

Ans. (c) : According to the quantum mechanics, the plot of ψ^2 versus distance from the nucleus (r) indicates the probability of an electron in a certain volume of space is the plot of the probability density. It explains a method for estimating an electrons probability at a certain location. This amputation generates a quantity called an electron may be found in a certain region at a certain place. Hence, the electron probability function is $4\,\pi r^2\,dr\,\psi^2$.

500. The number of radial nodes in 3s and 2p orbitals, respectively are

(a) 2 ; 2 (b) 2 ; 0

(c) 0 ; 0 (d) 3 ; 2

TS-EAMCET (Engg.), 06.08.2021

Ans. (b): No. of radial node = n – *l* – 1

n = Principle quantum number
l = Azimuthal quantum number

The value of *l* are–

$l = \underset{s}{0}\ \underset{p}{1}\ \underset{d}{2}\ \underset{f}{3}$

For 3s, No. of radial node = 3 – 0 – 1
= 2

For 2p, No. of radial node = 2 – 1 – 1
= 0

@apna_pdf

501. The orbital with 4 radial and 1 angular nodes is

(a) $5p_y$ (b) $6p_z$
(c) $4d_{xy}$ (d) $5d_{yz}$

TS EAMCET 05.08.2021, Shift-I

Ans. (b) : Radial nodes = n – l – 1
Angular node = l
where, n = Principle quantum number.
l = Azimuthal quantum number.
For $5p_y$, n = 5, l = 1
Radial node = 5 – 1 – 1 = 3
Angular node = 1
For $6p_z$, n = 6, l = 1
Radial node = 6 – 1 – 1 = 4
Angular node = 1
For $4d_{xy}$, n = 4, l = 2
Radial node = 4 – 2 – 1 = 1
Angular node = 2
For $5d_{yz}$, n = 5, l = 2
Radial node = 5 – 2 – 1 = 2
Angular node = 2
Hence, the orbital node 4 radial and 1 angular nodes is $6p_z$.

502. The orbital having two radial as well as two angular nodes is:

(a) 3p (b) 4d
(c) 4f (d) 5d

JEE Main 26.02.2021, Shift-I

Ans. (d) : Angular node = l
Where, l = azimuthal quantum number

Orbital	Angular node(l)	Radial node(n - l - 1)
5d	2	2
4f	3	0
3f	1	1
4d	2	1

503. Which of the following elements outermost orbit's last electron has magnetic quantum number m = 0?

(a) Na (b) O
(c) Cl (d) N

AIIMS 25 May 2019 (Evening)

Ans. (a) : Na $_{11}Na = 1s^2\ 2s^2\ 2p^6\ 3s^1$
For last electron, l=0, m=0

504. Which one of the following set of quantum numbers is not possible for 4p electron?

(a) $n = 4, l = 1, m = -1, m_s = +\frac{1}{2}$

(b) $n = 4, l = 1, m = 0, m_s = +\frac{1}{2}$

(c) $n = 4, l = 1, m = 2, m_s = +\frac{1}{2}$

(d) $n = 4, l = 1, m = -1, m_s = -\frac{1}{2}$

AIIMS 25 May 2019 (Evening)

Ans. (c): For 4p electron n=4, l=1, m=1, 0+1
ms $= \pm\frac{1}{2}$ As l = 1, m cannot be equal to 2.
Therefore set of quantum number is not possible.

505. In the electronic configuration of which of the given elements, 'Aufbau principle' or (n+l) rule is violated ?

(a) Mn (b) Ga
(c) La (d) Pu

AP EAPCET 24.08.2021 Shift-II

Ans. (c) : Aufbau principle states that the electrons are filled into an atomic orbital in the increasing order of orbital energy level.
Therefore La electronic configuration of the elements violated the Aufbau principle rule because La is lanthanoid element.

506. With increasing Principal Quantum number, the energy difference between adjacent energy levels in H-atom______

(a) Decreases
(b) Increases
(c) remain constant
(d) decreases at low level of 'n' & increases for higher value of 'n'

AP EAPCET 20.08.2021 Shift-II

Ans. (a): With increasing principle Quantum number, the energy difference between adjacent energy levels in H-atom is decreases.

507. The maximum number of electrons, present in an orbit that is represented by azimuthal quantum number (l) = 3, will be

(a) 8 (b) 2
(c) 14 (d) 6

AIIMS-1996

Ans. (c): l=3 corresponds to f-orbitals. Since there are seven f-orbitals and each orbital accommodates 2 electrons, So maximum number of electrons is 14.

508. What is maximum wavelength of line of Balmer series of hydrogen spectrum? ($R = 1.09 \times 10^7 m^{-1}$)

(a) 400 nm (b) 654 nm
(c) 486 nm (d) 434 nm

AIIMS-26 May, 2018

Ans. (b): For maximum wavelength in the Balmer series energy difference is lowest.

Thus, $\bar{v} = R \times Z2 \left(\frac{1}{n^2} - \frac{1}{n_2^2}\right), n_2 = 3 \text{ and } n_1 = 2$

$\therefore \frac{1}{\lambda} = 1.09 \times 10^7 \times 1^2 \left(\frac{1}{2^2} - \frac{1}{3^2}\right)$

$\Rightarrow \frac{1}{\lambda} = 1.09 \times 10^7 \times 1 \left(\frac{1}{4} - \frac{1}{9}\right)$

$\Rightarrow 1.09 \times 10^7 \times 1 \left(\frac{5}{36}\right)$

$\Rightarrow \lambda = \frac{36}{5 \times 1.09 \times 10^{7m}}$

$\Rightarrow 6.60 \times 10^{-7}$ m $\Rightarrow$ 660 nm

@apna_pdf

509. Which transition in the hydrogen atomic spectrum will have the same wavelength as the transition, n=4 to n=2 of He$^+$ spectrum?

(a) n=4 to n= 3 (b) n=3 to n= 2

(c) n=4 to n= 2 (d) n=2 to n= 1

AIIMS-2016

Ans. (d): $\because \frac{1}{\lambda} = z^2.R\left[\frac{1}{n_1^2} - \frac{1}{n_2^2}\right]$

$\therefore$ For He$^+$ ion, z=2

$$\frac{1}{\lambda} = 2^2 R\left[\frac{1}{2^2} - \frac{1}{4^2}\right]$$

$$\frac{1}{\lambda} = 4 \times R \times \frac{3}{16} = \frac{3}{4}R$$

The same value for H-atom is possible when electron jumps from n=2 to n=1 i.e.

$$\frac{1}{\lambda} = 1 \times R\left[\frac{1}{1} - \frac{1}{4}\right] \Rightarrow \frac{3}{4}R$$

510. In Bohr series of lines of hydrogen spectrum, the third line from the red end corresponds to which one of the following inter- orbit jumps of the electron for Bohr orbits in an atom of hydrogen

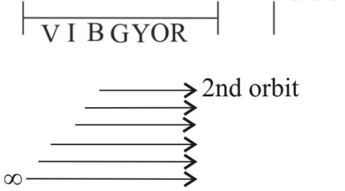
(a) 5→2 (b) 4→1

(c) 2→5 (d) 3→2

AIIMS-2017

Ans. (a): In hydrogen spectrum coloured radiaton means visible radiation corresponds to Balmer series.

(n_1=2, n_2=3, 4…….)



2nd line from the red end, it means 5→2

511. Which of the following combinations of quantum numbers is allowed?

(a) n l m m$_s$ — 3 2 1 0 (b) 2 0 0 $-\frac{1}{2}$

(c) 3 –3 –2 $+\frac{1}{2}$ (d) 1 0 1 $+\frac{1}{2}$

AIIMS-2013

Ans. (b): (a) is allowed as s cannot be zero

(c) is not allowed as *l* cannot be –3 because *l* can be any whole number from 0 to n–1 and it cannot be n.

(d) is not allowed as for l=o and m cannot be =1

512. The electrons identified by quantum numbers n and *l* for (i) n=4, *l*=1(ii) n=4, *l*=0(iii) n=3,*l*=2(iv)n=3,*l*=1 can be placed in order of increasing energy, from the lowest to highest, as

(a) (iv)<(ii)<(iii)<(i) (b) (ii)<(iv)<(i)<(iii)

(c) (i)<(iii)<(ii)<(iv) (d) (iii)<(i)<(iv)<(ii)

AIIMS-2014

Ans. (a): According to Aufbau's principle, the filling of electrons in various subshells of an atom takes place in the increasing order of energy, starting with the lowermost.

According to the Bohr–Bury rule i.e. (n+*l*) sum rule, the sub shell with the lower value of (n+*l*) is filled first if the values for (n+*l*) are equal, the one with the smaller value of n is filled first.

	n	*l*	(n+*l*)
(i)	4	1	5
(ii)	4	0	4
(iii)	3	2	5
(iv)	3	1	4

So, the correct order is iv < ii < iii < i.

513. Azimuthal quantum number defines

(a) e/m ratio of electron

(b) angular momentum of electron

(c) spin of electron

(d) magnetic momentum of electron

AIIMS-2002

Ans. (b): Generally azimuthal quantum number defines angular momentum.

514. The quantum number 'm' of a free gaseous atom is associated with:

(a) the effective volume of the orbital

(b) the shape of the orbital

(c) the spatial orientation of the orbital

(d) the energy of the orbital in the absence of a magnetic field

AIIMS-1998

Ans. (c): Magnetic quantum number m is associated with spatial orientation of the orbital. It is also called orientation quantum number because it gives the orientation or distribution of the electron clouds.

515. For principle quantum number n=4, the total number of orbitals having *l*=3 is:

(a) 3 (b) 7

(c) 5 (d) 9

AIIMS-2004

Ans. (b): For n=4, *l* =3 (f–subshell), number of values of m=2*l*+1=7 values

⇒ Number of orbitals in f-subshell is 7

516. Quantum numbers of an atom can be defined on the basis of

(a) Hund's rule

(b) Pauli's exclusion principle

(c) Aufbau's principle

(d) Heisenberg's uncertainty principle

AIIMS-2002

Ans. (b): Each electron in an atom is designated by a set of four quantum numbers. According to pauli's exclusion principle, no two electron in an atom have same values of all the four quantum numbers. Therefore consequently, an orbital accommodates two electron with opposite spins, these two electron have the same value of quantum number 'n' , '*l*' , and 'm' but value of 's' will be different.

@apna_pdf

517. The total number of orbitals in a shell with principal quantum number 'n' is:

(a) n^2 (b) n+1

(c) 2n (d) $2n^2$

AIIMS-1997

Ans. (a): No. of orbital in a shell $=n^2$.

518. In an atom the order of increasing energy of electrons with quantum numbers

(i) n = 4, l = 1 (ii) n = 4, l = 0

(iii) n = 3, l = 2 and (iv) n = 3, l = 1 is

(a) iii < (i) < iv < ii (b) ii < iv < i < iii

(c) i < iii < ii < iv (d) iv < ii < iii < i

AP-EAMCET (Engg.) - 2014

Ans. (d) : The order of increase of energy can be calculated from $(n + l)$ rule. If two orbitals have same value of $(n + l)$, the orbital with lover value of n will be filled first.

(i) For n = 4, l = 1, $(n + l) = 4+1 = 5$

(ii) For n = 4, l = 0, $(n + l) = 4+0 = 4$

(iii) For n = 3, l = 2, $(n + l) = 3+2 = 5$

(iv) For n = 3, l = 1, $(n + l) = 3+1 = 4$

So, the order is (iv) < (ii) < (iii) < (i)

519. The number of angular and radial nodes of 4d orbital respectively are

(a) 3, 1 (b) 1, 2

(c) 3, 0 (d) 2, 1

AP-EAMCET (Engg.) - 2014

Ans. (d) : Number of radial node $= n - l - 1$

Where, n = Principle quantum number

l = Azimuthal quantum number

∴ For 4d

$n = 4, l = 2$

Radial node $= 4 - 2 - 1 = 1$

Angular node $= l = 2$

Thus, the number of angular and radial node of 4d orbital is 2, 1 respectively.

520. Which of the following sets of quantum numbers is correct for an electron in 3d-orbital?

(a) $n = 3, l = 2, m = -3, s = +\frac{1}{2}$

(b) $n = 3, l = 3, m = +3, s = -\frac{1}{2}$

(c) $n = 3, l = 2, m = -2, s = +\frac{1}{2}$

(d) $n = 3, l = 2, m = -3, s = -\frac{1}{2}$

AP-EAMCET (Engg.) 2015

Ans. (c) : An electron for 3d-orbitals–

$n = 3, l = 2, m = -2, s = +\frac{1}{2}$

Note : Azimuthal quantum number of s, p, d and f orbital is 0, 1, 2 and 3 respectively.

521. The values of four quantum numbers of valence electron of an element are n = 4, l = 0, m = 0 and $s = +\frac{1}{2}$. The element is :

(a) K (b) Ti

(c) Na (d) Sc

AP-EAMCET (Engg.)-2004

Ans. (a) : The four quantum number are given as –

$n = 4$

$l = 0$

$m = 0$

and $s = +\frac{1}{2}$

The value of principle quantum number is 4, it means that elements belongs to the fourth period. The value of azimuthal quantum number is 0 that means electron present at s-orbital. m = 0 indicates that the valence electron is present in orbital of s-subshell. The value of s denote the orientation of electron. Hence, from the above data, it is clear that atom belongs to s-block and the name of metal is K.

522. The number of radial nodes of 3s and 2p orbitals respectively are

(a) 0, 2 (b) 2, 0

(c) 1, 2 (d) 2, 1

AP-EAMCET (Engg.) 2013

Ans. (b) Number of radial nodes $= n - \ell - 1$

Where n = no. of principle quantum number.

ℓ = Azimuthal quantum number.

For 3s	For 2p
$n = 3, \ell = 0$	$n = 2, \ell = 1$
Radial nodes = 3–0–1 = 2	Radial nodes = 2–1–1 = 0

The number of radial nodes for 3s and 2p are 2, 0 respectively.

523. With increase in principal quantum number n, the energy difference between adjacent energy levels in hydrogen atom

(a) increases

(b) decreases

(c) remains constant

(d) decreases for lower values of n and increases for higher values of n

AP - EAMCET(MEDICAL) - 2009

Ans. (b) : As we know, the energy difference between adjacent energy levels is inversely proportional to the principal quantum number, n. Therefore, with increase in n, the energy difference will decrease.

$$\Delta E \propto \left[\frac{1}{n_1^2} - \frac{1}{n_2^2}\right]$$

524. The correct set of quantum numbers for Rb (atomic no. 37) is

(a) $5,0,0,-\frac{1}{2}$ (b) $5,1,0,\frac{1}{2}$

(c) $6,0,1,\frac{1}{2}$ (d) $5,1,1,\frac{1}{2}$

JEE Main-2013

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Ans. (a) : The electronic configuration for Rb (37) is
Rb (37)
$= 1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2\ 3d^{10}\ 4p^6\ 5s^1$
For $5s^1$, $n = 5.\ l = 0,\ m = 0,\ s = \frac{1}{2}$

525. How many electrons in $_{19}$K have n = 3; l = 0 ?
(a) 1 (b) 2
(c) 4 (d) 3
JCECE - 2011

Ans. (b) : n = 3 and l = 0 means 3s-orbitals and s-orbital occupy 2 electrons.

526. The Balmer series in atomic hydrogen is observed in the following spectral region
(a) infrared (b) ultraviolet
(c) visible (d) far IR
AMU-2014

Ans. (c) : Balmer series in atomic hydrogen is observed in visible region.
Note:– Lyman series lies in UV region and paschen series lies in IR region and bracket and other lies in for IR region.

527. For the 19th electron of K the values of quantum number will be
(a) $4, 1, 0, +\frac{1}{2}$ (b) $4, 0, 0, +\frac{1}{2}$
(c) $3, 2, 0, +\frac{1}{2}$ (d) $3, 0, 0, +\frac{1}{2}$
AMU-2010

Ans. (b) : $_{19}K \rightarrow 1S^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^1$
Values of quantum number -
$n=4,\ I = 0,\ m = 0$ and $s = +\frac{1}{2}$

528. An electron with values 4,1,0 and +1/2 for the set of four quantum numbers n, l, m_l and m_s respectively, belongs to
(a) 4s - orbital (b) 4p - orbital
(c) 4d- orbital (d) 4f- orbital
AMU-2006

Ans. (b) : n = 4, l = 1 indicates 4p orbital.

529. An electron with values 4, 2,–2 and +1/2 for the set of four quantum numbers n, l, m_l and m_s, respectively, belongs to
(a) 4s-orbital (b) 4p-orbital
(c) 4d-orbital (d) 4f-orbital
AMU-2005

Ans. (c) : The value of 'n' and 'ℓ' equal to 4 and 3 respectively, corresponds to 4f–orbital, hence the electron will belong to 4f–orbital.

530. For l = 1, the correct set of values of m are
(a) 1, 2, 3 (b) 0, 1, 2
(c) 0 (d) -1, 0, +1
AMU-2004

Ans. (d) : For l =1
$m = -1, 0, +1\ [\ m = -l, \ldots\ldots.0, \ldots.. +l\ ]$

531. Which of the following represents correct set of the four quantum numbers (n, l, m and s, respectively) of a 4d electron?
(a) 4,3,2,+1/2 (b) 4,2,1,0
(c) 4,3,-2,+1/2 (d) 4,2,1,–1/2
AMU-2003

Ans. (d) : For 4d electron.
n=4, l=2
$m = -2, -1, 0+1, +2;\ s = \pm\frac{1}{2}$

532. The nineteenth electron of chromium has which of the following set of quantum number?

	n	l	m	s
(a)	3	0	0	±1/2
(b)	3	2	–2	±1/2
(c)	4	0	0	±1/2
(d)	4	1	–1	±1/2

AMU EXPLORER-2002

Ans. (c) : Atomic number of chromium is 24. The electronic configuration of chromium is $1s^2$, $2s^2$, $2p^6$, $3s^2$, $3p^6$, $4s^4$, $3d^5$. The nineteenth electron goes to the 4s orbital. The quantum number is illustrated below for 4s orbital.

$\boxed{\uparrow}$
4s

Principle quantum number (n) = 4
Azimuthal quantum number (l) = 0
Magnetic quantum number (m) = 0
Spin quantum number (s) = $\pm\frac{1}{2}$
Hence, the correct option of set of quantum number is 0.

533. The ion that is isoelectronic with CO is
(a) O_2^- (b) N_2^+
(c) CN^- (d) O_2^+
Assam CEE-2018
UP CPMT-2012
JCECE - 2006
J & K CET-(1998)
NEET-1997

Ans. (c) : Number of electrons in
$CO = 6+8=14$
$CN^- = 6+7+1=14$
$N_2^+ = 7+7-1=13$
$N_2^{2-} = 7+7+2=16$
$NO = 7+8+1=16$
CO is isoelectronic with CN^- because both species have same number of electrons.
Isoelcetronic species refers to the species which have same number of electrons.
CN^{-1} is isoelectronic with CO, both loose 14 electron.

534. Which of the following is not possible?
(a) $n = 2, l = 1, m = 0$ (b) $n = 2, l = 0, m = -1$
(c) $n = 3, l = 0, m = 0$ (d) $n = 3, l = 1, m = -1$
BCECE-2007

Ans. (b) : (a) n=2, ℓ=1, m=0, it is possible
(b) n=2, ℓ=0, m=–1, it is not possible because, if ℓ=0, m must be 0. The value of m totally depends on upon the value of ℓ (m= – ℓ to ℓ)
(c) n=3, ℓ=0, m= –0, it is possible
(d) n=3, ℓ=1, m= –1, it is possible

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535. In n = 3, l = 0 and m = 0, then atomic number is :

(a) 12 or 13 (b) 13 or 14

(c) 10 or 11 (d) 11 or 12

BCECE-2004

Ans. (d) : n=3, ℓ=0, m=0 indicates last shell is 3s so, electronic configuration will be $1s^2 2s^2 2p^6 3s^{1-2}$
So atomic number is 11 or 12.

536. The correct set of four quantum number for the valence electron of rubidium (Z = 37) is :

(a) n = 5, l = 0, m = 0, s = + 1/2

(b) n = 5, l = 1, m = 1, s = + 1/2

(c) n = 5, l = 1, m = 1, s = + 1/2

(d) n = 6, l = 0, m = 0, s = + 1/2

BCECE-2003

Ans. (a) : Electronic configuration of rubidium (z=37) is $[Kr]^{36}\ 5s^1$

$\therefore$ for valence electron ($5s^1$)

n=5, l =0, m=0, $s = \frac{1}{2}$

537. Azimuthal quantum number determines the

(a) size

(b) spin

(c) orientation

(d) angular momentum of orbitals

BCECE-2011

Ans. (d) : Angular momentum of orbital $= \sqrt{\ell(\ell+1)}\frac{h}{2\pi}$

538. What is the correct orbital designation of an electron with the quantum number,

$$\mathbf{n = 4, l = 3, m = -2, s = \frac{1}{2}?}$$

(a) 3s (b) 4f

(c) 5p (d) 6s

BCECE-2010

Ans. (b) : n=4 represent 4th orbit
l =3 represent f subshell
m= –2 represent orientation of f–orbital
$s = \frac{1}{2}$ represents direction of spin of electron
$\therefore$ the orbital is 4f.

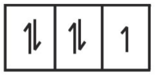
539. The correct set of quantum numbers for an element (Z = 17) for the unpaired electron will be –

(a) $3, 1, 1, \pm 1/2$ (b) $2, 0, 0, \pm 1/2$

(c) $3, 0, 0, \pm 1/2$ (d) $2, 1, 1, 0$

BCECE-2017

Ans. (a): Electronic configuration of (Z=17) $1s^2$, $2s^2$, $2p^6$, $3s^2$, $3p^5$ unpaired electron is present in 3p–orbital that can be shown as



Thus, for 3p, n=3, l=1, m= ± 1, $s = \pm\frac{1}{2}$

540. An e^- has magnetic quantum number as –3, what is its principal quantum number?

(a) 1 (b) 2

(c) 3 (d) 4

BITSAT 2016

Ans. (d) : When m = –3, l = 3, $\therefore$ n = 4.

541. Which of the following sequences of the energy levels of the subshells related to principal quantum number four (n=4)?

(a) s < p < d < f (b) s < d < p < f

(c) s < f < p < d (d) p < s < d < f

CG PET -2008

Ans. (a): The sequence of energies of the sub shells is compassed of using m + l rule where 'n' is principle quantum and 'l' is azimuthal quantum no. for same value of 'n' higher value of l have higher energy.
So,
s < p < d < f

542. Four different sets of quantum numbers for 4 electrons are given below

$e_1 = 4, 0, 0, -\frac{1}{2}$ $e_2 = 3, 1, 1, -\frac{1}{2}$

$e_3 = 3, 2, 2, +\frac{1}{2}$ $e_4 = 3, 0, 0, +\frac{1}{2}$

The order of energy of e_1, e_2, e_3, e_4 is

(a) $e_1 > e_2 > e_3 > e_4$ (b) $e_4 > e_3 > e_2 > e_1$

(c) $e_3 > e_1 > e_2 > e_4$ (d) $e_2 > e_3 > e_4 > e_1$

CG PET- 2013

Ans. (c) : Higher (n+l) value higher is the energy and for same (n+l) value higher n, higher will the energy.
Thus, $e_3 > e_1 > e_2 > e_4$

543. 2p orbitals have

(a) $n = 1, l = 2$ (b) $n = 1, l = 0$

(c) $n = 2, l = 1$ (d) $n = 2, l = 0$

CG PET -2004

Ans. (c) : In 2 p-orbital , 2 denotes principle quantum number (n=2) and p denotes azimuthal quantum number (l=1).

544. Which of the ions having following electronic structure would have maximum magnetic moment?

(a) $1s^2, 2s^2 2p^6, 3s^2 3p^6 3d^3$

(b) $1s^2, 2s^2 2p^6, 3s^2 3p^6 3d^5$

(c) $1s^2, 2s^2 2p^6, 3s^2 3p^6 3d^7$

(d) $1s^2, 2s^2 2p^6, 3s^2 3p^6 3d^9$

CG PET -2005

Ans. (b) : Magnetic moment $= \sqrt{n(n+2)}$, where n is no. of unpaired electrons.
Higher the number of unpaired electrons, higher is the magnetic moment.
Number of unpaired electrons are maximum in option b (5 unpaired electrons).
Option a and c :3 unpaired electrons
Option d : 1 unpaired electrons.

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545. A particle of mass nearly equal to proton is moving with a velocity nearly equal to the velocity of light. The wavelength of wave associated with it is

(a) directly proportional to its velocity
(b) inversely proportional to its energy
(c) (a) is wrong while (b) is correct
(d) Both (a) and (b) are correct

CG PET -2018

Ans. (a) :

$$\frac{\lambda_1}{\lambda_2}=\frac{m_2v_2}{m_1v_1}=\frac{\frac{1}{2}m_2v_2^2}{\frac{1}{2}m_1v_1^2}\frac{v_1}{v_2}=\frac{K.E._1}{K.E_2}=\frac{v_1}{v_2}$$

As $K.E_1 = K.E_2$

$$\therefore \frac{\lambda_1}{\lambda_2}=\frac{v_1}{v_2} \text{ or } \lambda \times v$$

546. A particle moving with a velocity 10^6 m/s will have de-Broglie wavelength nearly [Given, m = 6.62×10^{-27} kg, h = 6.62×10^{-34} J-s]

(a) 10^{-9} m
(b) 10^{-13} m
(c) 10^{-19} m
(d) 1 Å

CG PET -2009

Ans. (b): Given,
Velocity of particle $=10^6$ m/s
mass $=6.62\times10^{-27}$ kg
Plancks constant (h)$=6.62\times10^{-34}$ JS^{-1}

According to de-broglie wavelength $\lambda=\frac{h}{p}$

$$\text{or } =\frac{h}{mv} \quad [\therefore p = mv]$$

$$\lambda=\frac{6.62\times10^{-34}}{6.62\times10^{-27}\times10^{6}}=10^{-13}\text{m}$$

547. From the given sets of quantum numbers, the one that is inconsistent with the theory is

(a) $n = 3, l = 2, m = -3, s = +\frac{1}{2}$
(b) $n = 4, l = 3, m = 3, s = +\frac{1}{2}$
(c) $n = 2, l = 1, m = 0, s = -\frac{1}{2}$
(d) $n = 4, l = 3, m = 2, s = +\frac{1}{2}$

CG PET- 2010

Ans. (a) : When l=2, m≠–3

548. The correct set of four quantum number for the valence electrons of rubidium atom (Z = 37) is

(a) $5,0,0,+\frac{1}{2}$
(b) $5,1,0,+\frac{1}{2}$
(c) $5,1,1,+\frac{1}{2}$
(d) $5,0,1,+\frac{1}{2}$

[JEE Main 2014]

Ans. (a):
Electronic configuration of Rubidium is (Z = 37)
$= 1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^6 5s^1$
The valence electron is in 5s orbital
Its 4 quantum number are- n = 5, l = 0, m = 0, s = $+\frac{1}{2}$

549. The number of orbitals associated with quantum number n = 5, $m_s = +\frac{1}{2}$ is

(a) 25
(b) 50
(c) 15
(d) 11

[JEE Main 2020, 7 Jan Shift-I]

Ans. (a) : Total no. of electrons in n=5 are $2n^2$ i.e 2×5^2 =50

Thus electrons having, $m_s = \frac{+1}{2} = \frac{50}{2} = 25$ which is equal to no. of orbitals.

550. The quantum number of four electrons are given below:

I. n = 4, l = 2, m_l = –2, $m_s = -\frac{1}{2}$
II. n = 3, l = 2, m_l = 1, $m_s = +\frac{1}{2}$
III. n = 4, l = 1, m_l = 0, $m_s = +\frac{1}{2}$
IV. n = 3, l = 1, m_l = 1, $m_s = -\frac{1}{2}$

The correct order of their increasing energies will be

(a) IV < III < II < I
(b) I < II < III < IV
(c) IV < II < III < I
(d) I < III < II < IV

[JEE Main 2019, 8 April Shift-I]

Ans. (c) : Smaller the value of (n+l), smaller the energy if two or more sub-orbits have same values of (n+ l) suborbits with lower values of n has lower energy. The (n+ l) value of the given option are as follows:
(I) n=4, l =2; n + l =6
(II) n=3, l =2; n + l =5
(III) n=4, l =1; n + l =5
(IV) n=3, l =1; n + l =4
Among (II) and (III) n=3 has lower energy. Thus the correct order of their increasing energies will be IV < II < III < I

551. The number of subshells associated with n = 4 and m = –2 quantum number is

(a) 8
(b) 2
(c) 16
(d) 4

[JEE Main 2020, 2 Sep Shift-II]

Ans. (b) : For m=-2, it represent 2 subs hells.

552. The value of magnetic quantum number of the outermost electron of Zn^+ ion is

[JEE Main 2021, 31 Aug Shift-II]

Ans. (0) : $Zn^+ \rightarrow 1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^{10}\ 4s^1$
outermost electron is in 4s subshell m=0.

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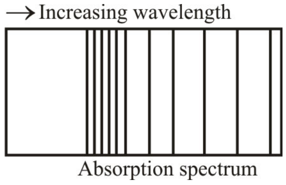
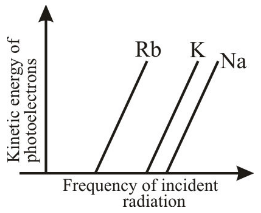
553. The figure that is not a direct manifestation of the quantum nature of atoms is

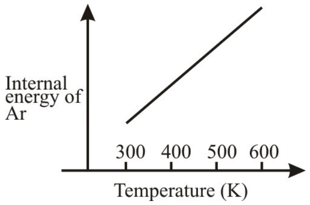
(a)



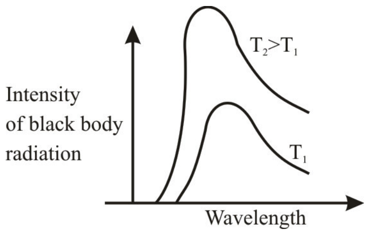
(b)



(c)

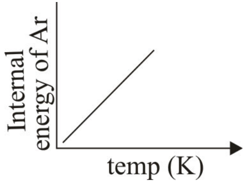


(d)



[JEE Main 2020, 2 Sep Shift-I]

Ans. (c) : The internal energy of 'Ar' or any gas has nothing to do with quantum nature of atom hence,



554. Maximum number of electrons in a shell principle quantum number n is given by

(a) n	(b) 2n
(c) n^2	(d) $2n^2$

J & K CET-(2012)

Ans. (d) : The maximum number of electrons that can be present in a shell is $2n^2$. Where n corresponds to a shell this was stated by Pauli exclusion principle.

555. The correct set of four quantum numbers for the electron in the outermost subshell of Cu atom (atomic number 29) in its ground state, is

	n	l	m_l	m_s
(a)	4	0	0	+1/2
(b)	3	0	0	+1/2
(c)	4	1	0	+1/2
(d)	3	1	+1	+1/2

J & K CET-(2016)

Ans. (a) : The electronic configuration of Cu in ground state [Ar] $3d^{10}\ 4s^1$

Hence, for outermost subshell, n=4 , l=0

m_l=0 and $m_s = +\frac{1}{2}$

556. The total number of orbitals associated with the principal quantum number n = 3, is

(a) 9	(b) 8
(c) 5	(d) 7

J & K CET-(2014)

Ans. (a) : by using the relation, no of orbital's $=n^2=(3)^2=9$.

557. How many quantum numbers are required to define the electron in an atom?

(a) 2	(b) 3
(c) 1	(d) 4

J & K CET-(2019)

Ans. (d) : Four quantum numbers (principal quantum number, azimuthal quantum number, magnetic quantum number and spin quantum number) are required to define or electron in an atom.

558. The electrons identified by quantum numbers n and l, (i) n = 4, l = 1 (ii) n = 4, l = 0 (iii) n = 3, l = 2 and (iv) n = 3, l = 1 can be placed in order of increasing energy as

(a) (i) < (ii) < (iii) < (iv)
(b) (iv) < (iii) < (ii) < (i)
(c) (iv) < (ii) < (iii) < (i)
(d) (iv) < (i) < (ii) < (iii)

J & K CET-(2011)

Ans. (c) : j

n	l	nl sub orbit	n + l
4	1	4p	5
4	0	4s	4
3	2	3d	5
3	1	3p	4

Higher the value of (n + l), higher the energy if (n + l) are same, sub orbit with lower value of n has lower energy.

Thus, 3p < 4s < 3d < 4p

Hence, correct order is (iv) < (ii) < (iii) < (i)

559. Out of the following which is the correct set of quantum numbers for outermost electron of potassium (Z= 19)?

	n	l	m	s
(a)	4	3	2	–1/2
(b)	4	2	0	–1/2
(c)	4	1	0	+1/2
(d)	4	0	0	–1/2

J & K CET-(2010)

Ans. (d) : Ans. (d) : K (z=19):$[Ar]^{18}\ 4s^1$

Outermost electron :$4s^1$

n=4, l =0, m=0, $s = +\frac{1}{2}$ or $\frac{-1}{2}$.

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560. The number electrons accommodated in an orbit with principal quantum number 2 is

(a) 2 (b) 6
(c) 10 (d) 8

J & K CET-(2007)

Ans. (d) : The number of electrons $=2n^2$
Where n = principal quantum number. For n =2
Number of electrons $= 2(2)^2 = 8$

561. The correct set of the four quantum numbers of a 4d electron is

(a) 4, 2, 1, –1/2 (b) 4, 2, 1, 0
(c) 4, 3, 2, +1/2 (d) 4, 3, –2, +1/2

J & K CET-(2005)

Ans. (a) : For 4d arbitral
Principal quantum Number (n) = 4
Azimuthal quantum number (l) –2 (For d-subshell l=2)
Magnetic quantum number (m) can have values ranging from $-l$ to $+l$ i.e –2 to +2
Spin quantum number (s) has only two values $+\frac{1}{2}$ and $-\frac{1}{2}$

562. The total number of orbital's possible for principal quantum number n is

(a) n (b) n^2
(c) 2n (d) $2n^2$

J & K CET-(2004)

Ans. (b) : The total number of orbital is a shell is n^2 the principal quantum number (symbolized) is one of four quantum number assigned to each electron in an atom to describe that electron is state. The total number of orbital possible for principal quantum n is n^2.

563. The electrons identified by quantum numbers

(i) n = 4, l = 1 (ii) n = 4, l = 0
(iii) n = 3, l = 2 (iv) n = 2, l = 1

Can be placed in order of increasing energy from the lowest to highest as

(a) (iv) < (ii) < (iii) < (i)
(b) (ii) < (iv) < (i) < (iii)
(c) (i) < (iii) < (ii) < (iv)
(d) (iii) < (i) < (iv) < (ii)

J & K CET-(2003)

Ans. (a) : According to Aufbau's principle the filling of electrons in Various subshells of an atom takes place in the increasing under of energy starting with lowest most.
According to the Bohr Bury rule i.e (n + l)Sum rule, the sub-shell with the lowest value of (n + l) if filled first. If the values for (n + l) are equal, the one with the smaller value of n is filled first.

	N	l	$(n + l)$
i.	4	1	5
ii.	4	0	4
iii.	3	2	5
iv.	3	1	4

The correct order is iv < ii < iii < i

564. n = 4 and l = 3 is designated as

(a) 4s (b) 4p
(c) 4d (d) 4f

J & K CET-(1999)

Ans. (d) : n = 4, l = 3
l = 0 for s sub-shell
l = 1 for p sub- shell
l = 2 for d sub- shell
l = 3 for f sub- shell
∴ 4f

565. Which of the following quantum numbers distinguishes the two electrons present in an orbital from each other?

(a) principal quantum number
(b) azimuthal quantum number
(c) spin quantum number
(d) none of these

J & K CET-(1999)

Ans. (c) : Spin quantum of any two electrons in an orbital cannot be same. If one has a value +1/2 other have –1/2.

$\frac{+1}{2}, \frac{1}{2}$

e.g. for $1s^2$

566. The correct set of quantum numbers for the unpaired electron of chlorine atom is (Atomic No. of Cl = 17 i.e. $3s^2$, $3p^5$)

	N	l	m
(a)	3	1	0
(b)	3	0	1
(c)	3	1	1
(d)	3	0	0

J & K CET-(1999)

Ans. (c) : The correct set of quantum number for the unpaired electron of chlorine atom is
n = 3, l = 1 and m = 0.1
For chlorine atom (Z = 17) the last
Electron enters into 3p orbital for which
n = 3, l = 1, m = –1, 0 or + 1 and $s = \pm\frac{1}{2}$

567. The maximum number of electrons in all those orbitals for which principal quantum number is 3 and azimuthal quantum number 2, is

(a) 2 (b) 8
(c) 10 (d) 18

J & K CET-(1997)

Ans. (c) : Principal quantum number, n = 3, azimuthal quantum ; l = 2,
Hence, for l = 2, it is d – subshell.
d – Subshell has 5 degenrate orbitals and 1 orbital contain maximum 2 electron
Hence, 5 orbital contain maximum 2 × 5 = 10 electron.

568. Which of the following has highest energy?

(a) n = 2, l = 1 (b) n = 3, l = 2
(c) n = 3, l = 1 (d) n = 2, l = 0

JCECE - 2006

Ans. (b) : Energy is highest in the outermost shell
n = 2, l = 1 = 2p
n = 3, l = 2 = 3d
n = 3, l = 1 = 3p
n = 2, l = 0 =2s
According to Dufbaus principle 3d has highest energy.

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569. The shape of the orbital with the value of l =2 and m = 0 is

(a) spherical (b) dumb-bell
(c) trigonal planar (d) square-planar

JCECE - 2009

Ans. (b) : s p d f
l = 0, 1 2 3d – Orbital is double dumb-bell shaped.

570. The electron, identified by quantum numbers n and l, (i) n = 4, l = 1 (ii) n = 4, l = 0 (iii) n = 3, l = 2 (iv) n = 3, l = 1 can be placed in order of increasing energy, from the lowest to highest, as

(a) (iv) < (ii) < (iii) < (i)
(b) (ii) < (iv) < (i) < (iii)
(c) (i) < (iii) < (ii) < (iii)
(d) (iii) < (i) < (iv) < (ii)

JCECE - 2014

Ans. (a) : (i) 4p (ii) 4s (iii) 3d (iv) 3p.
According to Aufbau rule, order of increasing energy is 3p < 4s < 3d < 4p.

571. The orbital angular momentum of an electron is 2s orbital is

(a) $+\frac{1}{2}\cdot\frac{h}{2\pi}$ (b) zero
(c) $\frac{h}{2\pi}$ (d) $\sqrt{2}\cdot\frac{h}{2\pi}$

JCECE - 2015

Ans. (b) : Orbital angular momentum

$$=\sqrt{l(l+1)}\frac{h}{2\pi}=0 \quad (\because \text{ for 2s-electron, } l=0)$$

572. The electrons identified by quantum numbers n and l, are as follows

I. n = 4, l = 1 II. n = 4, l = 0
III. n = 3, l = 2 IV. n = 3, l = 1

If we arrange them in order of increasing energy, i.e. from lowest to highest, the correct order is

(a) IV < II < III < I (b) II < IV < I < III
(c) I < III < II < IV (d) III < I < IV < II

JIPMER-2017

Ans. (a) : (i) More be the sum of n + 1 → more be the energy
(ii) Same sum, the more value of n have higher energy.
∴ n + 1 for →
(i) 4 + 1 = 5 (ii) 4 + 0 = 4
(iii) 3 + 2 = 5 (iv) 3 + 1 = 4
Order is (iv) < (ii) < (iii) < (i).

573. Among the following set of quantum numbers, the impossible set is

	n	**l**	**m**	**s**
(a)	3	2	–3	$-\frac{1}{2}$
(b)	4	0	0	$\frac{1}{2}$
(c)	5	3	0	$-\frac{1}{2}$
(d)	3	2	–2	$\frac{1}{2}$

JIPMER-2017

Ans. (a) : For each value of n, l = n –1 (max) and for each value of 1.
m = 1 to + 1
Thus, for 1 = 2, m = –2, –1, 0, 1, 2 and m = –3

574. Maximum number of electrons in a subshell of an atom determined by the following?

(a) $4l + 2$ (b) $2n^2$
(c) $4l – 2$ (d) $2l + 1$

JIPMER-2013

Ans. (a) : For a given shell, l the number of subshells, m_l = ($2l$ + 1) since each subshell can accommodate 2 electrons of opposite spin,
So, maximum number of electrons in a subshell = 2 ($2l$ + 1) = $4l + 2$.

575. If magnetic quantum number of a given atom represented by 3, then what will be its principal quantum number?

(a) 2 (b) 3
(c) 4 (d) 5

JIPMER-2006

Ans. (c) : If the magnetic quantum number of a given atom is represented by –3, then its principal quantum number will be 4.
For a given value of l,
m = –l, ……..0 …… + l when
m = –3, l = 3
For given value of n , l
Can have values from 0 to n –1 when
l = 3, n = 4, So that
n = –1, –4 –1 = 3

576. Number of orbitals in L energy level

(a) 1 (b) 2
(c) 3 (d) 4

JIPMER-2005

Ans. (d) : It is second energy level. Second energy level contains one s-orbital and three P orbitals. Therefore total number of orbital in L level is four.

577. The shape of an orbital is determined by

(a) n (b) l
(c) m (d) s

JIPMER-2004

Ans. (b) : The azimuthal quantum number (l) determines the shape of an orbital.
For l = 0 (spherical, s)
l = l (dumb-shape)

578. Azimuthal quantum number (l) defined

(a) shape of orbitals
(b) orientation of orbitals
(c) energy of orbitals
(d) size of orbitals

JIPMER-2019

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Ans.(a) : The azimuthal quantum number (l) determines the shape of an orbital

$l = 0$ (sperical, s)

$l = 1$ (dumb – bell, p) etc.

579. The correct set of quantum number for the unpaired electrons of chlorine atom is

(a) $2, 1, -1, +\frac{1}{2}$ (b) $2, 0, 0, +\frac{1}{2}$

(c) $3, 1, 1, \pm\frac{1}{2}$ (d) $3, 0, 0, \pm\frac{1}{2}$

Karnataka-CET-2017

Ans. (c) : The correct set of quantum number of the unpaired electron of chlorine atom is

$3, 1, 1, \pm\frac{1}{2}$

For chlorine atom (Z = 17) the last electron enters into 3p orbital for

Which n = 3, $l = 1$, m = –1, 0

or + 1 and. $s = \frac{+1}{2}$.

580. Consider the following sets of quantum numbers. Which of the following setting in not permissible arrangement of electrons in an atom?

	n	l	m	s
(a)	4	0	0	$-\frac{1}{2}$
(b)	5	3	0	$+\frac{1}{2}$
(c)	3	2	–2	$-\frac{1}{2}$
(d)	3	2	– 3	$+\frac{1}{2}$

Karnataka-CET-2016

Ans. (d) : For a given value of '*l*' the permission permissible value of 'm' are $-l, -(l-1) \ldots. 0 \ldots.. (l-1)\ l$

Thus for $l = 2$, m cannot have a value of –3.

581. The two electrons have the following set of quantum number, P = 3, 2, –2 + 1/2, Q = 3, 0, 0 + 1/2

Which of the following statement is true?

(a) P and Q have same energy

(b) P has greater energy than Q

(c) P has lesser energy than Q

(d) P and Q represent same electron

Karnataka-CET-2015

Ans. (b) : P has greater energy than Q as the *l* value P is greater than Q and the energy is give by (n + *l*) value.

582. The correct set of four quantum numbers for the outermost electron of sodium (Z = 11) is

(a) $3, 1, 1, \frac{1}{2}$ (b) $3, 2, 1, \frac{1}{2}$

(c) $3, 0, 0, \frac{1}{2}$ (d) $3, 1, 0, \frac{1}{2}$

Karnataka-CET-2012

Ans. (c) : As the electronic configuration of Na is : $Is^2\ 2s^2\ 2p^6\ 3s^1$

So, the outermost electron is $3s^1$ therefore quantum numbers for 3s':3,0, 0, $\frac{1}{2}$.

583. The set of quantum numbers for the outermost electron for copper in its ground state is

(a) $4, 1, 1, +\frac{1}{2}$ (b) $3, 2, 2, +\frac{1}{2}$

(c) $4, 0, 0, +\frac{1}{2}$ (d) $4, 2, 2, +\frac{1}{2}$

Karnataka-CET, 2010

Ans. (c) : The electronic configuration of the Cu atom is

$_{29}Cu = [Ar]\ 3d^{10}\ 4s^1$

Since, the outermost shell is 4s, thus outermost electron is in it.

For $4s^1$,

$n = 4, \quad l = 0, \quad m = 0, \quad s = +\frac{1}{2}$

584. The correct set of four quantum number for outermost electron of potassium (Z = 19) is

(a) $4, 1, 0, \frac{1}{2}$ (b) $3, 1, 0, \frac{1}{2}$

(c) $4, 0, 0, \frac{1}{2}$ (d) $3, 0, 0, \frac{1}{2}$

Karnataka-CET, 2009

Ans. (c) : K (19) : $1s^2, 2s^2 2p^6, 3s^2 3p^6, 4s^1$

$4s^1$ is the valence electron is potassium, hence the correct set of four quantum numbers for outermost electron is 4, 0, 0, $\frac{1}{2}$.

585. When the azimuthal quantum number has the value of 2, the number of orbitals possible are

(a) 7 (b) 5

(c) 3 (d) 0

Karnataka-CET, 2008

Ans. (b) : Given, azimuthal quantum number (l) = 2

Number of orbitals = $(2l + 1)$

$= (2 \times 2 + 1) = 4 + 1 = 5$

586. The number of angular and radial nodes in 3p orbital respectively are

(a) 3, 1 (b) 1, 1

(c) 2, 1 (d) 2, 3

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Karnataka-CET-2021

Ans. (b) : For angular node = ℓ

and Radial node = $n - \ell - 1$

Where, n = Principle quantum no.

ℓ = Azimuthal quantum no.

For 3p orbitals the value of ℓ for p-orbital is 1

$\therefore$ No. of angular node (ℓ) = 1

and No. of radial nodes = $n - \ell - 1 = 3 - 1 - 1 = 1$

@apna_pdf

587. The electrons, identified by quantum number n and *l*,
(I) n = 3; *l* = 2 n =5; *l* = 0 (III) n = 4; *l* =1 (IV) n = 4; *l* = 2 (V) n = 4; *l* = 0
can be placed in order of increasing energy, as
(a) I < V < III < IV < II
(b) I < V < III < II < IV
(c) V < I < III < II < IV
(d) V < I < II < IIII < IV
(e) V < I < IV < III < II

Kerala-CEE-2009

Ans. (d) (i) n = 3, $l = 2 \Rightarrow$ 3d
(ii) n = 5, $l = 0 \Rightarrow$ 5s
(iii) n = 4, $l = 1 \Rightarrow$ 4p
(iv) n = 4, $l = 2 \Rightarrow$ 4d
(v) n = 4, $l = 0 \Rightarrow$ 4s
According to Aufbau principle, An electron enters the orbital with lowest energy in order to increasing energies.
4s < 3d < 4p < 5s < ud

588. Which one of the following set of quantum numbers is not possible for electron in the ground state of an atom with atomic number 19?
(a) n = 2, *l* = 0, m = 0
(b) n = 2, *l* = 1, m = 0
(c) n = 3, *l* = 1, m = -1
(d) n = 3, *l* = 2, m = +2
(e) n = 4, *l* = 0, m = 0

Kerala-CEE-2006

Ans. (d) : $_{19}K = 1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6 4s^1$, *l* = 2 means d – subshell which is not present in K.

589. The correct set of quantum numbers (n, l and m respectively) for the unpaired electron of chlorine atom is:
(a) 2, 1, 0
(b) 2, 1, 1
(c) 3, 1, 1
(d) 3, 2, 1
(e) 3, 2, –1

Kerala-CEE-2004

Ans. (c) Cl (Z = 17) : $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^2x\ 3py^2\ 3pz^1$
$1s^2 2s^2\ 2p_x^2\ 2p_y^1\ 2p_z^1$
For the unpaired electron
n = 3, *l* = 1, m = –1, 0 or + 1

590. The number of electrons with azimuthal quantum number *l* = 1 and *l* = 2 for Cr in ground state respectively are
(a) 16, 5
(b) 16, 4
(c) 12, 4
(d) 16, 3
(e) 12, 5

Kerala-CEE-2015

Ans. (e) : Electrons configuration of
$_{24}Cr = 1s^2\ 2s^2\ sp^6\ 3s^2\ 3p^6\ 4s^1\ 3d^5$
Given,
azimuthal quantum number (*l*) = 1= p orbital
azimuthal quantum number (l) = 2 = d orbital
So, number of electrons in p– orbital
⇒ 12 and number of electrons in d–orbital = 5.

591. The magnetic quantum number for d-orbital is given by :
(a) 2
(b) 0, ±1, ±2
(c) 0, 1, 2
(d) 5

Manipal-2019

Ans. (b) :

n = 1	l = 0	m = 0	s
n = 2	l = 0,1	m = 0, ±1	s and p
n = 3	l = 0.1, 2	m = 0, ±1, ±2	s, p and d

592. Which of the following sets of quantum numbers is impossible arrangement?
(a) $n = 3,\ m = -2,\ s = +\frac{1}{2}$
(b) $n = 4,\ m = 3,\ s = +\frac{1}{2}$
(c) $n = 5,\ m = 2,\ s = -\frac{1}{2}$
(d) $n = 3,\ m = -3\ \ s = -\frac{1}{2}$

Manipal-2018

Ans. (d) :
n = 1, 2, 3, …..
l = 0, 1, 2, …. (n – 1) ex if
n = 3, l = 0, 1, 2
m = -l to l
$s = +\frac{1}{2}, \frac{-1}{2}$
n ≠ m so the following configuration is not possible.
$n = 3,\ m = -3,\ s = -\frac{1}{2}$

593. For *f*-orbital the values of m are :
(a) –2, –1, 0, +1, +2
(b) –3, –2, –1, 0, +1, +2, +3
(c) –1, 0, +1
(d) 0, +1, +2, +3

Manipal-2017

Ans. (b) : For f-orbital , *l* = 3 thus m lies from -3 to +3
Hence m, = -3, -2, -1, 0, +1, +2 , +3

594. What is the orbital angular momentum of an electron in 'f' orbital?
(a) $\frac{1.5h}{\pi}$
(b) $\frac{\sqrt{6}h}{\pi}$
(c) $\frac{\sqrt{3}h}{\pi}$
(d) $\frac{\sqrt{3}h}{2\pi}$

MHT CET-2014

Ans. (c) : Orbital angular momentum
$$mvr = \frac{h}{2\pi}\sqrt{l(l+1)} \quad \text{for f-orbital}$$
$l = 3$
∴ Orbital angular momentum
$$mvr = \frac{h}{2\pi}\sqrt{3(3+1)} = \frac{\sqrt{3}h}{\pi}$$
$$= \frac{\sqrt{3}h}{\pi}$$

@apna_pdf

595. The maximum number of electrons in a subshell is given by the expression

(a) $4l - 2$ (b) $4l + 2$
(c) $2l + 2$ (d) $2n^2$

NEET-1989

Ans. (b) : For an azimuthal quantum number l there are $2l + 1$ orbitals in a subshell since, each orbital can accommodate two electrons of opposite spin, the maximum number of electrons in a subshell is given by $2 \times (2l + 1) = 4l + 2$

596. The total number of electrons that can be accommodated in all the orbitals having principal quantum number 2 and azimuthal quantum number 1 are

(a) 2 (b) 4
(c) 6 (d) 8

NEET-1990

Ans. (c) : When n = 2 and l = 1 then subshell is 2p the number of orbital's in p-subshell.

$\Rightarrow (2l + 1) = (2 \times 1 + 1)$
$= 3$

Total (maximum) number of electrons

2 × number of orbital's
$\Rightarrow 2 \times 3$
$\Rightarrow 6$
(as each orbital contains 2 electrons)

597. For azimuthal quantum number l = 3, the maximum number of electrons will be

(a) 2 (b) 6
(c) 0 (d) 14

NEET-1991

Ans. (d) : As we known azimuthal quantum number l =3 denotes f – subshell and f-subshell contain seven orbitals. Each orbital can contain maximum of two electrons with opposite spin. Thus f-subshell contain total 14 electrons.

598. The following quantum numbers are possible for how many orbitals?

n = 3, l = 2, m = +2

(a) 1 (b) 2
(c) 3 (d) 4

NEET-2001

Ans. (a) : The three quantum number n, l, and m_l enable us to label completely an orbital. It is one of the d-orbital's present in 3d subshell.

599. If n = 6, the correct sequence for filling of electrons will be

(a) ns → (n-2)f → (n-1)d → np
(b) ns → (n-1)d → (n-2)f → np
(c) ns → (n-2)f → np → (n–1)d
(d) ns → np → (n–1)d → (n–2)f

NEET-2011

Ans. (a) : For n = 6 electron are filled as
$6s \rightarrow 4f \rightarrow 5d \rightarrow 6p$

This is because electron first enters in that orbital's for which (n + 1) is lower. In case, if (n + 1) is same it goes first in that orbital for which n is lowest.

600. Maximum number of electrons in a subshell of an atom is determined by the following

(a) $2l+1$ (b) $4l - 2$
(c) $2n^2$ (d) $4l + 2$

NEET-2009

Ans. (d) : For a given shell l,
the number of subshells. $m_l = (2l + 1)$
Since each subshell can accommodate 2 electrons of opposite spin, so maximum number of electrons in a subshell
$\Rightarrow 2(2l + 1) = 4l + 2$.

601. Which of the following is not permissible arrangement of electrons in an atom?

(a) n = 5, l = 2, m = 0, s + 1/2
(b) n = 5, l = 3, m = 0, s + 1/2
(c) n = 3, l = 3, m = 0, s + 1/2
(d) n = 4, l = 0, m = 0, s = -1/2

NEET-2009

Ans. (c) : If n = 3
l = 0 to (3 – 1) = 0, 1, 2
m = - l to + l = -2, -1, 0 +1, +2
$S = \pm\frac{1}{2}$
Is not a permissible set of quantum number

602. The correct set of four quantum numbers for the valence electron of rubidium atom (Z= 37) is

(a) 5, 1, 1, + 1/2 (b) 6, 0, 0 +1/2
(c) $5, 0, 0, +\frac{1}{2}$ (d) $5, 1, 0, +\frac{1}{2}$

NEET-2012

Ans. (c) : Electronic configuration of rubidium $(z = 37) \text{is} [\text{Kr}]^{36} 5S^1$
For valence electron ($5s^1$)
n = 5, l = 0, m = 0, s = $\frac{1}{2}$

603. The angular momentum of electron in 'd' orbital is equal to

(a) $2\sqrt{3}\frac{h}{2\pi}$ (b) 0 h
(c) $\sqrt{6}\frac{h}{2\pi}$ (d) $\sqrt{2}\frac{h}{2\pi}$

NEET-2015, cancelled

Ans. (c) : Angular momentum = $\sqrt{l(l+1)}\frac{h}{2\pi}$
For d orbital, l = 2
Angular momentum = $\sqrt{2(2+1)}\frac{h}{2\pi}$
$= \sqrt{6}\frac{h}{2\pi}$

604. What is the maximum number of orbital's that can be identified with the following quantum numbers?

n= 3, l =1, m_1 = 0

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(a) 1 (b) 2
(c) 3 (d) 4

NEET-2014

Ans.(a): Only one orbital $3p_z$ has following set of quantum number, n = 3, l = 1 and $m_l = 0$

605. What is the maximum numbers of electrons that can be associated with the following set of quantum numbers?
n = 3, *l* = 1 and m = –1
(a) 4 (b) 2
(c) 10 (d) 8

NEET-2013

Ans. (b) : The orbital associated with n = 3, *l* = 1 is 3p. One orbital (with m = –1 of Subshell Can accommodate maximum 2 electrons.

606. Two electrons occupying the same orbital are distinguished by
(a) azimuthal quantum number
(b) spin quantum number
(c) principal quantum number
(d) magnetic quantum number

NEET-I 2016

Ans. (b) : If two electrons in an atom are in the same atomic orbital, then they must have the same n, *l* and m values. Thus in order to satisfy pauli's exclusion principal, they must have opposite spins.

607. How many electrons can fit in the orbital for which n = 3 and *l* = 1?
(a) 2 (b) 6
(c) 10 (d) 14

NEET-II 2016

Ans. (a) : An orbital can always have a maximum no. of two electrons only.

608. Which set of quantum numbers is not possible?
(a) $3,2,-2,\frac{1}{2}$ (b) $3,2,-3,\frac{1}{2}$
(c) $4,0,0\frac{1}{2}$ (d) $5,3,0,\frac{1}{2}$

Tripura JEE-2022

Ans. (b) : When *l* = n, m, cannot be -3 value of m_l cannot numerically greater than the value of l.

609. Maximum number of electrons in a subshell with *l* = 3 and n = 4 is
(a) 14 (b) 16
(c) 10 (d) 12

NEET-2012

Ans. (a) : *l* = 3 and n = 4 represents 4f so total number of electrons in a subshell
2 (2*l* + 1)
⇒2(2 × 3 + 1) = 14 electrons. Hence
f-subshell can contain maximum 14 electrons.

610. The set of quantum number for 19th electron of chromium (Z = 24) is
(a) $4, 0, 0, +\frac{1}{2}$ (b) $4, 1, -1, +\frac{1}{2}$
(c) $3, 2, 2, +\frac{1}{2}$ (d) $3, 2, -2, +\frac{1}{2}$

UP CPMT-2011

Ans. (a) : Cr (Z = 24) : $1s^2, 2s^2, 2p^6, 3s^2, 3p^2 4s^1, 3d^5$

For 19th electron $\boxed{\uparrow}$ 4s'

$n = 4, l = 0, m = 0, s = +\frac{1}{2}$

611. No two electron can have the same values of …..quantum numbers.
(a) One (b) Two
(c) Three (d) Four

UPTU/UPSEE-2004

Ans. (d) : According to pauli principle 2 elelctron does not have the same value of all four quantum number. They have maximum same value are 3.

612. Which of the following electron has minimum energy?
(a) $n=4, l=0. m = 0.s=+\frac{1}{2}$
(b) $n=4, l=1. m = \pm 1.s=+\frac{1}{2}$
(c) $n=5, l=0. m = 0.s=+\frac{1}{2}$
(d) $n=3, l=2. m = -2.s=+\frac{1}{2}$

UPTU/UPSEE-2017

Ans. (a) : (i) Energy of electron depends on sum of n + 1 values.
(ii) For the same sum of n + 1, the orbital with lower value of n is filled first. Lower be the sum, lower the energy of electron.
(iii) Electrons are filled in increasing order of energy. Thus among the given options, n + 1 for :
(a) 4 + 0 = 4 (b) 5 + 0 = 5
(c) 4 + 1 = 5 (d) 3 + 2 = 5
4 + 0 = 4 is the

613. Which of the following set of quantum numbers represents the highest energy of an atom?
(a) $n = 3, l = 2, m = 1, s = +\frac{1}{2}$
(b) $n = 4, l = 0, m=0, s = -\frac{1}{2}$
(c) $n = 3, l = 0, m = 4, s = +\frac{1}{2}$
(d) $n = 3, l = 0, m = 1, s = +\frac{1}{2}$

UPTU/UPSEE-2016

Ans. (a): n = 3 , *l* = 0 represents 3s – orbital
n = 3, *l* = 01 represents 3p – orbital
n = 3, *l* = 2 represents 3d – orbital
n = 4, *l* = 0 represents 4s – orbital
The order of increasing energy of the orbitals is
3s < 3p < 4s < 3d

@apna_pdf

614. Consider the ground state of Cr atom (Z = 24). The number of electrons with the azimuthal quantum number, *l* = 1 and 2 are respectively

(a) 12 and 4 (b) 12 and 5
(c) 16 and 4 (d) 16 and 5

UPTU/UPSEE-2012

Ans. (b) : Electronic configuration of 24^{Cr}

$1s^2 2s^2 2p^6 3s^2 3p^6 3d^5 4s^1$

No. of electrons in *l* = 1(p-orbital) is

$6 + 6 = 12.$

No of electrons in *l* = 2 (d-orbital) is 5 the number of electrons with the azimuthal quantum number *l* = 1 and 2 respectively are 12 and 5

615. 'No two electrons in an atom can have the same set of quantum numbers.' This principle is known by which one of the following?

(a) Zeeman's exclusion principle
(b) Stark's exclusion principle
(c) Pauli's exclusion principle
(d) Hersbach's exclusion principle

UPTU/UPSEE-2011

Ans. (c) : the Pauli's exclusion principle states that in an atom or molecule, no two electrons can have the same set of all four electronic quantum numbers.

As an orbital can contain a maximum no. of only two electrons, the two electrons must have opposing spins, this means if one electron is assigned as a spin up $\left(+\frac{1}{2}\right)$ electron, the other electron must be spin-down $\left(-\frac{1}{2}\right)$ electron.

When n = 5, *l* = 0, 1, 2, 3, or 4 and m = -4 to +4 n = 5, *l* = 4, m = 0, s = $+\frac{1}{2}$ is a correct set of quantum number.

616. Identity the correct statement.

(a) Quantum numbers (n, *l*, m, s) are arbitratily
(b) All the quantum numbers (n, *l*, m, s) for any pair of electron in an atom can be identical under special circumstance
(c) All the quantum numbers (n, *l*, m, s)may not be required to describe an electron of an atom completely
(d) All the quantum numbers (n, *l*, m, s) are required to describe an electron of an atom completely)

WB-JEE-2013

Ans. (d) : All the quantum numbers (n, l, m, s) are required to describe an electron of an atom completely.

n describes the position and energy of the electron in an orbit or shell. *l* is used to describe subshell and the space of the orbital occupied by the electron.

m describes the preferred orientation of orbital's in space. s describes the spinning of an electron on its axis.

617. If the given four electronic configurations.

(i) n = 4, *l* = 1 (ii) n = 4, *l* = 0
(iii) n = 3, *l* = 2 (iv) n = 3, *l* = 1

are arranged in order of increasing energy, then the order will be

(a) (iv) < (ii) < (iii) < (i)
(b) (ii) < (iv) < (i) < (iii)
(c) (i) < (iii) < (ii) < (iv)
(d) (iii) < (i) < (iv) < (ii)

WB-JEE-2017

Ans. (a): $n = 4,\ l = 1$ 4P orbital
$n = 4,\ l = 0$ 4s orbital
$n = 3,\ l = 2$ 3d orbital
$n = 3,\ l = 1$ 3p orbital

According to (n + *l*) rule,

increasing order of energy

(iv) < (ii) < (iii) < (i)

618. Which of the following sets of quantum number represents the 19th electron of Cr (Z = 24)?

(a) $\left(4, 1, -1, +\frac{1}{2}\right)$ (b) $\left(4, 0, 0, +\frac{1}{2}\right)$
(c) $\left(3, 2, 0, -\frac{1}{2}\right)$ (d) $\left(3, 2, -2, +\frac{1}{2}\right)$

WB-JEE-2017

Ans. (b) : ${}_{24}Cr = [Ar]^{18}\, 4s^1 3d^5$

19th electron enters in $4s^1$ subshell

For $4s^1$

n = 4, *l* = 0, m = 0, s = $\frac{+1}{2}$

619. The difference between orbital angular momentum of an electron in a 4*f*-orbital and another electron in a 4s-orbital is

(a) $2\sqrt{3}$ (b) $3\sqrt{2}$
(c) $\sqrt{3}$ (d) 2

WB-JEE-2020

Ans. (a) : Orbital angular momentum is given by the formula,

$$\sqrt{l(l+1)} \times \frac{h}{2\pi}$$

∴ For 4f, l = 3

→ orbital angular momentum = $\sqrt{12} \times \frac{h}{2\pi}$

For 4s, l = 0,

orbital angular momentum = 0

∴ Difference = $\sqrt{12} - 0 = \sqrt{12} = 2\sqrt{3}$.

8. Bohr's Model for Hydrogen Atom

620. If radius of second Bohr orbit of the He^+ ion is 105.8 pm, what is the radius of third Bohr orbit of Li^{2+} ion?

(a) 158.7 $\overset{0}{A}$ (b) 158.7 pm
(c) 15.87 pm (d) 1.587 pm

NEET-17.07.2022

@apna_pdf

Ans. (b) : $r = \frac{n^2}{Z}\times a_0$

For He$^+$, n = 2

Z = 2

$$r_{He^+} = 105.8\,\text{pm}$$

$$r_{He^+} = \frac{(2)^2}{2}\times a_0$$

$$105.8 = \frac{4\times a_0}{2}$$

$$a_0 = \frac{105.8\times 2}{4} = 52.9$$

For Li^{2+}, n = 3, Z = 3

$$r_{Li^{2+}} = \frac{3^2}{3}\times a_0$$

= 3 × 52.9 = 158.7 pm

621. If the radius of the 3rd Bohr's orbit of hydrogen atom is r_3 and the radius of 4th Bohr's orbit is r_4. Then:

(a) $r_4 = \frac{9}{16}r_3$ (b) $r_4 = \frac{16}{9}r_3$

(c) $r_4 = \frac{3}{4}r_3$ (d) $r_4 = \frac{4}{3}r_3$

JEE Main-26.06.2022, Shift-I

Ans. (b) : $r = \frac{n^2}{z}$

For H– atom, we know = 1

So, $r \propto n^2$

$r_3 \propto 9$

$r_4 \propto 16$

From ratio $= \frac{r_3}{r_4} = \frac{9}{16}$

$$r_4 = \frac{16}{9}r_3$$

622. The hydrogen line spectrum provides evidence for the

(a) Heisenberg Uncertainty principle

(b) Wave like properties of light

(c) Diatomic nature of hydrogen

(d) Quantized nature of atomic energy states

SCRA-2012

Ans. (d) : The hydrogen like spectrum is an important piece of evidence to show the quantized electronic structure of an atom.

Atomic orbits have fixed energies.

623. The energy of an electrons in the 3rd orbit of an atom is –E.

The energy of an electron in the first orbit will be

(a) –3E (b) $-\frac{E}{3}$

(c) $-\frac{E}{9}$ (d) –9E

MPPET- 2009

Ans. (d) : Given that,

$$E_n = -\frac{13.6\,z^2}{n^2}\ \text{eV atom}^{-1}$$

For 3rd Oribit

$$E_3 = -E = \frac{-13.6(z)^2}{3^2} \qquad .....(i)$$

$$E_1 = \frac{-13.6(z)^2}{(1)^2} \qquad .....(ii)$$

Divided equation (i) and (ii) we get

$$\frac{-E}{E_1} = \frac{-13.6}{3^2}\times\frac{1^2}{-13.6}$$

$E_1 = -9E$

624. If the radius of 1s electron orbit of a hydrogen atom is 53 pm, then the radius of the 3p electron orbit would be

(a) 0.477 nm (b) 477 nm

(c) 159 pm (d) 17.66 nm

SCRA-2014

Ans. (a) : Given that,

$n = 1, r_1 = 53$ pm, $n = 3, r_3 = ?$

Now, from the radii expression-

$$r_n = \frac{52.9n^2}{z}\ \text{pm}$$

Where, n = no. of orbit.

z = atomic number

$$\therefore\quad r_3 = \frac{52.9\times 9}{1}\ \text{pm}$$

$r_3 = 476.1$ pm

or $r_3 = 0.476$ nm

625. The velocity of an electron in the first Bohr orbit is v_1. What is its velocity in the third Bohr's orbit?

(a) $v_1/9$ (b) $v_1/3$

(c) v_1 (d) $3v_1$

SCRA-2010

Ans. (b) : The velocity of an electron in the nth stationary orbit for H- like species is expressed as,

$$V_n = 2.18\times 10^6\ \frac{Z}{n}\ \text{m sec}^{-1}$$

Here, z = 1 and n= 3

So, Velocity in the third { ∵ velocity of e$^-$ in first Bohr orbit = V_1}

Bohr's orbit = $\frac{v_1}{3}$

626. The energy of the electron in the hydrogen atom is given by the expression :

(a) $\frac{-e^2}{r^2}$ (b) $\frac{-n^2h^2}{2\pi 2Z^2e^4m}$

(c) $\frac{-2\pi^2Z^2e^4}{n^2h^2}$ (d) $\frac{nh}{2\pi}$

AP-EAMCET-1991

@apna_pdf

Ans. (c) : The energy of the electron in the hydrogen atom is given as :

$$E_n = \frac{-2\pi^2 Z^2 e^4}{n^2 h^2}$$

627. The basic assumption of Bohr's model of hydrogen atom is that :

(a) the energy of the electron is quantised
(b) the angular momentum of the electron is quantised
(c) the radial distance of the electron is quantised
(d) the orbital velocity of the electron is quantized

AP-EAMCET-1994

Ans. (b) : Bohr's Model–

(1) Electrons are revolving around nucleus K, L, M, N in specific energy level with centripetal force given by nucleus.

$$\boxed{\frac{mu^2}{r} = \frac{ZKe^2}{r^2}}$$

(2) Only those orbits are allowed whose angular momentum (p) is integral multiple of $\frac{h}{2\pi}$.

$$\boxed{p = mvr = \frac{nh}{2\pi}}$$

628. The radius of the second Bohr's orbit is :

(a) 0.053 nm
(b) 0.106 nm
(c) 0.212 nm
(d) 0.0265 nm

AP-EAMCET-1995

Ans. (c) : Bohr radius $(r_n) = \in_0 n^2 h^2$

$$r_n = \frac{n^2 h^2}{4\pi^2 m e^2 kZ}$$

$$k = \frac{1}{4\pi \in_0}$$

$$\therefore \quad r_n = \frac{n^2 h^2 \in_0}{\pi m e^2 Z} = n^2 \frac{a_0}{Z}$$

Where, m = mass of electron
e = charge of electron
h = Planck's constant
k = Coulomb constant

$$\boxed{r_n = \frac{n^2 \times 0.53}{Z} \text{Å}}$$

Radius of n^{th} Bohr orbit for H-atom

$= 0.53\ n^2$ Å [Z = 1 for H-atom]

∴ Radius of 2^{nd} Bohr orbit for H-atom

$= 0.53 \times (2)^2 = 2.12$ Å

$= 0.212$ nm [1Å = 0.1 nm]

629. In the Bohr hydrogen atom, the electronic transition emiting light of longest wavelength is:

(a) n = 2 to n = 3
(b) n = 4 to n = 3
(c) n = 3 to n = 2
(d) n = 2 to n = 1

AP-EAMCET-1997

Ans. (b) : We know that $\Delta E = R_H\left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right)$

Thus the decreasing order of energy transition is–

$\boxed{\text{n=2 to n=3} > \text{n=2 to n=1} > \text{n=3 to n=2} > \text{n=4 to n=3}}$

Also, $E = \frac{hc}{\lambda}$

Emitting light of longest wavelength will have low energy and if the principle quantum number increases, the difference between the energy of two orbits decreases. Therefore, n = 4 to n=3 refers the lower energy.

Thus that should be the increasing order of wavelength.

630. The energy of an electron present in Bohr's second orbit of hydrogen atom is :

(a) – 1312 J atom^{-1}
(b) – 328 kJ mol^{-1}
(c) – 328 J mol^{-1}
(d) – 164 kJ mol^{-1}

AP EAMCET (Engg.) 2001

Ans. (b) : For Bohr's second orbit

$$E_A = \frac{-1312}{n^2} \text{kJ. mol}^{-1}$$

$$E_2 = \frac{-1312}{2^2} = -328 \text{ kJ/mol.}$$

631. Which one of the following statements is not correct?

(a) Rydberg's constant and wave number have same units
(b) Lyman series of hydrogen spectrum occurs in the ultraviolet region
(c) The angular momentum of the electron in the ground state of hydrogen atom is equal to $\frac{h}{2\pi}$
(d) The radius of first Bohr orbit of hydrogen atom is 2.116×10^{-8} cm

AP-EAMCET-2002

Ans. (d) : The radius of first Bohr orbit of hydrogen atom is 0.53 Å or 0.53×10^{-8} cm. Hence, statement is false.

- The unit of Rydberg constant as well as wave number $(\overline{v})$ is cm^{-1}. Hence, statement is true.
- The Lyman series of hydrogen spectrum occurs at the ultra violet region. Hence, the given statement is true.
- According to Bohr's theory, Angular momentum, $mvr = \frac{nh}{2\pi}$.

So, in ground state, angular momentum $= \frac{h}{2\pi}$.

632. An electron is moving in Bohr's fourth orbit. Its de-Broglie wavelength is λ. What is the circumference of the fourth orbit?

(a) $\frac{2}{\lambda}$
(b) 2λ
(c) 4λ
(d) $\frac{4}{\lambda}$

VITEEE-2014

Ans. (c) : According to Bohr's concept, an electron always move in the orbit with angular momentum (mvr) equal to $\frac{nh}{2\pi}$.

$$\therefore \quad mvr = \frac{nh}{2\pi}$$

@apna_pdf

$$r = \frac{n}{2\pi}\cdot\left(\frac{h}{mv}\right)$$

$$\left(\because \lambda = \frac{h}{mv}\ \text{de - Broglie equation}\right)$$

$$r = \frac{n\lambda}{2\pi}$$

For 4th orbit–

$$r = \frac{4\lambda}{2\pi} = \frac{2\lambda}{\pi}$$

$$\therefore\ \text{Circumference} = 2\pi r\ = 2\pi\times\frac{2\lambda}{\pi}$$

$$= 4\lambda$$

633. The energy (in ev) associated with the electron in the 1^{st} orbit of Li^{2+} is

(a) – 122.4 (b) – 61.15

(c) – 30.5 (d) – 244.6

TS-EAMCET (Engg.), 07.08.2021 Shift-II

Ans. (a) : Given that,

$n = 1, Z = 3$ (for Li^{3+})

$$\because \text{Energy of electron } (E_n) = -13.6\frac{Z^2}{n^2}\text{ev}$$

For 1^{st} orbit–

$$E_1 = -13.6\frac{(3)^2}{(1)^2}\text{ev}$$

or $E_1 = -122.4$ ev

634. Which energy level transition among the following will have the least wavelength?

(a) $n_4 \rightarrow n_3$ (b) $n_4 \rightarrow n_2$

(c) $n_4 \rightarrow n_1$ (d) $n_2 \rightarrow n_1$

AP EAPCET 25.08.2021, Shift-II

Ans. (c) : $n_4 \rightarrow n_1$ transition will have the least wavelength. The option (c) is correct. Energy is inversely proportional to wavelength. For an electron to undergo electronic transition from higher to lower energy level wavelength is least.

635. Calculate the de Broglie's wavelength of an electron residing in the 2^{nd} Bohr's orbit of a Hydrogen atom. (Bohr's radius, $a_0 = 0.529$Å)

(a) 0.2116 nm (b) 2.116 πÅ

(c) 21.16 m (d) 20116 μm

AP EAPCET 25.08.2021, Shift-II

Ans. (b) :

$$\lambda = \frac{h}{p} = \frac{h}{mv} \text{ ———— (1)}$$

$$\therefore\ \Delta V\,\Delta n = \frac{h}{4\pi m}$$

$$m\Delta V = \frac{h}{4\pi\Delta n} \text{ ———— (2)}$$

putting the vale in eq^n (1) we get

$$\lambda = \frac{h}{h}4\pi.\Delta n$$

$$\lambda = 4\pi\Delta n$$

$$\lambda = 4\pi\times 0.529\ \text{Å}\quad (\therefore\ \text{given } \Delta n = 0.529\ \text{Å})$$

$$\lambda = 2.116\ \text{Å}$$

636. If the wavelength of the first line of Balmer series is 656 nm, then the wavelengths of its second line and limiting line respectively are ———

(a) 485.9 nm & 434 nm

(b) 485.9 nm & 364.4 nm

(c) 715 nm & 434 nm

(d) 608 nm & 415.2 nm

AP EAPCET 25.08.2021, Shift-II

Ans. (b) : Given that $\lambda_1 = 656$ mm and $n_1 = n_2$ and $n_2 = 3$.

We know that or fist wavelength

$$\bar{v} = \frac{1}{\lambda_1} = R_H\left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right)$$

$$\frac{1}{656} = R_H\left(\frac{1}{2^2} - \frac{1}{3^2}\right)$$

$$\frac{1}{656\ \text{nm}} = R_H\left(\frac{1}{4} - \frac{1}{9}\right)$$

$$\frac{1}{656\ \text{nm}} = R_H\frac{5}{36} \text{ ———— (1)}$$

For second line, $n_1 = 2, n_2 = 4$

$$\frac{1}{\lambda_2} = R_H\left(\frac{1}{2^2} - \frac{1}{4^2}\right)$$

$$\frac{1}{\lambda_2} = R_H\left(\frac{1}{4} - \frac{1}{16}\right)$$

$$\frac{1}{\lambda_2} = R_H\frac{3}{16} \text{ ———— (2)}$$

Dividing equation (1) and (2) we get

$$\frac{\lambda_2}{656} = \frac{5}{36}\times\frac{16}{3}$$

$$\boxed{\lambda_2 = 485.9\ \text{nm}}$$

Wavelength of limiting line –

$n_1 = 2, n_2 = \infty$

So,

$$\frac{1}{\lambda} = R_H\left(\frac{1}{2^2} - \frac{1}{\infty^2}\right) = R_H\times\frac{1}{4}$$

Dividing (1) and (2) we get

$$\frac{\lambda}{656} = \frac{5}{36}\times 4$$

$$\lambda = \frac{20}{36}\times 656\ \text{nm} = 364.4\ \text{nm}$$

$$\boxed{\lambda_{nm} = 364.4\ \text{nm}}$$

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637. Which of the following corresponds to the energy of the possible excited state of hydrogen?

(a) –13.6 eV (b) 13.6 eV

(c) –3.4 eV (d) 3.4 eV

TS EAMCET-2017
BCECE-2012
NEET-2002

Ans. (c) : Energy level of an atoms are

$E_n = -13.6Z^2/n^2$ eV

Where Z = atomic number

Energy level (n) = 1, 2, 3, …..

For hydrogen atom, Z = 1

And first excited state, n = 2

$$\therefore E = \frac{-13.6\times1^2}{2^2}$$

E = –3.4 eV

638. The electron in the hydrogen jump on absorbing 12.75 eV of energy would jump to ____orbit

(a) 3 (b) 2

(c) 5 (d) 4

AP EAPCET 24.08.2021 Shift-II

Ans. (d) : We know that

$$E_n = \frac{-21.8\times10^{-19}}{n^2}\text{ Joule}$$

$$E_1 = \frac{-21.8\times10^{-19}}{1^2}$$

$E_1 = -21.8\times10^{-19}$J (n = 1 for ground state at H-atom)

After absorbing 12.75eV of energy the energy of electron will be -

$-21.8\times10^{-19} + 12.75\times1.6\times10^{-19}$

$-21.8\times10^{-19} + 20.4\times10^{-19}$

-1.4×10^{-19} J

Thus $\dfrac{-21.8\times10^{-19}}{n^2} = -1.4\times10^{-19}$

$$n^2 = \frac{21.8\times10^{-19}}{1.4\times10^{-19}}$$

$n^2 = 15.57$

$\boxed{n = 4}$

Thus the e^- will jump to the 4th orbit.

639. On the basis of Bohr's model. The radius of the 3rd orbit is——

(a) Equal to the radius of 1st orbit

(b) 3times the radius of 1st orbit

(c) 5 times the radius of 1st orbit

(d) 9 times the radius of 1st orbit

AP EAPCET 19-08-2021 Shift-I

Ans. (d) : From the equation of Bohr's model-

$$r_n = \frac{52.9(n^2)}{2}\text{ pm}$$

Where - r_n = radius of nth orbital

n = no of orbit

2 = atomic number

Given- n = 3

$$\therefore R_3 = \frac{52.9(3)^2}{2}\text{pm}$$

$$r_3 = \frac{9\times52.9}{2}\text{ pm …….(i)}$$

For the 1st orbit i.e. n = 1

$$r_1 = \frac{52.9\times(1)^2}{2}\text{ pm}$$

$$r_1 = \frac{52.9}{2}\text{ pm …….(ii)}$$

From (i) and (ii)

$r_3 = 9r_1$

Hence, the radius of the 3rd orbit is 9 times the radius of 1st orbit

640. Energy associated with the first orbit of He^+ is

(a) 8.72×10^{-18} joules (b) 0.872×10^{-18} joules

(c) -0.872×10^{-18} joules (d) -8.72×10^{-18} joules

COMEDK-2015
AMU-2015

Ans. (d) : For H-like particles,

$$E_n = \frac{-21.78\times10^{-19}}{n^2}Z^2\text{J}$$

For He^+, Z = 2, n = 1

$$= \frac{-21.78\times10^{-19}}{1^2}\times(2)^2 = -8.712\times10^{-18}\text{J}$$

641. Assuming Rydberg constants are equal, the ground state energy of the electron in hydrogen atom is equal to

(a) the ground state energy of the electron in He^+

(b) the first excited state energy of the electronic He^+

(c) the first excited state energy of the electron in Li^{2+}

(d) the ground state energy of the electron in Be^{3+}

COMEDK-2020

Ans. (b) : $E_n = -R_H.\dfrac{Z^2}{n^2}$

For ground state hydrogen atom : Z=1, n=1

$$\therefore E_1 = -13.6\times\frac{1}{1} = -13.6\text{eV}$$

For the ground state in He^+; Z=2, n=1

$$E_1 = -13.6\times\frac{4}{1} = -54.4\text{eV}$$

For the first excited state in He^+; Z=2, n=2;

$$E_2 = -13.6\times\frac{4}{4} = -13.6\text{eV}$$

For the first excited state in Li^{2+}; Z=3, n=2;

$$E_1 = -13.6\times\frac{9}{4} = -30.6\text{eV}$$

For the ground state energy of the electron in Be^{3+}; Z=4, n=1;

$= -13.6\times16 = -217.6$eV

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642. Match the following

List-I	List-II
(A) $mvr = \frac{nh}{2\pi}$	(i) Paschen series
(B) Infra-red	(ii) Electron total energy
(C) $\lambda = \frac{h}{p}$	(iii) de-Broglie equation
(D) $\frac{-e^2}{2\pi}$	(iv) Schrodinger equation
	(v) Bohr's equation

The correct answer is

	A	B	C	D
(a)	(v)	(ii)	(iii)	(i)
(b)	(iii)	(ii)	(v)	(iv)
(c)	(v)	(i)	(iii)	(ii)
(d)	(iv)	(i)	(ii)	(iii)

AP-EAMCET (Medical), 2008

Ans. (c) :

List-I	List-II
(A) $mvr = \frac{nh}{2\pi}$	Bohr's equation
(B) Infra-red	Paschen series
(C) $\lambda = \frac{h}{p}$	de-Broglie equation
(D) $\frac{-e^2}{2\pi}$	Electron total energy

643. The wavelength (in Å) of an emission line obtained for Li^{2+} during an electronic transition from $n_2 = 2$ to $n_1 = 1$ is (R = Rydberg constant)

(a) $\frac{3R}{4}$ (b) $\frac{3R}{4}$

(c) $\frac{4}{3R}$ (d) $\frac{4}{27R}$

AP-EAMCET (Medical), 2008

Ans. (d) : Given data:

$n_1 = 1$

$n_2 = 2$

$Z = 3$ (for Li^{2+})

$\lambda = ?$

Now, from Rydberg equation-

$$\overline{\upsilon} = RZ^2\left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right)$$

Or $$\frac{1}{\lambda} = R(3)^2\left(\frac{1}{1} - \frac{1}{4}\right)$$

$$\frac{1}{\lambda} = 9R \times \frac{3}{4}$$

Or $$\lambda = \frac{4}{27R}$$

644. The ratio of potential energy (PE) and total energy of an electron in a Bohr orbit of the hydrogen atom is

(a) 1 (b) 2

(c) −1 (d) $\frac{1}{2}$

TS-EAMCET 09.08.2021, Shift-I

Ans. (b) : Potential energy $(P.E.) = -\frac{Ke^2}{r_n}$ .....(i)

And, Total energy $(T.E.) = -\frac{1Ke^2}{2r_n}$ .....(ii)

$\therefore$ $\frac{P.E.}{T.E.} = \frac{-Ke^2/r_n}{-1Ke^2/2r_n}$

or $\frac{P.E.}{T.E.} = 2$

$\therefore$ P.E. : T.E. = 2 : 1

645. Electromagnetic radiation of wavelength 663 nm is just sufficient to ionise the atom of metal A. The ionization energy of metal A in kJ mol^{-1} is ——. (Rounded-off to the nearest integer) [$h = 6.63\times10^{-34}$ Js, $c = 3.00\times10^8$ ms^{-1}, $N_A = 6.02\times10^{23}$ mol^{-1}]

JEE Main 25.02.2021, Shift-II

Ans. : Given, wavelength (λ) = 663 nm {1nm = 10^{-9}m}

$= 663\times10^{-9}$m

We know that, $E = \frac{hc}{\lambda}$

For 1 mole of atom, total energy is given by,

$$\Rightarrow E = N_A \times \frac{hc}{\lambda}$$

$$\Rightarrow E = \frac{6.023\times10^{23}\times6.63\times10^{-34}\times3\times10^8}{663\times10^{-9}\times1000}$$

$= 3\times10^{-19}$ J

Ionisation energy per mol

$= 3 \times 10^{-19} \times 10^{-3} \times 6.02 \times 10^{23}$

$= 180.6$ KJ mol^{-1}

$= 181$ kJ mol^{-1}

646. **Assertion:** A spectral line will be seen for a $2P_x \rightarrow 2p_y$ transition.

Reason: Energy is released in the form of waves of light when the electron drops from $2p_x$ to $2p_y$ orbital.

(a) If both Assertion and Reason are true and the Reason is a correct explanation of the Assertion

(b) If both Assertion and Reason are true but Reason is not a correct explanation of the Assertion

(c) If Assertion is true but the Reason is false

(d) If both Assertion and Reason are false

AIIMS-1996

Ans. (d): In this case both assertion and reason are false. Both $2p_x$ and $2p_y$ orbitals have equal energy (2p orbitals are degenerate), there is no possibility of electron transition and hence, no energy is released and thus, no spectral line will be observed.

@apna_pdf

647. The maximum energy is possessed by an electron, when it is present

(a) in first excited state
(b) in nucleus
(c) at infinite distance from the nucleus
(d) in ground energy state

AIIMS-1996

Ans. (c): When electron is placed at an infinite distance from the nucleus the energy increases sharply.

The potential energy of the electron is minimum at equilibrium distance from the nucleus.

648. Assertion: Angular momentum of an electron in any orbit is given by angular momentum $= \frac{nh}{2\pi}$, where n is the principal quantum number

Reason: The principal quantum number n can have any integral values.

(a) If both Assertion and Reason are correct and the Reason is the correct explanation of Assertion
(b) If both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.
(c) If Assertion is correct but Reason is incorrect.
(d) If both the Assertion and Reason are incorrect.

AIIMS-2012-13

Ans. (b): Both assertion and reason are correct. Reason is not the correct explanation of assertion.

649. What is the energy (kJ/mol) associated with the de-excitation of an electron from n=6 to n=2 in He^+ ion?

(a) 1.36×10^6 (b) 1.36×10^3
(c) 1.16×10^3 (d) 1.78×10^3

AIIMS-27 May, 2018

Ans. (c): Given that,

n = 6 to n = 2

$$E = 13.6\times Z_1^2\left(\frac{1}{4}-\frac{1}{36}\right)$$

$$= 13.6\times4\left(\frac{9-1}{36}\right)$$

$$= 13.6\times4\times\frac{8}{36}$$

= 12.08 eV × 96 kJ/mol

= 1.16 × 10^3 KJ/mol

650. In Second orbit of H atom the velocity of e^- is:

(a) 2.18×10^6 m/sec (b) 3.27×10^6 m/sec
(c) 10.9×10^5 m/sec (d) 21.8×10^6 m/sec

AIIMS-27 May, 2018
AIIMS-2001

Ans. (c): $V = 2.18 \times 10^6 \times \frac{z}{n}$

$$V = 2.18\times10^6\times\frac{1}{2} = 10.9\times10^5 \text{ m/sec.}$$

Hence, $V = 10.9\times10^5$ m/sec

651. In hydrogen atomic spectrum, a series limit is found at 12186.3 cm^{-1}. Then, it belongs to

(a) Lyman Series (b) Balmer series
(c) Paschen series (d) Brackett series

AIIMS-2014

Ans. (c): Series limit is the last line of the series

i.e. $n_2 = \infty$

$$\therefore \quad \bar{v} = \frac{1}{\lambda} = R\left[\frac{1}{n_1^2}-\frac{1}{n_2^2}\right] = R\left[\frac{1}{n_1^2}-\frac{1}{\infty^2}\right]$$

$$\bar{v} = \frac{R}{n_1^2}$$

$$12186.3 = \frac{109677.76}{n_1^2}$$

$$n_1^2 = \frac{109677.76}{12186.3} = 9, \ n_1 = 3$$

The line belongs to Paschen series.

652. Based on equation, $E = -2.178\times10^{-18}\,J\left(\frac{Z^2}{n^2}\right)$, certain conclusions are written. Which of them is not correct?

(a) Larger the value of n, the larger is the orbit radius.
(b) Equation can be used to calculate the change in energy when the electron changes orbit.
(c) For n=1, the electron has a more negative energy than it does for n=6 which means that the electron is more loosely bound in the smallest allowed orbit.
(d) The negative sign in equation simply means that the energy of electron bound to the nucleus is lower than it would be if the electrons were at the infinite distance from the nucleus.

AIIMS-2015

Ans. (c): For n=1, the electron has a more negative energy than it does for n=6 which means that the electron is more loosely bound in the smallest allowed orbit.

653. The energy of electron in first energy level is -21.79×10^{-12} erg per atom. The energy of electron in second energy level is:

(a) -54.47×10^{-12} erg atom^{-1}
(b) -5.447×10^{-12} erg atom^{-1}
(c) -0.447×10^{-12} erg atom^{-1}
(d) -0.05447×10^{-12} erg atom^{-1}

AIIMS-2000

Ans. (b): Assume that atom to be hydrogen like,

Energy of n^{th} energy level

$E_n = \frac{-E_1}{x^2}$, where E_1 is energy of first energy level

$$E_2 = \frac{-E_1}{2^2} = \frac{-E_1}{4} = \frac{-21.79\times10^{-12}}{4}$$

$= -5.447\times10^{-12}$ erg per atom

@apna_pdf

654. If velocity of an electron in the first Bohr orbit of H is v_1 then velocity in second orbit will be

(a) v_1 (b) $2v_1$

(c) $\frac{v_1}{2}$ (d) $\frac{v_1}{4}$

SRMJEEE – 2007

Ans. (c) : The velocity of an electron of the n^{th} stationary state for hydrogen like species is expressed as–

$$V_n = 2.18 \times 10^6 \times \frac{z}{n} m/s$$

Where z = atomic number and n = orbit

Now, $V_1 = 2.18 \times 10^6 \times \frac{(1)}{(1)} m/s$

The velocity in second orbit is–

$$V_2 = 2.18 \times 10^6 \times \frac{(1)}{(2)}$$

or $V_2 = \frac{V_1}{2}$

$V \propto \frac{Z}{n}$ since, Z and n both have become twice, velocity of electron in second orbit of H^+ will be v.

655. If the energy of an electron in the second Bohr orbit of H-atom is –E, what is the energy of the electron in the Bohr's first orbit?

(a) 2E (b) –4E

(c) –2E (d) 4E

SRMJEEE – 2010

Ans. (b) : The expression of energy of hydrogen atom is :

$$E_n = -2.18 \times 10^{-18} \left(\frac{z^2}{n^2}\right) J$$

Given– $E_2 = -E$

$E_1 = ?$

$\therefore \quad E_2 = -2.18 \times 10^{-18} \times \frac{(1)^2}{(2)^2} J = -E \quad ...(i)$

and $E_1 = -2.18 \times 10^{-18} \times \frac{(1)^2}{(1)^2} J$ (from equation i)

or $E_1 = -4E$

656. According to Bohr's theory which one of the following values of angular momentum of hydrogen atom is not permitted?

(a) $\frac{1.25h}{\pi}$ (b) $\frac{h}{\pi}$

(c) $\frac{1.5h}{\pi}$ (d) $\frac{0.5h}{\pi}$

AP-EAMCET- (Engg.)-2011

Ans. (a): According to Bohr's theory.

$$mvr = \frac{nh}{2\pi}$$

Where, m = mass of atom

v = velocity

r = radius of n^{th} orbit

Therefore, the angular momentum is an integral multiple of $\frac{h}{2\pi}$.

Hence option (a) is not permitted for angular momentum of hydrogen atom.

657. In a hydrogen atom, the electron is at a distance of 4.768 Å from the nucleus. The angular momentum of the electron is

(a) $\frac{3h}{2\pi}$ (b) $\frac{h}{2\pi}$

(c) $\frac{h}{\pi}$ (d) $\frac{3h}{\pi}$

AP- EAMCET(Medical) -2010

Ans. (a): Given data:-

$$r_n = 4.768 Å$$

As we know the radius of first Bohr's orbit is –

$$r_n = 0.529 \frac{n^2}{Z} Å$$

$$4.768 = 0.529 \times n^2$$

$$n^2 = \frac{4.768}{0.529}$$

or $n^2 = 9$

$n = 3$

$\therefore$ Angular momentum of the electron is $(mvr) = \frac{nh}{2\pi} = \frac{3h}{2\pi}$

658. In the Bohr hydrogen atom, the electronic transition emitting light of longest wave length is:

(a) n = 2 to n =3 (b) n = 4 to n = 3

(c) n = 3 to n =2 (d) n = 2 to n = 1

AP – EAMCET - (Medical)-1997

Ans. (b) : The spectrum of hydrogen atom obey the following formula–

$$\bar{v} = R_H \left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right)$$

Where R_H = Rydberg constant

In the Paschen series of hydrogen atom spectrum, the minimum energy difference found in n =4 to n = 3 due to which they have longest wavelength.

659. What is the lowest energy of the spectral line emitted by the hydrogen atom in the Lyman series?
(h = Planck's constant, c = Velocity of light, R=Rydberg's constant).

(a) $\frac{5hcR}{36}$ (b) $\frac{4hcR}{3}$

(c) $\frac{3hcR}{4}$ (d) $\frac{7hcR}{144}$

AP-EAMCET (Engg.)-2005

@apna_pdf

Ans. (c): Given data:- For the Lyman series-

$n_1 = 1, \quad n_2 = 2$

From the Rydberg equation-

$$\bar{\nu} = R\left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right)$$

where- $\bar{\nu}$ = wave number

R = Rydberg constant

$$\bar{\nu} = R\left(\frac{1}{1} - \frac{1}{4}\right)$$

or $\bar{\nu} = \frac{3R}{4}$

$\because \quad \lambda = \frac{1}{\bar{\upsilon}}$

$\therefore \quad \lambda = \frac{4}{3R}$

Now,

$$E = \frac{hc}{\lambda}$$

$$E = \frac{hc \times 3R}{4}$$

or $E = \frac{3hcR}{4}$

For lowest energy of the spectral line in Lyman series $n_1 = 1$, $n_2 = 2$.

660. According to Bohr's theory, the angular momentum for an electron of 3rd orbit is

(a) $3\hbar$ (b) $1.5\hbar$

(c) $9\hbar$ (d) $2\frac{\hbar}{\pi}$

VITEEE 2014

Ans. (a) : According to Bohr's theory, the angular momentum of e^- in n^{th} orbit is equal to

$$mvr = \frac{nh}{2\pi}$$

For 3rd orbit,

$$mvr = \frac{3h}{2\pi}$$

$$\text{So, } mvr = 3.\hbar \Rightarrow \left(\because \hbar = \frac{h}{2\pi}\right)$$

661. What transition in the hydrogen spectrum would have the same wavelength as the Balmer transition, n = 4 to n = 2 of He⁺ spectrum?

(a) n = 4 to n = 2 (b) n = 3 to n = 2

(c) n = 2 to n = 1 (d) n = 4 to n = 3

VITEEE-2013

Ans. (c): According to the question

$$\lambda_H = \lambda_{He^+}$$

$$R_H Z_H^2\left[\frac{1}{n_1^2} - \frac{1}{n_2^2}\right] = R_H Z_{He^+}^2\left[\frac{1}{2^2} - \frac{1}{4^2}\right]$$

$$R_H \times 1\left[\frac{1}{n_1^2} - \frac{1}{n_2^2}\right] = R_H \times 4\left[\frac{1}{4} - \frac{1}{16}\right]$$

$$\left[\frac{1}{n_1^2} - \frac{1}{n_2^2}\right] = 4 \times \frac{4-1}{16} = 4 \times \frac{3}{16} = \frac{3}{4}$$

for first line $n_2 = 2$, $n_1 = 1$

$$\left[\frac{1}{1^2} - \frac{1}{2^2}\right] = \left[\frac{1}{1} - \frac{1}{4}\right] = \frac{3}{4}$$

Hence $n_1 = 1, \quad n_2 = 2$

So, transition $n_2 = 2$ to $n_1 = 1$ will give spectrum of the same wavelength as that of Balmer transition $n_2 = 4$ to $n_1 = 2$ in He^+.

662. What is the degeneracy of the level of H-atom that has energy $\left(-\frac{R_H}{9}\right)$?

(a) 16 (b) 9

(c) 4 (d) 1

VITEEE 2013

Ans. (b): Energy of electron form n^{th} terms is

$$E_n = -\frac{R_H Z^2}{n^2}$$

For H–atom,

$$\frac{-R_H}{9} = \frac{-R_H \times 1^2}{n^2}, \qquad n^2 = 9$$

663. The ground state energy of hydrogen atom is –13.6 eV. The energy of second excited state of He⁺ ion in eV is

(a) –54.4 (b) –3.4

(c) –6.04 (d) –27.2

[JEE Main 2019, 10 Jan Shift-II]

Ans. (c) : Given that,

energy of hydrogen atom = 13.6 eV.

Second excited state is 3rd orbit–

$$E = -13.6\,\frac{z^2}{n^2}\text{eV} = -13.6 \times \frac{4}{9}\text{eV}$$

$$= -6.04 \text{ eV.}$$

664. The energy of electron in the first Bohr orbit of H atom is - 13.6 eV. The possible energy value of the excited state (s) for electrons in Bohr orbits of hydrogen is

(a) -3.4 eV (b) -4.2 eV

(c) -6.8 eV (d) +6.8 eV

AMU-2011

Ans. (a): The energy of electron on Bohr orbits of hydrogen atoms is given by the expression

$$E_n = \frac{-13.6 \times Z^2}{n^2}\text{eV}$$

For first excited state, n = 2

$$\therefore \quad E_2 = \frac{-13.6 \times (1)^2}{2^2} = \frac{-13.6}{4} = -3.4\text{eV}$$

665. The energy of electron in n^{th} orbit of hydrogen atom is

(a) $\frac{13.6}{n}$eV (b) $\frac{13.6}{n^2}$eV

(c) $\frac{13.6}{n^3}$eV (d) $\frac{13.6}{n^4}$eV

AMU EXPLORER-2002

Karnataka-CET-2016

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Ans. (b) : The energy of electron in nth orbit of hydrogen atom is given below-

or $E_n = \frac{13.6}{n^2} eV$

666. The spectrum of H^+ is expected to be similar to that of

(a) Be^{2+} (b) Li^+

(c) Na (d) He^+

AMU EXPLORER-2002

Ans. (d) : Helium ion (He^+) and hydrogen has one electron in their outermost shell so both show the same spectrum having similar spectral lines of transitions.

667. For which of the following species, Bohr's theory is not applicable?

(a) 0^{7+} (b) Be^{3+}

(c) Li^{2+} (d) He^{2+}

Assam CEE-2014

Ans. (d) : Bohr's theory is applicable to the species containing only one electron. He^{2+} contain no electron.

668. The ratio of energy of the electron in ground state of hydrogen to the electron in first excited state of Be^{3+} is

(a) 1 : 4 (b) 1 : 8

(c) 1 : 16 (d) 16 : 1

Assam CEE-2014

Ans. (a) : $E_x = -13.6\left(\frac{z^2}{n^2}\right)eV$

$E_1(H)$ = -13.6 eV in ground state n = 1, for H atom z = 1

$E_2(Be^{3+}) = \left[\frac{-13.6\times(4)^2}{(2)^2}\right]$ in first excited state

n = 2 for Be^{3+}, z = 4

$\therefore\ E_1 : E_2 = 1:4$.

669. The Bohr's orbit radius for the hydrogen atom (n = 1) is approximately 0.53 Å. The radius for the first excited state (n = 2) orbit is :

(a) 0.27 Å (b) 1.27 Å

(c) 2.12 Å (d) 3.12 Å

BITSAT-2013

BCECE-2004

Ans. (c) : Radius of nth orbit hydrogen atom = 0.530Å

Number of excited state = (n) = 2

Atomic number of hydrogen atom (z) = 1

We know that the Bohr radius

$$r = \frac{n^2}{z}\times \text{Radius of atom} = \frac{(2)^2}{1}\times 0.530$$

$$= 4 \times 0.530$$

$$= 2.12 \text{ Å}$$

670. The energy of an electron in second Bohr orbit of hydrogen atom is–

(a) -5.44×10^{-19} eV (b) -5.44×10^{-19} cal

(c) -5.44×10^{-19} kJ (d) -5.44×10^{-19} J

AIIMS 26 May 2019 (Evening)

BITSAT 2017

BCECE-2010

Ans. (d) : For H atom, $E_X = \frac{-13.6z^2}{n^2}eV$

For second orbit, n = 2

z = 1 (for hydrogen)

$\therefore\ E_2 = \frac{-13.6\times(1)^2}{(2)^2} = -\frac{13.6}{4}eV$

$= \frac{-13.6\times1.6\times10^{-19}}{4}$ J

$= -5.44\times10^{-19}$ J

671. The wave number of the spectral line in the emission spectrum of hydrogen will be equal to 8/9 times the Rydberg's constant if the electron jumps from–

(a) n = 3 to n = 1 (b) n = 10 to n = 1

(c) n = 9 to n = 1 (d) n = 2 to n = 1

BCECE-2014

Ans. (a) : wave number, $\bar{\nu} = \frac{1}{\lambda} = R_H\left(\frac{1}{n_1^2}-\frac{1}{n_2^2}\right)$,

where R_H is Rydberg's constant $\frac{8}{9}R_H = R_H\left(\frac{1}{n_1^2}-\frac{1}{n_2^2}\right)$

When, transition is from n_2 = 3 to n_1 = 1 then,

$\bar{\nu} = \frac{1}{\lambda} = R_H\left(\frac{1}{1^2}-\frac{1}{3^2}\right) = \frac{8}{9}.R_H$

672. In hydrogen atom, if energy of an electron in ground state is 13.6 eV, then that in the 2nd excited state is –

(a) –1.51 eV (b) –34 eV

(c) –6.04 eV (d) +13.6 eV

BCECE-2018

Ans. (a) : 2nd excited state means third energy level

$E_3 = \frac{E_1}{3^2} = -\frac{13.6}{9} = -1.51eV$

673. The wave number of the limiting line in Lyman series of hydrogen is 109678 cm^{-1}. The wave number of the limiting line in Balmer series of He^+ would be :

(a) 54839 cm^{-1} (b) 109678 cm^{-1}

(c) 219356 cm^{-1} (d) 438712 cm^{-1}

BITSAT-2014

Ans. (b) : Given that,

R_H = 109678 cm^{-1}

Wave number of the limiting line in Balmer series of He^+

$\bar{\nu} = R_H.Z^2\left[\frac{1}{n_1^2}-\frac{1}{n_2^2}\right]$

$\bar{\nu} = 109678\times(2)^2\left[\frac{1}{(2)^2}-\frac{1}{\infty}\right]$

$\bar{\nu}$ = 109678 cm^{-1}

674. If the radius of H is 0.53 Å, then what will be the radius of $_3Li^{2+}$?

(a) 0.17 Å (b) 0.36 Å

(c) 0.53 Å (d) 0.59 Å

BITSAT-2012

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Ans. (a) : We know that,

$$(\text{H-like}) = \frac{r_n(\text{H - atom})\times n^2}{Z}$$

For ground state, n = 1

$$\therefore \quad r_n\left({}_3Li^{2+}\right) = \frac{0.53\times1}{3}$$
$$= 0.17\text{Å}$$

675. The first emission line in the atomic spectrum of hydrogen in the Balmer series appears at

(a) $\frac{9R}{400}cm^{-1}$ (b) $\frac{7R}{144}cm^{-1}$

(c) $\frac{3R}{4}cm^{-1}$ (d) $\frac{5R}{36}cm^{-1}$

BITSAT-2016

Ans. (d) : For Balmer $n_1 = 2$ and $n_2 = 3$;

$$v = R\left(\frac{1}{2^2}-\frac{1}{3^2}\right) = \frac{5R}{36}cm^{-1}$$

The first emission line in the atomic spectrum of hydrogen in the Balmer series appears at $\frac{5R}{36}cm^{-1}$.

676. The wavelength of an electron having kinetic energy equal to 4.55×10^{-25}J is (h=6.6 $\times10^{-34}kgm^2s^{-1}$mass of electron =$9.1\times10^{-31}$kg)

(a) 7.25×10^{-7}nm (b) 725m

(c) 7.25×10^{-7}m (d) 7.25×10^{7}m

CG PET-2011

Ans. (c) : Applying de Broglie wavelength

$$(\lambda) = \frac{h}{\sqrt{2me}}$$

Where, m = mass of electron = 9.1×10^{-31} kg, h = 6.6×10^{-34} kg m^2 s^{-1}

E = K.E. =4.55×10^{-25} J

$$\lambda = \frac{6.6\times10^{-34}}{\sqrt{2\times9.1\times10^{-31}\times4.55\times10^{-25}}}$$

$$= \frac{6.6\times10^{-34}}{9.1\times10^{-28}} = 7.25\times10^{-7}\text{ m.}$$

677. For which of the following species, Bohr theory does not apply?

(a) H (b) He^+

(c) H^+ (d) Li^{2+}

CG PET -2005, AIIMS-2000

Ans. (c) : One of the limitations of Bohr's atomic model is that it does not explain the spectra of multi-electron atoms all these species like H, He^+ and Li^{2+} are iso electronic and have only one electron. Their electronic configurations are same and so their spectra is explained by Bohr's atomic model But H^- has 2 electron.

678. Bohr's radius of 2nd orbit of Be^{3+} is equal to that of

(a) 4th orbit of hydrogen

(b) 2nd orbit of He^+

(c) 3rd orbit of Li^{2+}

(d) first orbit of hydrogen

CG PET -2009

Ans. (d) : Bohr radius for nth orbit = $0.53A\times\frac{n^2}{z}$

Where, z = atomic number

$\therefore$ Bohr radius of 2nd orbit of Be^{3+} =

$$\frac{0.53\times(2)^2}{4} = 0.53\overset{0}{A}$$

(d) Bohr radius of 1st orbit of H = $\frac{0.53\times(1)^2}{1} = 0.53\overset{0}{A}$

Hence, Bohr's radius of 2nd orbit of Be^{3+} is equal to that of first orbit of hydrogen.

679. The IE of hydrogen atom is 13.6 eV. The energy required to remove a electron in the n=2 state of the hydrogen atom is

(a) 27.2eV (b) 13.26eV

(c) 6.8eV (d) 3.4eV

J & K CET-2015

CG PET-2010

Ans. (d) : The ionization energy of hydrogen atom is 13.6 eV energy required to move to second state is,

The change in energy involve in removing the electron from n = 2

$$\Delta E = E_\infty - E(2)$$

$$\Delta E = 0 - \left(\frac{-13.6}{2^2}\right)$$

$$\Delta E = \frac{+13.6}{4}$$

$$\Delta E = 3.4\text{ eV}$$

680. Which one of the following about an electron occupying the 1s-orbital in a hydrogen atoms is incorrect? (The Bohr radius is represented by a_0)

(a) The electron can be found at a distance $2a_0$ from the nucleus.

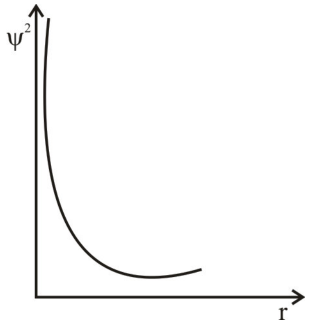
(b) The magnitude of the potential energy is double that of its kinetic energy on an average.

(c) The probability density of finding the electron is maximum at the nucleus.

(d) The total energy of the electron is maximum when it is at a distance a_0 from the nucleus.

[JEE Main 2019, 9 April Shift-II]

Ans. (d) : Explanation of point a :



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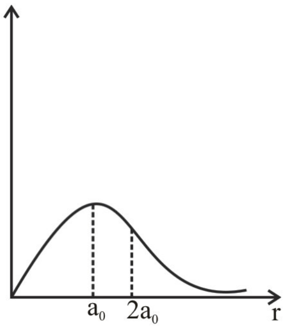

The radial propability graph shows that electron in is can be formed at $2a_0$

Explanation of point b, c, d

$E_n = -13.6$

$$E_n = -13.6 \times \frac{z^2}{n^2} e^v \text{ ....(i)}$$

$$K.E. = 13.6 \times \frac{z^2}{n^2} e^v \text{ ....(ii)}$$

$$P.E. = -27.2 \times \frac{z^2}{n^2} e^v \text{ ....(iii)}$$

From (ii) and (iii) equalion, |PEl = l K. E.| and P. E. = $2E_n$

From eq. (i), if n increases; en becomes less negative and vice versa.

So, if n = 1

i.e. when e^- is at distance a_0 from nucleolus En has maximum value.

681. The radius of the second Bohr orbit for hydrogen atom is (Planck's constant (h) = 6.6262×10^{-34} Js; mass of electron = 9.1091×10^{-31} kg; charge of electron (e) = 1.60210×10^{-19} C; permittivity of vacuum ($\in_0$) = 8.854185×10^{-12} $kg^{-1}m^{-3}A_2$)

(a) 1.65Å (b) 4.76Å

(c) 0.529Å (d) 2.12Å

[JEE Main 2017]

Ans. (d) : Radius of n^{th} orbit is–

$$r_n = \frac{0.529n^2}{Z} Å$$

n = 2, Z = 1

$r_2 = 0.53 \times 4$ Å = 2.12 Å

682. Which of the following is the energy of a possible excited state of hydrogen?

(a) +13.6 eV (b) –6.8 eV

(c) –3.4 eV (d) +6.8 eV

[JEE Main-2015]

Ans. (c) : E_1 for H - atom = 13.6 eV

$$E_2 \text{ for H - atom } = -\frac{13.6 \text{ eV}}{2^2} = -3.4 \text{ eV}$$

$$E_3 \text{ for H - atom } = -\frac{13.6}{3^2} \text{eV} = -1.5 \text{ eV}$$

Hence, energy of possible excited state of hydrogen is –3.4 eV.

683. The radius of the second Bohr orbit in terms of the Bohr radius, a_0, in Li^{2+} is

(a) $\frac{2a_0}{3}$ (b) $\frac{4a_0}{3}$

(c) $\frac{4a_0}{9}$ (d) $\frac{2a_0}{9}$

[JEE Main 2020, 8 Jan Shift-II]

Ans. (b) : For 2^{nd} Bohr orbit of Li^{2+},

z = 3, n = 2

$$r = \frac{a_0.n^2}{z}$$

$$= \frac{a_0.(2)^2}{3}$$

$$= \frac{4a_0}{3}$$

684. According to Bohr's atomic theory,

I. kinetic energy of electron is $\propto \frac{Z^2}{n^2}$

II. the product of velocity (v) of electron and principal quantum number (n), 'vn' $\propto Z^2$.

III. frequency of revolution of electron in an orbit is $\propto \frac{Z^3}{n^3}$

IV. coulombic force of attraction on the electron is $\propto \frac{Z^3}{n^4}$

Choose the most appropriate answer from the options given below.

(a) Only III (b) Only I

(c) I, III and IV (d) I and IV

[JEE Main 2021, 24 Feb Shift-II]

Ans. (d) : According to Bohr's theory :

(A) $K.E. = 13.6 \frac{z^2}{n^2} \frac{eV}{atom} \Rightarrow K.E. \propto \frac{z^2}{n^2}$

(B) speed of $e^- \propto \frac{z}{n}$

$\therefore v \times n \propto z$

(C) Frequency of revolution of $e^- = \frac{v}{2\pi r}$

$\therefore$ Frequency $\propto \frac{z^2}{n^3}$

(D) $F \propto \frac{z}{\left(\frac{n^2}{z}\right)^2}$

$F \propto \frac{z^3}{n^4}$

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685. The kinetic energy of an electron in the second Bohr orbit of a hydrogen atom is equal to $\frac{h^2}{xma_0^2}$. The value of 10× x is ....(a_0 is radius of Bohr's orbit)
(Nearest integer) (Given, $\pi = 3.14$)
[JEE Main 2021, 27 Aug Shift-I]

We know that,

$$K.E. = \frac{1}{2}mv^2 \qquad .....(i)$$

$$mvr = \frac{nh}{2\pi} \rightarrow (\text{Bohr's model})$$

$$(mv)^2 = \frac{n^2h^2}{4\pi^2r^2}$$

$$mv^2 = \frac{1}{m} \times \frac{n^2h^2}{4\pi^2r^2} \qquad .....(ii)$$

Put (ii) in (i)–

$$K.E. = \frac{1}{2} \times \frac{1}{m} \times \frac{n^2h^2}{4\pi^2r^2}$$

Now, $n_0 = 2$, $r_1 = a_0$, $r_2 = a_0 \times (2)^2 = 4a_0$

$$K.E. = \frac{1}{2} \times \frac{2^2h^2}{4\pi^2(4a_0)^2m}$$

$$\Rightarrow \qquad \frac{h^2}{32\pi^2a_0^2m}$$

from question–

$$\frac{h^2}{xma_0^2} = \frac{h^2}{32\pi^2ma_0^2}$$

$$\frac{1}{x} = \frac{1}{32\pi^2}$$

$$x = 32\pi^2$$

$$x = 315.5$$

$$10x = 315.5 \times 10$$

$$= 3155$$

686. Given below are two statements.
Statement-I According to Bohr's model of an atom, qualitatively the magnitude of velocity of electron increases with decrease in positive charges on the nucleus as there is no strong hold on the electron by the nucleus.
Statement-II According to Bohr's model of an atoms, qualitatively the magnitude of velocity of electron increases with decrease in principal quantum number. In the light of the above statements, choose the most appropriate answer from the options given below.
(a) Both statement I and statement II are false.
(b) Both statement I and statement II are true.
(c) Statement I is false but statement II are true.
(d) Statement I is true but statement II is false.
[JEE Main 2021, 26 Aug Shift-I]

Ans. (c) : According to Bohr's model of an atom,

$$V \propto \frac{Z}{n}$$

Z = atomic number of atom, corresponds to the +ve charge so as Z increases velocity increases so statement I is worng.
and as 'n' decreases velocity increases so, statement-II is correct.

687. Given below are two statements.
Statement-I Bohr's theory accounts for the stability and line spectrum of Li^+ ion.
Statement-II Bohr's theory was unable to explain the splitting of spectral lines in the presence of a magnetic field. In the light of the above statements, choose the most appropriate answer from the options given below:
(a) Both statement I and II are true.
(b) Statement I is false but statement II is true.
(c) Both statements I and II are false.
(d) Statement is true but statement II is false.
[JEE Main 2021, 18 March Shift-II]

Ans. (b) : Statement -1 is false since, Bohr's theory accounts for the stability and spectrum of single electronic species (e.g. H_e^+, Li^{2+} etc)
statement – II is true since, Bohr's theory was unable to explain the splitting of spectral lines in the presence of a magnetic field.

688. Bohr model of hydrogen atom was unable to explain
(a) Rydberg's formula of atomic spectra
(b) Heisenberg's uncertainty principle
(c) Planck's law of energy quantization
(d) Rutherford' model of atomic structure
J & K CET-(2012)

Ans. (b) : Bohr model of hydrogen atom could not explain :
(i) de Broglie concept of dual nature of matter and Heisenberg's uncertainty principle.
(ii) the splitting of lines in magnetic and electric field.

689. Energy of one mole of photons of radiation whose frequency is 5×10^{14} Hz is
(a) 199.51 kJ mol^{-1} (b) 189.51 kJ mol^{-1}
(c) 198.51 kJ mol^{-1} (d) 188.51 kJ mol^{-1}
J & K CET-(2014)

Ans. (a) : Given, Frequency $\nu = 5\times10^{14}$ $\because$ Energy of 1 photon, $E = h\upsilon$

$$\therefore \text{ Energy of 1 mole of photon, } E' = N_Ah\upsilon$$

$$= 6.022\times10^{23}\times6.626\times10^{-34}\times5\times10^{14}$$

$$= 199.508\times10^3 J\ mol^{-J} = 199.51\ kJmol^{-1}$$

690. Let the energy of an n^{th} orbit of H atom be $-21.76 \times 10^{-19} / n^2$J. What will be the longest wavelength of energy required to remove an electron from the third orbit?
(a) 0.628 nm (b) 1.326×10^{-7} m
(c) 0.798 pm (d) 0.821 μm
J & K CET-(2017)

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Ans. (d) : Given, energy of an nth orbit of H atom

$$E = \frac{-21.76\times10^{-19}}{n^2} J$$

We know that,

$$E = \frac{hc}{\lambda} \Rightarrow \lambda = \frac{hc}{E}$$

Where, c = speed of light = 3×10^8m/s

h = Plank's constant = 6.6×10^{-34}

$$\lambda = \frac{6.6\times10^{-34}\times10^8\times n^2}{-21.76\times10^{-19}}$$

For n = 3

$$\lambda = \frac{6.6\times10^{-34}\times3\times10^8\times(3)^2}{-21.76\times10^{-19}}$$

$\lambda = 8.2\times10^{-7} = 0.82\times10^{-6}$ m = 0.82μm

691. With respect to atomic spectrum, each line is the Lyman series is due to electrons returning

(a) from a particular higher energy level to n=3
(b) from a particular higher energy level to n=2
(c) from a particular higher energy level to n=1
(d) from a particular higher energy level to n=4

J & K CET-(2018)

Ans. (c): Lyman series : n = 2, 3, 4, 5 to n = 1

692. What is the maximum no of emission lines obtained when the excited electrons of a hydrogen atom in n=5 drop to ground state?

(a) 10 (b) 5
(c) 12 (d) 15

J & K CET-(2010)

Ans. (a) : Number of emission lines in the spectrum be equal to (n_2–n_1) (n_2–n_1+1) where n_2=5 and n_1=1

$$\therefore \frac{(5-1)(5-1+1)}{2} = \frac{20}{2} = 10 \text{ lines}$$

693. The value of Rydberg constant is

(a) 109678 cm^{-1} (b) 109876 cm^{-1}
(c) 108769 cm^{-1} (d) 108976 cm^{-1}

J & K CET-(2007)

Ans. (a) : Rydberg constant is a physical constant relating to atomic spectra. Denoted by R_∞ for heavy atoms and R_H for hydrogen. value of Rydberg constant is 109678 cm^{-1}.

694. The wavelength of a spectral line in Lyman series, when electron jumping back to 2nd orbit, is

(a) 1162 (b) 1216
(c) 1362 (d) 1176

J & K CET-(2007)

Ans. (b) : $\frac{1}{\lambda} = R_H\left[\frac{1}{n_1^2} - \frac{1}{n_2^2}\right]$

For Lyman Series n_1=1, n_2=2

$$\bar{v} = 109\,677 \text{ cm}^{-1}\left(\frac{1}{1^2} - \frac{1}{2^2}\right) = 109677\times\frac{3}{4}\text{ cm}^{-1}$$

$$= 82258 \text{ cm}^{-1}$$

$$\lambda = \frac{1}{\bar{v}} = \frac{1}{82258}\text{cm}^{-1} = 1.216\times10^{-5}\text{cm}$$

$$= 1216\times10^{-8} = 1216\,\text{Å}$$

695. What is the energy (in eV) required to excite the electron from n = 1 to n = 2 state in hydrogen atom? (n = principal quantum number).

(a) 13.6 (b) 3.4
(c) 17.0 (d) 10.2

VITEEE-2012

Ans. (d) : Energy required to excite the electron from n = 1 to n = 2

$$\Delta E = 13.6z^2\left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right) = 13.6\times(1)^2\left(\frac{1}{1^2} - \frac{1}{2^2}\right)$$

$$13.6\left(1 - \frac{1}{4}\right) = 13.6\times\frac{3}{4}$$

= 10.2 eV

696. The first emission line in the electronic spectrum of hydrogen in the Balmer series appears at cm^{-1}

(a) 9R/400 cm^{-1} (b) 7R/144 cm^{-1}
(c) 3R/4 cm^{-1} (d) 5R/36 cm^{-1}

J & K CET-(2003)

Ans. (d) :

For Balmer series n_1= 2 and n_2 = 3

For the first line

$$\bar{v} = R\left(\frac{1}{2^2} - \frac{1}{3^2}\right) = R\left(\frac{1}{4} - \frac{1}{9}\right) = \frac{5R}{36}\text{cm}^{-1}$$

697. Which of the following atomic models involve the concept of stationary orbitals?

(a) Bohr's model (b) Thomson model
(c) Rutherford model (d) wave model

J & K CET-(2002)

Ans. (a) : According to Bohr's concept electrons revolve only is those orbits which have a fixed value of energy these orbital are called stationary orbitals.

698. Which of the following value of n_1 in the relationship is $\frac{1}{\lambda} = R_H\left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right)$ is correct when $n_2 > n_1$ corresponds to Paschen lines in the Hydrogen spectrum?

(a) 1 (b) 2
(c) 3 (d) 4

J & K CET-(2001)

Ans. (c): The paschen line all lie in the infrared band. This series overlaps with the next (Brackett) series, i.e. the shortest line in the bracket series has a wavelength that falls among the paschen series. For paschen lines in the hydrogen spectrum the value of n is 3.

699. Transition from n=4, 5, 6 to n = 3 in hydrogen spectrum gives

(a) Lyman series (b) Balmer series
(c) Paschen series (d) Pfund series

J & K CET-(2000)

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Ans. (c) : For Paschen series,

$n_1 = 3,\ n_2 > n_1$, i.e. $n_2 = 4, 5, 6, \ldots\ldots\ldots\infty$

700. According to Bohr's theory of hydrogen atom, which of the following is quantized for an electron?

(a) acceleration (b) velocity
(c) angular momentum (d) angular acceleration

J & K CET-(1997)

Ans. (c) : According to Bohr's theory, electron can move in that circular path around the nucleous, in which the angular momentum of an electron is either $\frac{h}{2\pi}$ or $\frac{nh}{2\pi}$, n=1 ,2 ,3 ……...
So, angular momentum is quantized for the electron.

701. The ionization energy of hydrogen atom in its ground state is -13.12×10^5 J mol^{-1}. The energy of the electron corresponding to the first excited state will be

(a) -42.48×10^5 J mol^{-1}
(b) -26.24×10^5 J mol^{-1}
(c) -6.56×10^5 J mol^{-1}
(d) -3.28×10^5 J mol^{-1}

J & K CET-(1997)

Ans. (d) : First excited state means, n= 2

$$E_2 = \frac{-13.12\times10^5}{2^2}\ \text{J mol}^{-1}$$
$$= -3.28\times10^5\ \text{J mol}^{-1}$$

702. The expression of angular momentum of an electron in a Bohr's orbit is:

(a) $\frac{nh}{3\pi}$ (b) $\frac{nh}{2\pi}$
(c) $\frac{h}{4\pi}$ (d) $\sqrt{l(l+1)}.\frac{h}{2\pi}$

JCECE - 2003

Ans. (b): The expression of angular momentum of an electron in a Bohr's orbit is $\frac{nh}{2\pi}$.

703. Ratio of kinetic energy of hydrogen and helium gas at 300 K is :

(a) 2 : 1 (b) 4 : 5
(c) 1 : 1 (d) 1 : 2

JCECE - 2006

Ans. (c) : We know that,

$$\text{K.E.} = \frac{3}{2}nRT$$

Therefore,

$$\text{K.E.} \propto n$$

or $$\text{K.E.} \propto \frac{w}{M}$$

$$\frac{\text{K.E.}_{H_2}}{\text{K.E.}_{He}} = \frac{M_{He}}{M_{H_2}}$$
$$= \frac{2}{2} = \frac{1}{1}$$

$\text{K.E.}_{H2} : \text{K.E.}_{He} = 1:1$

704. The wavelength of the radiation emitted, when in a hydrogen atom electron falls from infinity to stationary state one, would be (Rydberg constant = 1.097×10^7 m^{-1})

(a) 91 nm (b) 192 nm
(c) 406 nm (d) 9.1×10^{-8} nm

JCECE - 2008

Ans. (a) : $\frac{1}{\lambda} = R_H z^2\left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right)$

$$\frac{1}{\lambda} = 1.097\times10^7\times(1)^2\text{m}^{-1}\left(\frac{1}{1^2} - \frac{1}{\infty}\right)$$

Therefore, $\lambda = 91\times10^{-9}$ m

$\lambda = 91$ nm

705. The energy of second Bohr orbit of the hydrogen atom is –328 kJ mol^{-1}; hence the energy of fourth Bohr orbit would be

(a) – 41 kJ mol^{-1} (b) – 1312 kJ mol^{-1}
(c) – 164 kJ mol^{-1} (d) – 82 kJ mol^{-1}

JCECE - 2008, 2012

Ans. (d) : The energy of second Bohr orbit of hydrogen atom (E_2) is –328 kJ mol^{-1} therefore

$$-328 = \frac{E}{2^2} \Rightarrow E_n = -328\times4 = -1312\text{kJ mol}^{-1}$$

$\therefore$ $E_n = \frac{-1312}{n^2}$kJ mol^{-1}

If n = 4,

$\therefore$ $E_4 = -\frac{1312}{4^2}\text{kJ mol}^{-1} = -82\,\text{kJ mol}^{-1}$

706. When an electron in hydrogen spectrum jumps from n = 7 to n = 2, the total number of spectral lines possible are

(a) 21 (b) 15
(c) 5 (d) 9

JCECE - 2016

Ans. (b) : Total number of spectral lines for the transition from n (Higher) → n(lower) will be = $\frac{\Delta n.(\Delta n+1)}{2}$

Where,

Δn = Difference of $n_H - n_L = 7 - 2 = 5$

$\therefore$ Total number of lines $= \frac{5\times6}{2} = 15$

707. An electron is moving in Bohr's fourth orbit. Its de-Broglie wave length is λ. What is the circumference of the fourth orbits?

(a) $\frac{2}{\lambda}$ (b) 2λ
(c) 4λ (d) $\frac{4}{\lambda}$

JIPMER-2014

Ans. (c) : According to Bohr's concept an electron always move in the orbit with angular momentum (mvr) equal to nh/2π

$$mvr = \frac{nh}{2\pi}$$

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$$r = \frac{n}{2\pi}\left(\frac{h}{mv}\right)$$

$$r = \frac{n\lambda}{2\pi}$$

(From de–Broglie equation, $\lambda = \frac{h}{mv}$)

For fourth orbit (n=4)

$$r = \frac{2\lambda}{\pi}$$

$\therefore$ circumference= $2\pi r = 2\pi \times \frac{2\lambda}{\pi} = 4\lambda$

708. The ratio of the difference in energy between the first and the second Bohr orbit to that between the second and the third Bohr orbit is

(a) 1/2 (b) 1/3

(c) 4/9 (d) 27/5

JIPMER-2012

Ans. (d) : $\Delta E = E_2 - E_1 = \frac{1312}{1^2} - \frac{1312}{2^2} = 1312\left(\frac{3}{4}\right)$

$$= E_3 - E_2 = \frac{1312}{2^2} - \frac{1312}{3^2} = 1312\left(\frac{5}{36}\right)$$

$\therefore E_2 - E_1 : E_3 - E_2 = \frac{3}{4} : \frac{5}{36} = 27:5$

709. Ratio of radii of second and first Bohr orbits of H atom is

(a) 2 (b) 4

(c) 3 (d) 5

JIPMER-2005

Ans. (b) : According to Bohr's rule, $r \propto n^2$

Where r is radii and n is the number of orbit

So, $\frac{r_1}{r_2} = \frac{(2)^2}{(1)^2} = 4$

Hence, ratio of radii is 4.

710. What will be the number of waves formed by a Bohr electron in one complete revolution in its second orbit?

(a) Three (b) Two

(c) One (d) Zero

JIPMER-2016

Ans. (b) : $\text{Number of waves} = \frac{\text{circumference of orbit}}{\text{de – Broglie wavelength of electron}}$

$$\lambda = \frac{h}{mv}$$

$$\mu = \frac{2\pi r}{\frac{h}{mv}} = \frac{2\pi}{h} \times mvr$$

$$mvr = \frac{nh}{2\pi}, \mu = \frac{2\pi}{h} \times \frac{nh}{2\pi}$$

μ= n

For second orbit, n =2

$\therefore$ number of waves,μ = 2

711. If the energies of the two photons in the ratio of 3 : 2, their wavelength will be in the ratio of

(a) 2 : 3 (b) 9 : 4

(c) 3 : 2 (d) 1 : 2

Karnataka-CET-2011

Ans. (a) : $E = \frac{hc}{\lambda}$

$$E \propto \frac{1}{\lambda}$$

$$\frac{E_1}{E_2} = \frac{\lambda_2}{\lambda_1}$$

$$\frac{3}{2} = \frac{\lambda_2}{\lambda_1}$$

$\therefore \lambda_1 : \lambda_2 = 2 : 3$

712. The radius of the first Bohr orbit of hydrogen atom is 0.529Å. The radius of the third orbit of H^+ will be

(a) 8.46Å (b) 0.705Å

(c) 1.59Å (d) 4.29Å

(e) 2.98Å

Kerala-CEE-2007

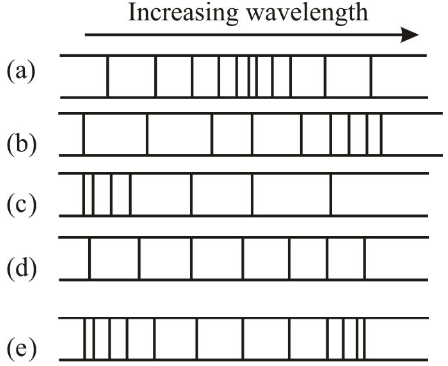
Ans. (d) : According to Bohr model,

Radius of hydrogen atom $(r_n) = \frac{0.529 \times n^2}{z}$ Å

$$r_3 = \frac{0.529 \times (3)^2}{1}$$

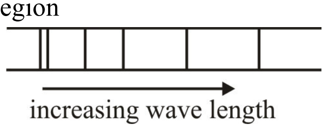
=4.79Å

713. Which diagram best represents the appearance of the line spectrum of atomic hydrogen in the visible region?



Kerala-CEE-2007

Ans. (c) : Line spectrum of atomic hydrogen in the visible region



714. Which transition in the hydrogen atomic spectrum will have the same wavelength as the transition, n = 4 to n = 2 of He^+ spectrum?

(a) n = 4 to n = 3 (b) n = 3 to n = 2

(c) n = 4 to n = 2 (d) n = 3 to n = 1

(e) n = 2 to n = 1

Kerala-CEE-2011

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Ans. (e) : $\frac{1}{\lambda}=z^2R_H\left[\frac{1}{n_1^2}-\frac{1}{n_2^2}\right]$

For He^2, $\frac{1}{\lambda}=z^2R_H\left[\frac{1}{2^2}-\frac{1}{4^2}\right]=4\times\frac{3}{16}=\frac{3}{4}$

For H, $\frac{1}{\lambda}=1^2R_H\left[\frac{1}{1^2}-\frac{1}{2^2}\right]=\frac{3}{4}$

Hence, for hydrogen n=2, n=1

715. The ratio of frequency corresponding to the third line in Lyman series of hydrogen atomic spectrum to that of the first line in Balmer series of Li^{2+} spectrum is

(a) $\frac{4}{5}$ (b) $\frac{5}{4}$

(c) $\frac{4}{3}$ (d) $\frac{3}{4}$

(e) $\frac{3}{8}$

Kerala-CEE-2012

Ans. (d) : Lyman series $n_1=1$

For third line of Lyman series, $n_2 = 4$

For hydrogen, z = 1

$$v_H=\frac{c}{\lambda}=c.R_HZ^2\left(\frac{1}{n_1^2}-\frac{1}{n_2^2}\right)$$

$$=cR_H(1)^2\left(\frac{1}{1}-\frac{1}{(4)^2}\right)=\frac{15}{16}R_H\cdot c$$

For lithium, Z = 3

For first line of Balmer series, $n_1 = 2$, $n_2=3$

$$v_{Li^{2+}}=c.R_H(3)^2\left(\frac{1}{(2)^2}-\frac{1}{(3)^2}\right)=c.R_H\times9\times\frac{5}{36}$$

$$=\frac{5}{4}c.R_H$$

$$\frac{v_H}{v_{Li^{2+}}}=\frac{\left(\frac{15}{16}\right)cR_H}{\left(\frac{5}{4}\right)cR_H}=\frac{15}{16}\times\frac{4}{5}=\frac{3}{4}$$

716. The shortest wavelength of the line in hydrogen atomic spectrum of Lyman series when R_H = 109678 cm^{-1} is

(a) 1002.7Å (b) 1215.67 Å

(c) 1127.30 Å (d) 911.7 Å

(e) 1234.7 Å

Kerala-CEE-2014

Ans. (d) : For Lyman series, $n_1=1$ and for shortest wavelength, $n_2=\infty$

$$\therefore \bar{v}=\frac{1}{\lambda}=R_H\left(\frac{1}{1^2}-\frac{1}{\infty^2}\right)=109678\ cm^{-1}$$

$$\lambda=\frac{1}{109678}cm=911.7\times10^{-8}cm=911.7Å$$

717. In the hydrogen atom spectrum, the emission of the least energetic photon taken place during the transition from n= 6 energy level to n = ...energy level.

(a) 1 (b) 3

(c) 5 (d) 4

(e) 2

Kerala-CEE-2016

Ans. (c) : As we move towards outer shell the energy increases but the difference between the successive shalls decreases

$E_2–E_1>E_3–E_2>E_4–E_3$---------

Hence, the emission of least energetic photon takes place during the transition from n=6 energy level to n=5 energy level.

718. The energy of an electron is the 3S orbital (excited state) of H – atom is

(a) – 1.5eV (b) – 13.6eV

(c) – 3.4eV (d) 4.53eV

(e) 4.53eV

Kerala-CEE-2017

Ans. (a) : $E_n=\frac{-13.6}{n^2}eV$

$$E_1=-\frac{13.6\times1}{n^2}eV$$

$$E_n=-\frac{13.6}{(3)^2}eV=-\frac{13.6}{9}=-1.5eV$$

= – 1.51ev (n=3, for 3s–orbital)

719. The shortest wavelength of Paschen series in hydrogen spectrum is 8182 Å. The first member of the Paschen series is nearly.

(a) 15400 Å (b) 12200 Å

(c) 13400 Å (d) 18700 Å

(e) 16700 Å

Kerala-CEE-2020

Ans. (d) : For the calculation of wavelength of spectral lines Rydberg gave a formula,

$$\frac{1}{\lambda}=R_HZ^2\left[\frac{1}{n_1^2}-\frac{1}{n_2^2}\right]$$

Where, λ = Wavelength

R_H = Rydberg's constant

Z = Atomic number of atom

n_1 and n_2 = integers

$R_H = 1.0973 \times 10^7\ m^{-1}$

$$\frac{1}{\lambda}=1.0973\times10^7\left(\frac{1}{(3)^2}-\frac{1}{(4)^2}\right)$$

$$\frac{1}{\lambda}=1.0973\times10^7\times\frac{7}{16\times9}$$

$$\frac{1}{\lambda}=\frac{16\times9}{7\times1.0973\times107}$$

$$\lambda=\frac{144}{7.6811}\times10^{-7}$$

$\lambda = 18.747 \times 10^{-7}$

$\lambda = 18747 \times10^{-10}$ (∵ $1m = 10^{-10}$ Å)

$\lambda \approx$ 18,800 Å

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720. In the atomic spectrum of hydrogen, the spectral lines pertaining to electronic transition of n = 4 to n = 2 refers to :

(a) Lyman series (b) Balmer series
(c) Paschen series (d) Brackett series

Manipal-2018

Ans. (b) : In Balmer series, electrons transfer from higher orbits to 2nd orbit.

721. Which of the following statement do not form a part of Bohr's model of hydrogen atom?

(a) Energy of the electrons in the orbits are quantized.
(b) The electron in the orbit nearest the nucleus has the lower energy.
(c) Electrons revolve in different orbits around the nucleus
(d) The position and velocity of the electrons in the orbit cannot be determined simultaneously

NEET-1989

Ans. (d) : According is the Heisenberg uncertainty principle, the position and velocity of the electrons in the orbit cannot be determined simultaneously. This statement is not correct according to Bohr's model because according to Bohr's model it was possible to determine both position and velocity simultaneously.

722. If r is the radius of the first orbit, the radius of nth orbit of H-atom is given by

(a) rn^2 (b) rn
(c) r/n (d) r^2n^2

NEET-1988

Ans. (a) : Radius of nth orbit= r_1n^2 (for H–atom).

723. The energy of an electron in the nth Bohr orbit of hydrogen atom is

(a) $-\frac{13.6}{n^4}eV$ (b) $-\frac{13.6}{n^3}eV$
(c) $-\frac{13.6}{n^2}eV$ (d) $-\frac{13.6}{n}eV$

NEET-1992

Ans.(c): Energy of an electron in n^{th} Bohr orbit of hydrogen atom $(E) = -\frac{13.6}{n^2}eV \quad (Z = 1)$

724. Who modified Bohr's theory by introductin elliptical orbits for electrons path?

(a) Rutherford (b) Thomson
(c) Hund (d) Sommerfeld

NEET-1999

Ans. (d) : Sommerfeld modified Bohr's theory. According to him electrons move in elliptical orbits in addition to circular orbits.

725. The Bohr orbit radius for the hydrogen atom (n =1) is approximately 0.530Å. The radius for the first excited state (n=2) orbit is (in Å)

(a) 4.77 (b) 1.06
(c) 0.13 (d) 2.12

NEET-1998

Ans. (d) : Radius of hydrogen atom = 0.53Å
Number of excited state (n) = 2
Atomic number of hydrogen atom (Z)=1
We know that the Bohr radius.

$$r = \frac{n^2}{Z} \times r_n = \frac{(2)^2}{1} \times 0.530$$
$$= 4 \times 0.530$$
$$= 2.12Å$$

726. In a Bohr's model of an atom, when an electron jumps from n = 1 to n = 3, how much energy will be emitted or absorbed?

(a) 2.389×10^{-12} ergs (b) 0.239×10^{-10} ergs
(c) 2.15×10^{-11} ergs (d) 0.1936×10^{-12} ergs

NEET-1996

Ans. (d) : According to Bohr's model of atom

$$\Delta E = 2.18 \times 10^{-18}\left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right)J$$
$$= 2.18 \times 10^{-18}\left(\frac{1}{2} - \frac{1}{9}\right)J$$
$$= 1.9 \times 10^{-18} J$$
$$= 1.9 \times 10^{-18} \times 10^7 \text{ erg}$$
$$= 0.19 \times 10^{-10} \text{ erg}$$

727. According to the Bohr theory, which of the following transitions in the hydrogen stom will give the ratio the least energic photon?

(a) n = 6 to n = 1 (b) n = 5 to n = 4
(c) n = 6 to n = 5 (d) n = 5 to n = 3

NEET-Mains 2011

Ans. (c) : We know that

$$\Delta E \propto \left[\frac{1}{n_1^2} - \frac{1}{n_2^2}\right], \text{ where } n_2 > n_1$$

∴ n=6 to n=5 will give least energetic photon

728. The energy of second Bohr orbit of the hydrogen atom is –328 kJ mol^{-1}. hence the energy of fourth Bohr orbit would be

(a) –41 kj mol^{-1} (b) –82 kj mol^{-1}
(c) –164 kj mol^{-1} (d) –1312 kj mol^{-1}

NEET-2005

Ans. (b) : Energy of electron in n^{th} orbit of hydrogen

$$E_n = -\frac{E}{n^2}$$

Where E is a constant

$$E_2 = \frac{E}{2^2} = -328 \text{kJ mol}^{-1}$$

E= 4×328 kJ mol^{-1}

$$E_4 = \frac{-E}{4^2} = \frac{-4 \times 328}{16} \text{kJ mol}^{-1}$$
$$= -82 \text{ kJ mol}^{-1}$$

729. The radius of which of the following orbit is same as that of the first Bohr's orbit of hydrogen atom

(a) He^+ (n = 2) (b) Li^{2+} (n = 2)
(c) Li^{2+} (n = 3) (d) Be^{4+} (n = 2)

UP CPMT-2013

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Ans. (d) : For H-like particles, the radii of the first stationary states are given by the expression

$$r_n = \frac{a_0 n^2}{Z}$$

For H-atom, n = 1 and Z = 1

∴ $r_n = a_0$ = Bohr radius = 52.9 pm.

(a) For He^+ ion, n = 2 and Z = 2

$$\therefore \quad r_n = \frac{a_0(2)^2}{2} = 2a_0$$

(b) For Li^{2+} ion, n = 2 and Z = 3

$$\therefore \quad r_n = \frac{a_0(2)^2}{3} = \frac{4a_0}{3}$$

(c) For Li^{2+} ion, n = 3 and Z = 3

$$\therefore \quad r_n = \frac{a_0(3)^2}{3} = 3a_0$$

(d) For Be^{4+} ion, n = 2 and Z = 4

$$\therefore r_n = \frac{a_0(2)^2}{4} = a_0 \;\; = \text{Bohr radius} = 52.9 \text{ pm}$$

730. Number of spectral lines of Lyman series of electron when it jumps from 6 to first level (in Lyman series), is

(a) 9
(b) 12
(c) 15
(d) 18

UP CPMT-2009

Ans. (c): Number of spectral lines $= \frac{n(n-1)}{2}$

$$= \frac{6(6-1)}{2}$$

$$= 15$$

731. What is the wave number of 4th line in Balmer series of hydrogen spectrum? (R = 1,09,677 cm^{-1})

(a) 24,630 cm^{-1}
(b) 24,360 cm^{-1}
(c) 24,730 cm^{-1}
(d) 24,372 cm^{-1}

UP CPMT-2008

Ans. (d): $\bar{v} = R\left(\frac{1}{n^2_1} - \frac{1}{n^2_2}\right)$

For Balmer series n_1 = 2 and for 4th line in Balmer series $n_2 = 6$

R = 109677 cm^{-1}

$$\bar{v} = 109677\left(\frac{1}{2^2} - \frac{1}{6^2}\right)$$

$$= 109677\left(\frac{1}{4} - \frac{1}{36}\right)$$

$$\bar{v} = 24{,}372 \text{ cm}^{-1}$$

732. What are the values of n_1 and n_2 respectively for H_β line in the Lyman series of hydrogen atomic spectrum?

(a) 3 and 5
(b) 2 and 3
(c) 1 and 3
(d) 2 and 3

UP CPMT-2008

Ans. (c): H_β line is formed when electron jumps from 3rd orbit in Lyman series.

$$n_1 = 1, n_2 = 3$$

733. The energy of second Bohr orbit of the hydrogen atom is – 328 kJ mol^{-1}; hence the energy of fourth Bohr orbit would be

(a) –41kJ mol^{-1}
(b) –1312 kJ mol^{-1}
(c) –164kJ mol^{-1}
(d) –82 kJ mol^{-1}

UPTU/UPSEE-2007

Ans. (d) : Energy of 2nd orbit= –328 kJ/mol

Now, energy of 4th orbit will be $= -\frac{328}{4} = -82 \text{ kJ mol}^{-1}$

734. The wavelength of the radiation emitted, when in a hydrogen atom electron falls from infinity to stationary state, would be (Rydberg constant = 1.097 × 10^7 m^{-1})

(a) 91 nm
(b) 192 nm
(c) 406 nm
(d) 9.1 × 10^{-8} nm

UPTU/UPSEE-2007

Ans. (a) : $\frac{1}{\lambda} = v_H = R_H\left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right)$

$$= 1.097 \times 10^7\left(\frac{1}{1^2} - \frac{1}{\infty^2}\right)$$

$$= \frac{1}{1.097 \times 10^7} \text{ m} = 9.11 \times 10^{-8} \text{ m}$$

$$= 91.1 \times 10^{-9} \text{ m}$$

$$= 91.1 \text{ nm}$$

735. The radius of hydrogen atom in the ground state is 0.53Å.The radius of Li^{2+} ion (atomic number = 3) in a similar state is:

(a) 0.176Å
(b) 0.30Å
(c) 0.53Å
(d) 1.23Å

UPTU/UPSEE-2014, 2005

Ans. (a) :

Radius of Li^{2+} ion $= r_1 \times \frac{n^2}{z} = 0.53 \times \frac{1^2}{3} = 0.17$ Å

736. For a Bohr atom angular momentum M of the electron is : (n=0,1,2,....)

(a) $\frac{nh^2}{4\pi}$
(b) $\frac{n^2h^2}{4\pi}$
(c) $\frac{\sqrt{nh^2}}{4\pi}$
(d) $\frac{nh}{2\pi}$

UPTU/UPSEE-2005

Ans. (d) : For a Bohr atom, angular momentum m of the electron (mvr) $= \frac{nh}{2\pi}$

737. If an e^- is revolving in the first bohr orbit of a H-atom with a velocity of 2.19 × 10^8 cms^{-1}, what will be the velocity of the e^- in the third orbit of H-atom ?

(a) 2.19 × 10^8 cms^{-1}
(b) 7.3 × 10^7 cms^{-1}
(c) 6.57 × 10^8 cms^{-1}
(d) 1.09 × 10^8 cms^{-1}

UPTU/UPSEE-2018

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Ans. (b) : The velocity of electron in different orbits is given by the following expression,

$$V_n = V_o \times \frac{z}{n}$$

Given, for first Bohr orbital of H–atom

$V_o = 2.19\times10^8$ cm s^{-1}

∴ the velocity of e– in third orbit of H–atom is (∵ n=3)

$$V_n = 2.19\times10^8\times\ \frac{1}{3}$$

$= 0.73\times10^8$ cm s^{-1}

$= 7.3\times10^7$ cm s^{-1}

738. The radius of which of the following orbit is same as that of the first Bohr's orbit of hydrogen atom?

(a) Li^{2+} (n = 2) (b) Li^{2+} (n = 3)

(c) Be^{3+} (n = 2) (d) He^+ (n = 2)

UPTU/UPSEE-2015

Ans. (c) : $r_n = r_H \times \frac{n^2}{z}$

For Li^{2+} (n=2)

$$r_{Li^{2+}} = r_H \times \frac{(2)^2}{3} = \frac{r_H \times 4}{9}$$

For Li^{2+} (n=3)

$$r_{Li^{2+}} = r_H \times \frac{(3)^2}{3} = 3r_H$$

For Be^{3+} (n=2)

$$r_{Be^{3+}} = r_H \times \frac{(2)^2}{4} = r_H$$

For He^+ (n=2)

$$r_{He^+} = \frac{r_H \times (2)^2}{4} = 2r_H$$

Thus, Be^{3+} (n=2) has same radius as that of the first Bohr's orbit of H–atom.

739. The ratio of the difference in energy between the first and second Bohr orbit to that between the second and third Bohr orbit is

(a) $\frac{1}{2}$ (b) $\frac{1}{27}$

(c) $\frac{4}{9}$ (d) $\frac{27}{5}$

UPTU/UPSEE-2013

Ans. (d) : : $E_1 - E_2 = -13.6 \times Z^2 \left(\frac{1}{1^2} - \frac{1}{2^2}\right)$

$$E_1 - E_2 = -13.6\ \times Z^2 \left(\frac{3}{4}\right) \qquad \text{——— (i)}$$

$$E_2 - E_3 = -13.6\ \times Z^2 \left(\frac{1}{2^2} - \frac{1}{3^2}\right)$$

$$E_2 - E_3 = -13.6\ \times Z^2 \left(\frac{5}{36}\right) \qquad \text{——— (ii)}$$

From eq^n. (i) and (ii)

$$\left(\frac{E_1 - E_2}{E_2 - E_3}\right) = \frac{3\times36}{4\times5} = \frac{27}{5}$$

740. Which one of the following represents the correct ratio of the energy of electron in ground state of H atom to that of the electron in the first excited state of Li^+?

(a) 4:9 (b) 9:4

(c) 1:4 (d) 4:1

UPTU/UPSEE-2011

Ans. (a) : $E_n \propto \frac{Z^2}{n^2}$

For H atom, $E_1 \propto \frac{1^2}{1^2}$ [∵ Z = 1 for hydrogen]

$E_1 = 1$

For Li^+ ion, $E_2 \propto \frac{3^2}{2^2}$ [∵ Z = 3 for Li^+ ion]

$E_2 = \frac{9}{4}$

Thus, E1/E2 = 1 / $\frac{9}{4}$ or 4 : 9

741. What is the energy required to move the electron from ground state of H atom to the first excited state? Given that the ground state energy of H atom is 13.6 eV and that the energy E_n of an electron in nth orbital of an atom or ion of atomic number Z is given by the equation

$E_n = -(13.6Z^2/n^2)$.

(a) 13.6 eV (b) 3.4 eV

(c) 10.2 eV (d) –10.2 eV

UPTU/UPSEE-2011

Ans. (c) : $E_n = \frac{-13.6}{n^2} \times Z^2$

The energy required to move from ground state (n = 1) of H to first excited state (n = 2) is

$$\Delta E = E_2 - E_1 = -13.6\left(\frac{1}{2^2} - \frac{1}{1^2}\right) = 13.6 \times \frac{3}{4} = 10.2 \text{ eV}$$

742. An electron from one Bohr stationary orbit can go to next higher orbit

(a) by emission of electromagnetic radiation

(b) by absorption of any electromagnetic radiation

(c) by absorption of electromagnetic radiation of particular frequency

(d) without emission or absorption of electromagnetic radiation

UPTU/UPSEE-2008

Ans. (c) : According to Bohr's atomic model, if energy is supplied to an electron it may jump from a lower energy level to higher energy level. Energy is absorbed in the form of quanta (or photon)

$$\Delta E = h\nu$$

Where, ν is the frequency.

According to above postulate an electron from one Bohr stationary orbit can go to next higher orbit by the absorption of electromagnetic radiation of particular frequency.

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743. For the Paschen series the values of n_1 and n_2 in the expression

$$\Delta E = R_H c\left(\frac{1}{n_1^2}-\frac{1}{n_2^2}\right)$$

(a) $n_1=1, n_2=2,3,4,\ldots$ (b) $n_1=2, n_2=3,4,5,\ldots$

(c) $n_1=3, n_2=4,5,6,\ldots$ (d) $n_1=4, n_2=5,6,7,\ldots$

WB-JEE-2009

Ans. (c) : Paschen series is the third series of hydrogen spectrum and lies in the infrared region, therefore for this series, $n_1 = 3$ and $n_2 > n_1$, i.e. 4, 5, 6, ...

744. In Sommerfeld's modification of Bohr's theory, the trajectory of an electron in a hydrogen atom is

(a) a perfect ellipse

(b) a closed ellipse like curve, narrower at the perihelion position and flatter at the aphelion position

(c) a closed loop on a spherical surface

(d) a rosette.

WB-JEE-2010

Ans. (a) : According to Sommerfeld's modification, the trajectory of an electron in a hydrogen atom is a closed ellipse like curve in addition to circular orbits.

745. The electronic transitions from n = 2 to n = 1 will produce shortest wavelength in (Where n = principal quantum state)

(a) Li^{2+} (b) He^+

(c) H (d) H^+

WB-JEE-2011

Ans. (a) : $\frac{1}{\lambda} = Z^2 R_H\left[\frac{1}{n_1^2}-\frac{1}{n_2^2}\right]$

$n_1 = 1, n_2 = 2$

$$\frac{1}{\lambda} = Z^2 R_H\left[\frac{1}{1}-\frac{1}{4}\right] = \frac{1}{\lambda} = \frac{3}{4}R_H Z^2$$

$$\therefore \lambda \propto \frac{1}{Z^2}$$

Hence, elements having high atomic number will produce shortest wavelength.

746. The energy of an electron in first Bohr orbit of H-atoms is 13.6 eV. the possible energy value of electron in the excited state of Li^{2+} is

(a) -122.4 eV (b) 30.6 eV

(c) -30.6 eV (d) 13.6 eV

WB-JEE-2011

Ans. (c) : $E_n = E_1 \times \frac{Z^2}{n^2}$

E_1 = energy of hydrogen in first orbit

$n = 2, Z = 3$

$$E_n = -13.6 \times \frac{(3)^2}{(2)^2} = -30.6 \text{ eV}$$

747. The emission spectrum of hydrogen discovered first and the region of the electromagnetic spectrum in which it belongs, respectively are

(a) Lyman, ultraviolet (b) Lyman, visible

(c) Balmer, ultraviolet (d) Balmer, visible

WB-JEE-2014

Ans. (d) : Balmar spectrum of hydrogen was discovered first and it lies in the visible region.

748. The time taken for an electrin to complete one revolution in Bohr orbit of hydrogen atom is

(a) $\frac{4m^2\pi r^2}{n^2h^2}$ (b) $\frac{n^2h^2}{4mr^2}$

(c) $\frac{4\pi^2 mr^2}{nh}$ (d) $\frac{nh}{4\pi^2 mr^2}$

WB-JEE-2016

Ans. (c) : We know according to Bohr's theory

$$mvr = \frac{nh}{2\pi}$$

$$V = \frac{nh}{2\pi mr}$$

∴ Time required for one complete revolution

$$T = \frac{2\pi r}{V} = \frac{2\pi r}{nh}\times 2\pi mr = \frac{4\pi^2 mr^2}{nh}$$

749. The energy required to break one mole of hydrogen-hydrogen bonds in H_2 is 436 KJ. What is the longest wavelength of light required to break a single hydrogen- hydrogen bond?

(a) 68.5 nm (b) 137 nm

(c) 274 nm (d) 548 nm

WB-JEE-2016

Ans. (c) : Amount of energy required to break one H-H bond is $\frac{436\times10^3}{6.023\times10^{23}} = \frac{436}{6.023\times10^{20}}$ J mol^{-1}

Now,

$$E = \frac{hc}{\lambda}$$

$$\lambda = \frac{6.626\times10^{-34}\times3\times10^8}{436}\times6.023\times10^{20}$$

$$= \frac{6.626\times6.023\times3}{436}\times10^{-6} = 274 \text{ nm}$$

750. The radius of the first Bohr orbit of a hydrogen atom is 0.53×10^{-8} cm. The velocity of the electron in the first Bohr orbit is

(a) 2.188×10^8 cm s^{-1} (b) 4.376×10^8 cm s^{-1}

(c) 1.094×10^8 cm s^{-1} (d) 2.188×10^9 cm s^{-1}

WB-JEE-2020

Ans. (a) : The formula used for the velocity of electron in Bohr orbit of a hydrogen atom is:

$$V = \frac{nh}{2\pi mr}$$

$$V = \frac{1\times6.6\times10^{-34}}{2\times3.14\times9.1\times10^{-31}\times0.53\times10^{-10}}$$

$$= 2.18\times10^6 \text{ ms}^{-1}$$

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9. Isobars and Isotopes

751. $\left({}_{32}Ge^{76}, {}_{34}Se^{76}\right)$ **and** $\left({}_{14}Si^{30}, {}_{16}S^{32}\right)$ **are examples of**
(a) isotopes and isobars
(b) isobars and isotones
(c) isotones and isotopes
(d) isobars and isotopes

WB-JEE-2014

Ans. (b) : ${}_{32}Ge^{76}$ and ${}_{34}Se^{76}$ have the same mass number but different atomic number, so they are isobars.
Number of neutrons in ${}_{14}Si^{30} = 30 - 14 = 16$
Number of neutrons in ${}_{16}S^{32} = 32 - 16 = 16$
Because of the presence of some number of neutrons, ${}_{14}Si^{30}$ and ${}_{16}S^{32}$ are called isotones.

752. ${}_{19}K^{40}$ **and** ${}_{20}Ca^{40}$ **are known as**
(a) isotopes (b) isobars
(c) isotones (d) isodiaphers

UP CPMT-2002

Ans.(b): ${}_{19}K^{40}$ and ${}_{20}Ca^{40}$ both have same mass no but different atomic number, are called isobars.

753. Isotopic pair is
(a) ${}_{20}X^{40}$, ${}_{21}Y^{40}$ (b) ${}_{20}X^{40}$, ${}_{20}Y^{41}$
(c) ${}_{40}X^{20}$, ${}_{41}Y^{20}$ (d) None of these

UP CPMT-2005

Ans. (b) : Key Idea: Isotopes are the atoms of same element which have different atomic masses (due to different number of neutrons). They had same atomic numbers.
∴ choice (b) is the correct answer because both (${}_{20}X^{40}$, ${}_{20}X^{41}$) have same atomic number but different atomic mass.

754. O_2 and O_3 are
(a) allotropes (b) isotopes
(c) isomorphs (d) polymorphs

UP CPMT-2010

Ans. (a) : Since, in O_2 and O_3 different numbers of same element i.e. oxygen are present, these are allotropes.
Note. Different crystalline structures, different number of atoms and different nuclear spins all result in allotropy.

755. An isobar of ${}_{20}Ca^{40}$ is
(a) ${}_{18}Ar^{40}$ (b) ${}_{20}Ca^{38}$
(c) ${}_{20}Ca^{42}$ (d) ${}_{18}Ar^{38}$

MHT CET-2008

Ans. (a) : Isobars have same atomic mass but different atomic numbers. Therefore, the isobars of ${}_{20}Ca^{40}$ is ${}_{18}Ar^{40}$.

756. Isotones have
(a) same number of protons
(b) same number of electrons
(c) same number of neutrons
(d) same isotopic mass

UP CPMT-2010

Ans. (c): Species having the same number of neutron but different atomic number as well as atomic mass are called isotones. E.g. ${}^{39}_{18}Ar, {}^{40}_{19}K$.

10. Line Spectrum of Hydrogen

757. The ratio of the shortest wavelength of two spectral series of hydrogen spectrum is found to be about 9. The spectral series are
(a) Lyman and Paschen
(b) Brackett and Pfund
(c) Paschen and Pfund
(d) Balmer and Brackett

[JEE Main 2019, 10 April Shift-II]

Ans. (a) :
$$\frac{\dfrac{1}{\lambda_2} = R_H\left(\dfrac{1}{n_1^2}-\dfrac{1}{n_2^2}\right)Z^2}{\dfrac{1}{\lambda_1} = R_H\left(\dfrac{1}{m_1^2}-\dfrac{1}{m_2^2}\right)Z^2}$$
As for shortest wavelengths both n_2 and m_2 are ∞ and z for H is 1
$$\therefore\ \frac{\lambda_1}{\lambda_2} = 9(\text{given})$$
$$\therefore\ 9 = \left(\frac{m_1}{n_1}\right)^2$$
$$\text{or } \left(\frac{3}{1}\right)^2 = \left(\frac{m_1}{n_1}\right)^2$$
$m_1 = 3$ (lyman)
$n_1 = 1$ (paschen)

758. The shortest wavelength of H atom in the Lyman series is λ_1. The longest wavelength in the Balmer series of He^+ is
(a) $\frac{36\lambda_1}{5}$ (b) $\frac{5\lambda_1}{9}$
(c) $\frac{9\lambda_1}{5}$ (d) $\frac{27\lambda_1}{5}$

[JEE Main 2020, Sep Shift-II]

Ans. (c) : As we know
$$\Delta E = \frac{hc}{\lambda}$$
So, $\lambda = \frac{hc}{\Delta E}$ for λ minimum i.e. shortest; ΔE = maximum For Lyman series n = 1 & for ΔE max.
Transition must be form n = ∝ to n = 1
So,
$$\frac{1}{\lambda} = R_H Z^2 \left(\frac{1}{n_1^2}-\frac{1}{n_2^2}\right)$$
$$\frac{1}{\lambda} = R_H Z^2 \ (1-0)$$
$$\frac{1}{\lambda} = R \times (1)^2 \Rightarrow \lambda_1 = \frac{1}{R}$$
For longest wavelength ΔE = minimum for Balmer Series n = 3 to n = 2 will have ΔE = minimum.
for He^+ (Z) = 2

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So,

$$\frac{1}{\lambda_2} = R_H \times Z^2 \left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right)$$

$$\frac{1}{\lambda_2} = R_H \times 4 \left(\frac{1}{4} - \frac{1}{9}\right)$$

$$\frac{1}{\lambda_2} = R_H \times \frac{5}{9}$$

$$\boxed{\lambda_2 = \lambda_1 \times 5/9}$$

759. Match the type of series given in Column I with the wavelength range given in Column II and choose the correct option.

Column I	Column II
A. Lyman	1. Ultraviolet
B. Paschen	2. Near infrared
C. Balmer	3. Far infrared
D. Pfund	4. Visible

Codes

(a) 1 2 4 3 (b) 4 3 1 2

(c) 3 1 2 4 (d) 4 3 2 1

JIPMER-2017

Ans. (a) : The correct match is

(A) → Lyman → (1) Ultraviolet

(B) → Paschen → (2) Near infrared

(C) → Balmer → (4) Visible

(D) → Pfund → (3) Far infrared

760. What is the wave number of 4th line in Balmer series of hydrogen spectrum? (R = 1, 09, 677 cm^{-1})

(a) 24,630 cm^{-1} (b) 24,360 cm^{-1}

(c) 24,730 cm^{-1} (d) 24,372 cm^{-1}

JIPMER-2009

Ans. (d) : $\bar{V} = R\left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right)$

For Balmer series n_1= 2 and for 4th line in Balmer series $n_2 = 6$

$$R = 109677\ cm^{-1}$$

$$\bar{V} = 109677\left(\frac{1}{2^2} - \frac{1}{6^2}\right)$$

$$= 109677\left(\frac{1}{4} - \frac{1}{36}\right)$$

$$\bar{V} = 24,372\ cm^{-1}$$

761. What are the values of n_1 and n_2 respectively for H_β line in the Lyman series of hydrogen atomic spectrum 44?

(a) 3 and 5 (b) 2 and 3

(c) 1 and 3 (d) 2 and 4

JIPMER-2009

Ans. (c) : H_β line is formed when electron jumps from 3rd orbit to 1st orbit in Lyman Series

$\therefore n_1 = 1, n_2 = 3$

762. Which is the shortest wavelength line in the Lyman series of the hydrogen spectrum? ($R=1.097\times10^{-2}nm^{-1}$)

(a) 94.21 nm (b) 91.16 nm

(c) 911.6 nm (d) 933.6 nm

JIPMER-2004

Ans. (b) : : For Lyman Series $\frac{1}{\lambda} = R\left(\frac{1}{(1)^2} - \frac{1}{n^2}\right)$

Hence for λ to be smallest n should be greatest

$$\frac{1}{\lambda_{min}} = 1.097\times10^{-2}\left(1 - \frac{1}{\infty 2}\right)$$

$\Rightarrow 1.097 \times 10^{-2}$

or

$$\lambda_{min} = \frac{1}{1.097\times10^{-2}} = 91.16\,nm$$

763. The wave number of the spectral line in the emission spectrum of hydrogen will be equal to $\frac{8}{9}$ times the Radberg's constant if the electron jumps from

(a) n = 3 to n = 1 (b) n = 10 to n = 1

(c) n = 9 to n = 1 (d) n = 2 to n = 1

Karnataka-CET, 2010

Ans. (a) : Wave number of spectral line in emission spectrum of hydrogen,

$$\bar{v} = R_H\left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right) \quad \ldots (i)$$

Given $\bar{v} = \frac{8}{9}R_H$

On putting the value of $\bar{v}$ in Eq. (i), we get

$$\frac{8}{9}R_H = R_H\left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right)$$

$$\frac{8}{9} = \frac{1}{(1)^2} - \frac{1}{n_2^2}$$

$$\frac{8}{9} - 1 = -\frac{1}{n_2^2}$$

$$\frac{1}{3} = \frac{1}{n_2}$$

$\therefore \quad n_2 = 3$

Hence, electron jumps from $n_2 = 3$ to $n_1 = 1$

764. X-rays are electromagnetic radiation whose wavelengths are the order of:

(a) 1 metre (b) 10^{-1} metre

(c) 10^{-5} metre (d) 10^{-10} metre

NDA (II)-2015

Ans : (d) X-ray are electromagnetic radiation whose wavelength are the order of 10^{-10} meter.

- X-ray are produces when high velocity electron collide with metal plates
- It have shorter wavelength of the electromagnetic spectrum.
- It have capability to travel in vaccum.

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765. The shortest wavelength in hydrogen spectrum of Lyman series when $R_H = 109678\ cm^{-1}$, is

(a) 1002.7Å (b) 1215.67Å

(c) 1127.30Å (d) 911.7Å

(e) 1234.7Å

Kerala-CEE-2010

Ans. (d) : For Lyman Series, $n_1 = 1$

$$\bar{V} = \frac{1}{\lambda} = R_H\left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right) = R_H\left(\frac{1}{1^2} - \frac{1}{\infty^2}\right)$$

Or

$$\lambda = \frac{1}{R_H} = \frac{1}{109678 cm^{-1}}$$

$= 911.7 \times 10^{-8}$

$= 911.7Å$

766. What will be the longest wavelength line in Balmer series of spectrum?

(a) 546 nm (b) 656 nm

(c) 566 nm (d) 356 nm

NEET-1996

Ans. (b) : The longest wavelength means that lowest energy. We known that relation for wavelength

$$\frac{1}{\lambda} = R_H\left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right)$$

Here $n_1 = n_2$ $n_2 = 3$

RH is Rydberg constant = 109677 cm^{-1}

$$\frac{1}{\lambda} = 109677\left(\frac{1}{(2)^2} - \frac{1}{(3)^2}\right) = 15233$$

Or

$$\lambda = \frac{1}{15233} = 6.56 \times 10^{-5}\ cm$$

$\Rightarrow 6.56 \times 10^{-7}\ \lambda \Rightarrow 656$ nm

767. The wave number of hydrogen atom in Lymen series is 82200 cm^{-1}. The electron goes from

(a) $n_3 \to n_2$ (b) $n_2 \to n_1$

(c) $n_4 \to n_3$ (d) None of these

UPTU/UPSEE-2013

Ans. (b) : According to Rydberg formula

$$\bar{V} = R\left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right)$$

Here, R = 109677 = 109678 cm^{-1}

$\bar{V} = 82200\ cm^{-1}$

$$\text{Thus, } \frac{82200}{109678} = \left(\frac{1}{12} - \frac{1}{n_2^2}\right)$$

Or

$$\frac{3}{4} = \left(1 - \frac{1}{n_2^2}\right)$$

$$\frac{1}{n_2^2} = 1 - \frac{3}{4} = \frac{1}{4}$$

Or

$n_2 = 2$

∴ The electron jumps from second orbit (n_2) to ground state (n_1)

768. Splitting of spectrum lines in magnetic field is

(a) Stark effect (b) Raman effect

(c) Zeeman effect (d) Rutherford effect

UPTU/UPSEE-2008

Ans. (c) : Stark effect ⇒ The splitting of spectral lines under the influences of electric field is called stark effect.

Zeeman effect ⇒ The splitting of spectral lines under the influences of magnetic field is called Zeeman effect.

769. Heat treatment of muscular pain involves radiation of wavelength of about 900 nm. Which spectral line of H-atoms is suitable for this purpose? [$R_H = 1\times10^5 cm^{-1}$, $h = 6.6 \times 10^{-34}$ Js, $c = 3 \times 10^8\ ms^{-1}$]

(a) Paschen, 5→3 (b) Paschen, ∞→3

(c) Lyman, ∞→1 (d) Balmer, ∞→2

[JEE Main 2019, 11 Jan Shift-I]

Ans. (b) : $\frac{1}{\lambda} = R_H\left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right) = 10^7\left(\frac{1}{3^2} - \frac{1}{\infty}\right)$

$\lambda = 9 \times 10^{-7}$ m

∴ $\lambda = 900$ nm

770. In hydrogen spectrum, the series of lines appearing in ultra violet region of electromagnetic spectrum are called :

(a) Balmer lines (b) Lyman lines

(c) Pfund lines (d) Brackett lines

Manipal-2017

Ans. (b) : Lyman series was found out in the ultraviolet region by Lyman.

Balmer series was found out in the visible region by Balmer.

Bracket series was found out in the infrared region by Brackett.

P fund series was found out in the infrared region by P fund.

11. Filling of Orbital's in atom

771. In a given atom no two electrons can have the same values for all the four quantum numbers. This is called

(a) Hund's Rule

(b) Aufbau principle

(c) Uncertainty principle

(d) Pauli's Exclusion principle

NEET-1991

Ans. (d) : In a given atom no two electrons can have the same values for all the four quantum numbers. This is called Pauli's Exclusion principle.

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772. Wave nature of electrons was demonstrated by

(a) Schrodinger
(b) de-Broglie
(c) Davisson and Germer
(d) Heisenberg

UP CPMT-2004
J & K CET-(1999)

Ans. (c) : (a) **Schrodinger** He put forward new model of atom by taking into account the de-Broglie concept of dual nature matter and Heisenberg's uncertainly principle. He described the motion of electron in threo dimensional space in the form of mathematical equation known as Schrödinger wave equation.

(b) **de-Broglie** According to him, all the material particles possess wave character as well as particle character.

$$\lambda = \frac{h}{mv} \text{(de - Broglie equation)}$$

Water, λ = Wavelength
h = Planck's constant
m = mass of particle
v = Velocity of particle

(c) **Davisson and Germer** They carried out experiment to show the wave character of electrons. They observed when a beam of electrons is allowed to fall on the surface of nickel crystal are received on photographic plate, a diffraction pattern similar to that of X-rays is obtained. Since, X-rays are electromagnetic rays, it means electrons have wave character also.

(d) **Heisenberg's uncertainty principle** It states that position and momentum of an electron cannot be measured accurately and simultaneously.

$\therefore$ Correct answer is (c) because wave nature of electron is demonstrated by Davission and Germer.

773. The observation that the ground state of nitrogen atom has 3 unpaired electrons in its electronic configuration and not otherwise is associated with:

(a) Pauli's exclusion principle
(b) Hund's rule of maximum multiplicity
(c) Heisenberg's uncertainty principle
(d) Ritz combination principle

JCECE - 2005

Ans. (b) : According to Hund's rule while filling orbital's of a Subshell pairing of electrons does not take place until all the orbitals of the subshell are singly occupied.

774. Hund's rule state that

(a) Number of two e^- can be in two separate orbitals
(b) Number of two e^- can be present with similar spin in a orbital
(c) No e^- can exist in d orbital
(d) None of the above

JIPMER-2019

Ans. (d) : Hund's rule of maximum multiplicity states that, the pairing of electrons in the orbital's of a particular subshell (p, d or f) does not take place until all the orbital of as subshell are singly occupied. Thus all he given statements are not related to Hund's rule.

775. The scientist who proposed the atomic model based one the quantization of energy for the first time was

(a) Max Planck
(b) Neils Bohr
(c) de-Broglie
(d) Heisenberg

J & K CET-(2008)

Ans. (b) : Neils Bohr utilized the concept of quantization of energy (Proposed by max Planck) first time to give a new model of atom.

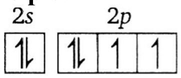
776. Who used the quantum theory for the first time to explain the structure of atom?

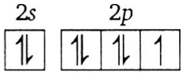
(a) de Broglie
(b) Bohr
(c) Heisenberg
(d) Einstein

J & K CET-(2005)

Ans. (b) : To overcome the objections of Rutherford's model and to explain the hydrogen spectrum, Bohr proposed a quantum mechanical model of the atom, which is based on the quantum theory of radiation and the classical laws of physics.

777. Which is not in accordance to aufbau principle?

(a)


(b)


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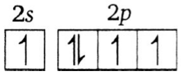

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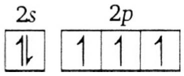


BCECE-2008

Ans. (c) : Aufball principle states that in the ground state of an atom, the orbital with lower energy is filled up first before the filling of the orbital's with a higher energy commences, increasing order of energy of various orbital's is

1s, 2s, 2p, 3s, 4s, 3d, 3p, 5s etc.

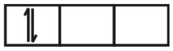
778. The Pauli exclusion principle applies to the following option.

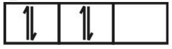
(a) H
(b) H^+
(c) H^-
(d) He^+

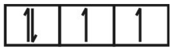
Manipal-2016

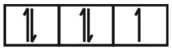
Ans. (c) : Since H has one electron and $H^{\oplus}$ has no electron the Pauli exclusion principle does not apply to them however $H^{\ominus}$ has two electrons; hence this principle applies on it.

779. Select the correct options according to Hund's rule and Pauli exclusion principle.

I.


II.


III.


IV.


Codes :

(a) Both I and II
(b) Both II and III
(c) Both I and III
(d) Both III and IV

Manipal-2016

Ans. (d) : Figure given in option (d) follow the Hund's rule and Pauli exclusion principle.

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03.

Classification of Elements and Periodicity in Properties

1. Valency and Oxidation State

1. Identify the incorrect statement from the following

(a) Lithium is the strongest reducing agent among the alkali metals.
(b) Alkali metals react with water to form their hydroxides.
(c) The oxidation number of K in KO2 is +4.
(d) Ionisation enthalpy of alkali metals decreases from top to bottom in the group

NEET-17.07.2022

Ans. (c) : The group first is known as alkali metal and show only +1 oxidation state in all of their compound. KO_2 is a superoxide.

The oxidation state of K in KO_2 is –

$x + 2(-1/2) = 0$

$x - 1 = 0$

$x = +1$

So, the oxidation state of K is + 1.

2. The average oxidation number of bromine in Br_3O_8 is

(a) $\frac{16}{3}$ (b) $\frac{4}{3}$
(c) $\frac{3}{4}$ (d) $\frac{5}{2}$
(e) $\frac{8}{3}$

Kerala CEE -03.07.2022

Ans. (a) : Given, Br_3O_8

Let oxidation number of Br is x and we know oxidation number of O is (–2). Then

$3(x) + 8(-2) = 0$

$3x - 16 = 0$

$3x = 16$

$x = \frac{16}{3}$

So, the average oxidation number Br in Br_3O_8 is $\frac{16}{3}$.

3. Given below are statements:

Statement I : The pentavalent oxide of group -15 element, E_2O_5, is less acidic than trivalent oxide, E_2O_3 of the same element.

Statement II : The acidic character of trivalent oxide of group 15 elements, E_2O_3 , decreases down the group.

In light **of** the above statements, choose **most appropriate** answer from the options given below:

(a) Both Statement I and Statement II are true
(b) Both Statement I and Statement II are false
(c) Statement I. true, but Statement II is false
(d) Statement I. false, but Statement II is true

JEE Main-28.06.2022, Shift-I

Ans. (d) : As oxidation no. decreases, Acidic behaviour decreases.

∴ $E_2O_5 : 2x - 10 = 0$
$x = +5$
$E_2O_3 : 2x - 6 = 0$
$x = +3.$

∴ E_2O_5 is more acidic than E_2O_3.

4. Choose the correct stability order of group 13 element in their +1 oxidation state.

(a) Al < Ga < In < Tl (b) Tl < In < Ga < Al
(c) Al < Ga < Tl< In (d) Al < Tl < Ga < In

JEE Main-26.06.2022, Shift-I

Ans. (a) : The correct stability order of group 13 element in their +1 oxidation state is –

Al < Ga < In < Tl

Because, inert pair effect as you moving down the group, the stability of oxidation state the increases while the stability of +3 oxidation state decreases.

5. In which of the following compounds an element exhibits two different oxidation states?

(a) N_2H_4 (b) N_3H
(c) NH_2CONH_2 (d) NH_4NO_3

Karnataka CET-17.06.2022, Shift-II

Ans. (d) : Oxidation States of –

(a) In N_2H_4, the oxidation state of N is (– 2)

$2(x) + 4 = 0$ (oxidation state of H = +1)
$x = -2$

(b) In N_3H, the oxidation state of N is $\left(\frac{-1}{3}\right)$

$3(x) + 1 = 0$ (oxidation state of H = +1)
$x = \frac{-1}{3}$

(c) In NH_2CONH_2, the oxidation state of N is (–3)

$x + 2 + 4 - 2 + x + 2 = 0$
$2x = -6$
$x = -3$

(d) In NH_4NO_3 is breaks into $NH_4^+ \ NO_3^-$.

So, it has two different oxidation states.

In NH_4^+ , the oxidation state of N is –

@apna_pdf

$x + 4 = 1$
$x = -3$

In NO_3^-, the oxidation state of N is –

$x + (-6) = -1$
$x = +5$

Thus the oxidation state of N in NH_4^+, is –3 while in NO_3^-, is +5.

6. Which of the following does not have valence electron in 3d- subshell?

(a) Fe (III) (b) Cr(I)
(c) Mn (II) (d) P(0)

BITSAT-2012
AIIMS-2002

Ans. (d): Phosphorous is not a d-block element. It is an element of P-block of group 15.
Thus cannot have any valence electron in d-subshell.
All other element are d-block elements therefore has valence electron in 3d-subshell
Electronic configuration of these are
Fe(III)= $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^5$
Cr(I)= $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^5$
Mn(II)= $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^5$

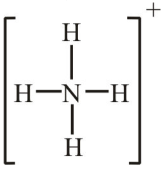
7. Identify the element for which electronic configuration in +3 oxidation state is [Ar]$3d^5$.

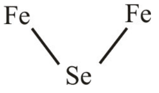
(a) Ru (b) Mn
(c) Co (d) Fe

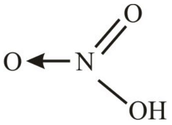
(JEE Main 2021, 1 Sep Shift-II)

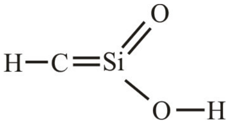
Ans. (d) : The atomic number of Ar is 18 due to presence of electrons in d-orbital's and add 5 electron in the d-orbital. Total number of electrons in X^{3+} is 23. Oxidation means loss of electrons, so +3 charges implies 3 electrons loss by X to form X^{3+}.
Hence, the number of electrons in X = 23 + 3 = 26
Therefore the element is Fe.

8. Which among the following structures does not correctly represent the bonding capacities (valancies) of the atoms involved?

(a)


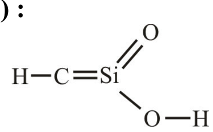
(b)


(c)


(d)


AP EAPCET-6 Sep. 2021, Shift-II

Ans. (d) :



This structure not correctly represent the bonding capacities i.e. valencies in the atoms involved. because valency of carbon is 4 but one carbon has three bonds and other five.

9. 1 mole of metal 'M' reacts completely with alcohol to give 1.5 moles of H_2. Then what will be the valency of metal 'M'?

(a) 4 (b) 3
(c) 2 (d) 1

GUJCET-2020

Ans. (b) : On the reaction of metal and the alcohol, the metal replace the hydrogen ion of the alcohol, and liberates hydrogen gas.
The reaction can be written as–
$M^{nt} + R - OH \rightarrow (R - O)n\ M + 1/2\ H_2$
If one mole of metal gives 3/2 moles of hydrogen, it can be written as– $M \rightarrow m^{3+} + 3e^-$
Therefore, the valency of metal is 3.

10. Assertion: I_2O_5 is used to detect CO.
Reason: In I_2O_5 the oxidation number of I is 5.

(a) If both Assertion and Reason are correct and Reason is the correct explanation of Assertion.
(b) If both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.
(c) If Assertion is correct but Reason is incorrect.
(d) If both the Assertion and Reason are incorrect.

AIIMS 26 May 2019 (Morning)

Ans. (b): $I_2O_5 + 5CO \rightarrow I_2 + 5CO_2$
Solid iodine pentoxide with gaseous carbon monoxide in the presence of air gives carbon dioxide and solid iodine.
Oxidation state of I in I_2O_5

$2x + 5 \times (-2) = 0$
$2x - 10 = 0$
$x = 5$

11. Which one of the following represents the correct order of electron releasing tendency of metals?

(a) Zn > Cu > Ag (b) Ag > Cu > Zn
(c) Cu > Zn > Ag (d) Cu > Ag > Zn

NDA (II)-2019

Ans : (b) The correct order of electron releasing tendency of metals are–
Ag>Cu>Zn
The tendency of metals to lose electron is determine by their position in electrochemical series.

12. Assertion: $S_2O_7^{2-}$ & $Cr_2O_7^{2-}$ both exist.
Reason: Both have same valence electrons.

(a) If both Assertion and Reason are correct and Reason is the correct explanation of Assertion.
(b) If both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.
(c) If Assertion is correct but Reason is incorrect.
(d) If both the Assertion and Reason are incorrect.

AIIMS 26 May 2019 (Morning)

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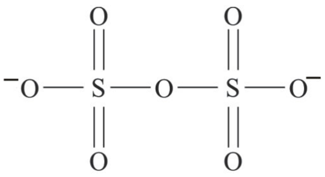
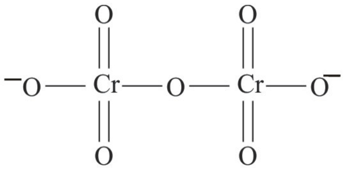
Ans. (a): The structure of $S_2O_7^{2-}$ is–



and the structure of $Cr_2O_7^{2-}$ is–



Both having the same structure and same valence electrons.

13. The element that forms stable compounds in low oxidation state is

(a) Mg (b) Al
(c) Ga (d) Tl

TS EAMCET-2017

Ans. (d) : The element that forms stable compound in low oxidation state is Thallium (Tl) due to inert pair effect, and poor shielding. Increased effective nuclear charge holds the 6s electron tightly.

14. The valency of an element depends upon the

(a) total number of protons in an atom
(b) mass number of an atom
(c) total number of neutrons in an atom
(d) total number of electrons in the outer most shell of an atom

NDA (I)-2017

Ans : (d) The valency of an element depends upon the total number of electrons in the outer most shell of an atoms.

15. Match List-I with List-II and select the correct answer using the code given below the Lists:

List-I (Element)	List-II (Highest Valency)
A. Sulphur	**1. Five**
B. Phosphorous	**2. Six**
C. Lead	**3. Two**
D. Silver	**4. Four**

Code:

	A	B	C	D
(a)	2	4	1	3
(b)	2	1	4	3
(c)	3	1	4	2
(d)	3	4	1	2

NDA (II)-2016

Ans. (b) :

List-I (Element)	List–II (Highest volume)
A. Sulphur	Six
B. Phosphorous	Five
C. Lead	Four
D. Silver	Two

16. Which oxidation state for nitrogen is correctly given ?

	Compound	Oxidation
(a)	NH_3	+ 3
(b)	$[Co(NH_3)_5Cl]$	+ 1
(c)	Mg_3N_2	– 3
(d)	NH_2OH	+ 1

BCECE-2016

Ans. (c) : The oxidation state of nitrogen is

(i) In NH_3
$x + 3(+1) = 0$
$x + 3 = 0$
$x = -3$

(ii) In $[CO(NH_3)_5Cl]$
$+1 + 5[x+3(+1)]-1 = 0$
$5[x+3] = 0$
$x + 3 = 0$
$x = -3$

(iii) In Mg_3N_2
$3(+2) + 2x = 0$
$6 + 2x = 0$
$x = -3$

(iv) In NH_2OH
$x + 2(+1) + (-2) + 1 = 0$
$x + 2 - 2 + 1 = 0$
$x = -1$

17. The number of electrons is the valence shell of the central atom of a molecules is 8. The molecule is

(a) BCl_3 (b) BeH_2
(c) SCl_2 (d) SF_6

AP EAMCET (Engg.) -2014

Ans. (c) : The number of electrons is the valence shell of the central atom of a molecules is 8. The molecule is SCl_2. The central S atom has 2 bond pairs of electrons and 2 lone pairs of electrons.

18. The valency shell of element A contains 3 electrons while the valency shell of element B contains 6 electrons. If A combines with B, the probable formula of the compound formed will be

(a) AB_2 (b) A_2B
(c) A_2B_3 (d) A_3B_2

BITSAT-2014

Ans. (c) : The element A is ns^2np^1 and B is ns^2np^4. They can form compound of the type A_2B_3.

19. Variable valency is a general feature of :

(a) s-block elements (b) p-block elements
(c) d-block elements (d) (b) and (c) both

MPPET-2013

Ans. (c) : Variable valency is the feature of d-block element. Variation in valency is due to participation of (n – 1)d electron in bond formation. d-block elements have empty inner orbitals, the electrons are added to incomplete inner shells.

20. One mole of N_2H_4 loses 10 moles of electrons to form a new compound Z. Assuming that all the nitrogens appear in the new compound, what is the oxidation state of nitrogen in Z? (There is no change in the oxidation state of hydrogen.)

(a) –1 (b) –3
(c) +3 (d) +5

AP EAMCET (Engg.) 2012

Ans. (c) : Given,

$$N_2H_4 - 10e^- \longrightarrow Z^{10+} \ (\text{with two N atoms})$$

Since, total oxidation number of two N atoms in N_2H_4

$$2x + 4 = 0$$
$$2x = -4$$

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$\therefore$ N_2H_4 Losses 10 e^- so total oxidation number of two N-atoms increases by 10, i.e. the total oxidation number of two N-atoms is

$$Y = -4 + 10 = +6$$

$\therefore$ Oxidation number of each N atom in $Z^{10+} = +3$

21. Which of the following is non-existent?

(a) AlF_6^{3-} (b) CoF_6^{3-}
(c) BF_6^{3-} (d) SiF_6^{2-}

AMU – 2010

Ans. (c) : BF_6^{3-} does not exist because boron does not have d-orbital maximum covalency of B is only 4 as it does not have d-orbital.

AlF_6^{3-}, SiF_6^{2-}, CoF_6^{3-} exist because they have d- orbital in valence shell to expand their valency.

22. The valency of the element having atomic number 9 is

(a) 1 (b) 2
(c) 3 (d) 4

MPPET- 2009

Ans. (a) : The atomic number 9 the atom is fluorine. The electronic configuration of an element of atomic number 9 is 2, 7. It requires one electron to get stable noble gas configuration. Hence, its valency is 1.

23. The oxidation number of O in OF_2 is

(a) –2 (b) +1
(c) +2 (d) –1

BCECE-2009

Ans. (c) : Let the oxidation number of O is x.
In OF_2

$$x + 2(-1) = 0$$
$$x - 2 = 0$$
$$x = +2$$

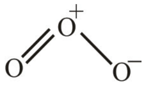
Thus, the oxidation number of O in OF_2 is +2.

24. The oxidation state of oxygen is zero in

(a) CO (b) O_3
(c) SO_2 (d) H_2O_2

CG PET -2007

Ans. (b) : For carbon monoxide, the sum of the individual oxidation number of the constituent atoms must equal the charge on the ion,
Hence, the oxidation number oxygen – 2.
The oxidation number of an oxygen atom in the ozone is zero.



Average oxidation state $= \dfrac{-1+1+0}{3} = 0$

25. The number of electrons in the valence shell of sulphur in SF_6 is:

(a) 12 (b) 10
(c) 8 (d) 11

UPTU/UPSEE-2005

Ans. (a) : The number of electrons in the valence shell of sulphur in SF_6 is 12 because the valency of sulphur is +6 and six fluoxine atoms each having combine to sulphur.

26. Xenon hexafluoride reacts with silica to form a xenon compound X. The oxidation state of xenon in X is :

(a) +2 (b) +4
(c) +6 (d) 0

AP-EAMCET (Engg.)-2004

Ans. (c) : When xenon hexafluoride reacts with silica to form xenon oxytetrafluoride.

$$\underset{\text{Xenonhexafluroide}}{2XeF_6} + \underset{\text{Silica}}{SiO_2} \longrightarrow \underset{\text{Xenonoxytetrafluoride}}{2XeOF_4} + SiF_4$$

$XeOF_4$

Let Oxidation state of Xe in x is.

$$\therefore \quad x - 2 - 4 = 0$$
$$x = +6$$

27. Which of the following element shows maximum valency?

(a) Carbon (b) Barium
(c) Nitrogen (d) Sulphur

UP CPMT-2003

Ans. (d) : Use the number of electrons in valence shell to find the maximum valence shown by the element.

(a) C, atomic number=6, $1s^2, 2s^2, 2p^2$
$\because$ it has 4 electrons in valence shell
$\therefore$ its maximum valency is 4
(b) Barium belongs to group 2 (at. no=56)
$\because$ it has 2 electrons in valence shell
$\therefore$ its maximum valency is 2.
(c) Nitrogen (at. no. 7) = $1s^2, 2s^2, 2p^3$
$\because$ valence shell has 5 electrons
$\therefore$ it can have maximum valency of 5.
(d) Sulphur (at. no. 16) $1s^2, 2s^2, 2p^6, 3s^2, 3p^4$
$\because$ valence shell has 6 electrons
$\therefore$ it can have maximum valency of 6.
$\therefore$ sulphur shows maximum valency among given choices.

28. Which one of the following elements show different oxidation states?

(a) Sodium (b) Fluorine
(c) Chlorine (d) Potassium

AP-EAMCET (Medical), 2001

Ans. (c) : The elements having d-orbital shows different oxidation states. In the given elements only chlorine has vacant d-orbital. So, it can show –1, +1, +3, +5 and +7 oxidation state.

29. Metals having ns^1 as the valence electronic configuration:

(a) are strong oxidizing agents
(b) are highly electronegative
(c) are highly electropositive
(d) have a first ionization potential of more than 10 eV/atom

AP-EAMCET (Med.)-1999

Ans. (c) : If the outer electronic configuration goes to ns^1 valence shell then the metal is belongs to the alkali metal. As we know, alkali metals are more electropositive with low ionization energies in the periodic table. Electropositivity increases down the group in the alkali metal.

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30. **Which of the following covalent molecules is an exception of octet rule?**
(a) $BeCl_2$ (b) CO_2
(c) H_2O (d) CH_4

AP-EAMCET/1999

Ans. (a): $BeCl_2$ has a covalent molecule. In Beryllium, there are 4 electron in $BeCl_2$. Hence, octet rule is not obeyed in $BeCl_2$.

31. **Which of the following sequence is correct with reference to the oxidation number of iodine?**
(a) $I_2 > ICl < HI < HIO_4$ (b) $HIO_4 < ICl < I_2 < HI$
(c) $I_2 < HI < ICl < HIO_4$ (d) $HI < I_2 < ICl < HIO_4$

AP EAMCET- 1997

Ans. (d) : Let the oxidation number of iodine is x.

(i) In HI	(ii) In I_2
$+1+x = 0$	$x=0$
$x = -1$	
(iii) In ICl	(iv) In HIO_4
$x + (-1) = 0$	$+1 + x + 4(-2) = 0$
$x + 1= 0$	$1 + x - 8 = 0$
$x = +1$	$x - 7 = 0$
	$x = +7$

Hence, According to the increasing oxidation number iodine are -
$HI < I_2 < ICl < HIO_4$

32. **The oxidation state of sodium in sodium amalgam is**
(a) +1 (b) -1
(c) zero (d) +2

AP EAMCET- 1996

Ans. (c) : The formula of sodium amalgam is Na–Hg Sodium amalgam's are mixture not a compound. The oxidation state of metal in sodium. Amalgam is always zero. Hence, the oxidation number of sodium in sodium amalgam is zero.

33. **The oxidation state of iodine in ICl_2^- is**
(a) +1 (b) –1
(c) +2 (d) –3

AP EAMCET- 1995

Ans. (a) : Given the molecule is ICl_2^-.
Let, oxidation state of I is x.
In ICl_2^-
$x + 2(-1) = -1$
$x - 2 = -1$
$x = -1 + 2$
$x = +1$
Hence, the oxidation state of iodine is +1.

34. **The Oxidation number of chlorine in $KClO_3$ is**
(a) +5 (b) -5
(c) +1 (d) -1

AP EAMCET- 1993

Ans. (a) : Given that , $KClO_3$
Let the oxidation number of Cl is x.
We know that, the oxidation state of K is +1, and oxygen is –2.
$\therefore$ In $KClO_3$
$1+X + 3(-2) = 0$
$X - 5=0$
$X = +5$

35. **In which of the following sulphur has the lowest oxidation state?**
(a) H_2SO_4 (b) SO_2
(c) H_2SO_3 (d) H_2S

AP EAMCET- 1993

Ans. (d) :

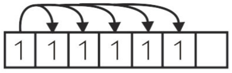
(i) In H_2SO_4	(ii) In SO_2
$2 \times (+1) + x + 4(-2) = 0$	$x + 2(-2) = 0$
$2 + x - 8 = 0$	$-4 + x =0$
$x = + 6$	$x = +4$
(iii) In H_2SO_3	(iv) In H_2S
$2(+1) +x + 3(-2) = 0$	$2(+1) + x = 0$
$+2 + x - 6 = 0$	$2 + x =0$
$x - 4 = 0$	$x= -2$
$x = + 4$	

Hence, In H_2S has the lowest oxidation state of sulphur.

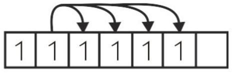
36. **An f-shell containing 6 unpaired electrons can exchange**
(a) 6 electrons (b) 9 electrons
(c) 12 electrons (d) 15 electrons

VITEEE, 2014

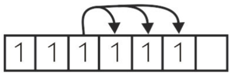
Ans. (d) : The electron with same spin present in the degenerate orbitals tends to exchange their position
The possible exchange of f^6 – configuration



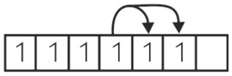
5 exchange by e^-1



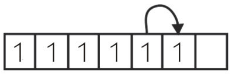
4 exchange by e^-2



3 exchange by e^-3



2 exchange by e^-4



1 exchange by e^-5

Thus, the total exchange of f^6 – configuration is $= 5 + 4 + 3 + 2 + 1 = 15$ electrons.

2. Periodic Laws

37. **The long form of periodic Table is based on**
(a) mass of the atom (b) atomic number
(c) shapes of the atom (d) electronegegativity

CGPET-2012
J&K CET-1998, AIIMS-1994

Ans. (b): The long form (modern periodic table) periodic table is based on the increasing atomic number. The atomic number is the number of protons in the nucleus of an atom. The number of protons define the identity of an element.

38. **Given below are two statements:**
One is labelled as Assertion (A) and the other is labelled as Reason (R).
Assertion (A) Metallic character decreases and non-metallic character increases on moving from left to right in a period.

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Reason (R) It is due to increase in ionisation enthalpy and decrease in electron gain enthalpy, when one moves from left to right in a period.

In the light of the above statements, choose the most appropriate answer from the options given below.

(a) (A) is false but (R) is true
(b) (A) is true but (R) is false
(c) Both (A) and (R) are correct and (R) is the correct explanation of (A)
(d) Both (A) and (R) are correct but (R) is not the correct explanation of (A)

(JEE Main 2021, 31 Aug Shift-I)

Ans. (b) : Metallic character decreases and non-metallic character increases on moving from left to right in a period due to decrease ionization enthalpy and increase in electron gain enthalpy from left to right in a period.

39. The interaction energy of London forces between two particles is proportional to r^x, where r is the distance between the particles. The value of x is

(a) 3
(b) –3
(c) –6
(d) 6

(JEE Main 2021, 26 Aug. Shift-II)

Ans. (c) : According to London forces, "Greater than Polorisability of the interacting particles greater is the magnitude of interaction energy."

The energy of interaction force $\propto \frac{1}{r^6}$ where, r = distance between particles. The interaction energy of London forces is inversely proportional to sixth power of the distance between two interacting particles.

40. In the modern periodic table the acidic nature of oxides_______.

(a) Increases from left to right and decreases from top to bottom
(b) Decreases from right to left and increases from top to bottom
(c) Remains same across a period and increases from top to bottom
(d) Decreases from left to right and remains the same down the group

AP-EAMCET 25-08-2021 Shift - I

Ans. (a) : Acidic nature increases from left to right and decreases top to bottom in modern periodic table because the electronegativity decreases down the group. Electronegativity is the property of the element to attract electron pairs. When the metal is more electropositive, it has more basic oxide in nature and less in acidic character.

41. The plot of square root of frequency of X-ray emitted against atomic number led to suggestion of which law/rule?

(a) Periodic law
(b) Modern periodic law
(c) Hund's rule
(d) Newland's law

MHT CET-2014

Ans. (b) : Moseley gave the modern periodic law. He showed the atomic number is more fundamental property of an element than its atomic mass.

The square root of the frequency of a line (x-ray spectrum) is related to the atomic number Z.

$\sqrt{\nu} = a\,(z - b)$

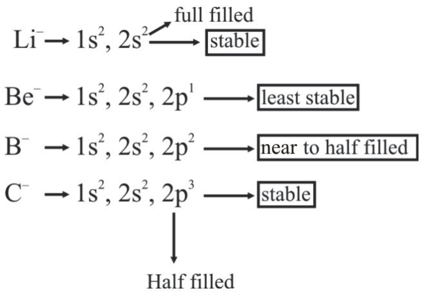
Where, Z = Atomic number
a = Proportionality constant
b = Another constant

42. Identify the least stable ion amongst the following :

(a) Be^-
(b) Li^-
(c) B^-
(d) C^-

MPPET-2013

Ans. (a) :


full filled
$Li^- \rightarrow 1s^2, 2s^2 \rightarrow$ stable
$Be^- \rightarrow 1s^2, 2s^2, 2p^1 \rightarrow$ least stable
$B^- \rightarrow 1s^2, 2s^2, 2p^2 \rightarrow$ near to half filled
$C^- \rightarrow 1s^2, 2s^2, 2p^3 \rightarrow$ stable
Half filled

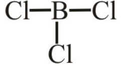
- Be^- is least stable.

43. Which one of the following has incomplete octet?

(a) NH_3
(b) BCl_3
(c) CCl_4
(d) PCl_3

UP CPMT-2012

Ans. (b) : ${}_5B$=2, 3
${}_{17}Cl$=2, 8, 7



In BCl_3, B has 6 electrons.
Therefore, it has incomplete octet.

44. Atomic numbers of elements X,Y and Z are 50, 78 and 60 respectively. these elements are placed in modern long from of Periodic Table respectively in

(a) p- block, d-block and f-block
(b) p-block, d- block and s- block
(c) s- block, p-block and d-block
(d) s-block, d-block and f- block

CG PET- 2011

Ans. (a) : Atomic number x=50 is tin(Sn).
It is an P-block element.
The electronic configuration of tin (Sn) is $[Kr]4d^{10}5s^2sp^2$.
Atomic number y = 78 is platinum (Pt).
It is an d-block element.
The electronic configuration of Platinum (Pt) is $[Xe]4f^{14}5d^96s^1$.
Atomic number z = 60 is neodymium (Nd).
It is an f-block element.
The electronic configuration of Nd is $[Xe]4f^46s^2$.
Therefore, In modern periodic table x, y and z are p-block, d-block and f-block element.

@apna_pdf

45. Which of the following is a wrong statement? In a given period of the Periodic Table, the s-block element has, in general, a higher value of

(a) electronegativity (b) atomic radius
(c) ionisation energy (d) electron affinity

JIPMER-2010

Ans. (b): Atomic radius decrease along the period so, s-block element will have high atomic radius.

- Electron affinity increases along the period so, s-block element will have less electron affinity.
- Electronegativity increases along the period so, s-block element will have less electro-negativity.
- Ionization energy increase along the period so, s-block element will have less Ionization energy.

46. Ortho and para- hydrogen have

(a) Identical chemical properties but different physical properties
(b) identical physical and chemical properties
(c) Identical physical properties but different chemical properties
(d) different physical and chemical properties.

WB-JEE-2010

Ans. (a) : Ortho and para hydrogen are similar in chemical properties but differ in some of the physical properties.

- Melting point of para hydrogen is 13.83k while that of ordinary hydrogen is 13.95k
- Boiling point of para hydrogen is 20.26k while that of ordinary hydrogen is 20.39k.
- The vapour pressure of liquid para hydrogen is higher than that of ordinary liquid hydrogen.

47. In a periodic table the basic character of oxides

(a) increases from left to right and decreases from top to bottom
(b) decreases from right to left and increases from top to bottom
(c) decreases from left to right and increases from top to bottom
(d) decreases from left to right and increases from bottom to top.

WB-JEE-2010

Ans. (c) : In the periodic table, on moving along a period, the tendency to lose electrons decreases and thus, the metallic character decrease since the oxides of non-metal are acidic. Thus, on moving along a period from left to right basic character decrease. While on moving down top to bottom in a group basic character increases due to increase in metallic character.

48. In which one of the following pairs the radius of the second species is greater than that of the first?

(a) Na, Mg (b) O^{2-}, N^{3-}
(c) Li^{+}, Be^{2+} (d) Ba^{2+}, Sr^{2+}
(e) Al, Be

Kerala-CEE-2007

Ans. (b) : O^{2-} and N^{3-} both are isoelectronic but differ in the charge possessed by them as the negative charge increases, the electrons are held less tightly by the nucleus, therefore O^{2-}, N^{3-} have greater the electrons more the repulsion and hence the larger size.

49. Which of the following does not exhibit the periodicity in properties of the elements?

(a) s- block (b) d- block
(c) p- block (d) f- block

CG PET -2005

Ans. (c) : All the periodic properties exhibit regular trends while moving across the period as well as moving down the group but in exactly opposite manner. The n/p ratio does not behave in this manner and hence p-block element not show the periodicity in properties of the element.

50. Which of the following does not exhibit the periodicity in properties of the elements?

(a) Ionisation energy (b) n/p ratio
(c) Electro negativity (d) Atomic radius

CG PET -2005

Ans. (b) : Electron affinity, Electronegativity and atomic radius follow the periodicity in properties of the element but n/p ratio does not behave in this manner. Hence, the n/p ratio does not exhibit the periodicity in properties of the element.

51. The first artificial disintegration of an atomic nucleus was achieved by:

(a) Geiger (b) Wilson
(c) Madam Curie (d) Rutherford

JCECE - 2005

Ans. (d) : The first artificial disintegration is the term coined by Ernest Rutherford, for the process by which an atomic nucleus is broken by bombarding it with high speed alpha particle's either from a particle accelerator or a naturally decaying radioactive substance such as radium.

52. As per the modern periodic law, "the physical and chemical properties of elements are periodic functions of their

(a) Atomic number"
(b) Electronic configuration"
(c) Atomic weight"
(d) Atomic size"

A.P.EAMCET 1998

Ans. (a) : According to modern periodic law, "The physical and chemical properties of the elements are periodic function of their atomic numbers.
Atomic weight is defined as the number of protons and neutrons in an atom. Atomic size is define as the distance between an atom's nucleus and its outermost shell is measured in atomic size.

53. In the long form of Periodic Table, the elements having lowest ionization potential are present in

(a) I group (b) IV group
(c) VII group (d) zero group

A.P.EAMCET 1992

Ans. (a) : The group I of the periodic table, the element is loosely attached to the nucleus, it easily to remove the electron from atom. Hence, the group-I has lowest ionization potential.

54. The law of triads is applicable to a group of

(a) Cl, Br, l (b) C,N,O
(c) Na, K, Rb (d) H,O,N

JEE Main, 24.09.2019

@apna_pdf

Ans. (a): According to the law of triads, in a group of three elements, the average atomic masses of the first and last element would be approximately equal to the atomic mass of middle elements.
Do bereiner also suggested that the law of triads can also be extended for other quantifiable properties such as density of elements.
Bromine must be approximately equal to the average of atomic masses of chlorine and Iodine.
Hence, Cl, Br, I are follow the law of triads.

(3.c) Periodic Classification, Periodic Trends

55. Which of the following electronic configurations corresponds to an inert gas?

(a) $1s^2, 2s^2, 2p^5$ (b) $1s^2, 2s^2, 2p^6$
(c) $1s^2, 2s^1$ (d) $1s^2, 2s^2, 2p^6, 3s^1$

BITSAT-2010
A.P.EAMCET 1993
NEET-1989

Ans. (b) : Inert gas configuration has outermost shell has completely filled. So the option (b) is correct for inert gas configuration.

56. Which of the following pairs has both members from the same period of periodic table :

(a) Na, Ca (b) Na, Cl
(c) Ca, Cl (d) Cl, Br

BITSAT 2010
BCECE-2006

Ans. (b) : $_{11}$Na 2, 8, 1; $_{17}$Cl 2, 8, 7
These have same number of shells. Hence, they are the elements of the same period.

57. Identify the correct order of the size of the following.

(a) $Ca^{2+} < K^+ < Ar < Cl^- < S^{2-}$
(b) $Ar < Ca^{2+} < K^+ < Cl^- < S^{2-}$
(c) $Ca^{2+} < Ar < K^+ < Cl^- < S^2$
(d) $Ca^{2+} < K^+ < Ar < S^{2-} < Cl^-$

NEET-2010, 2007

Ans. (a) : The isoelectronic ions ionic radii of anions is more than that of cations further the size of anion increases with increases in negative charge 4th size of the cation decrease with increases in positive charge.
The increasing of the size of ions are:-
$Ca^{2+} < K^+ < Ar < Cl^- < S^{2-}$

58. Which of the following represents the correct order of increasing electron gain enthalpy with negative sign for the elements O, S, F and Cl?

(a) Cl < F < O < S (b) O < S < F < Cl
(c) F < S < O < Cl (d) S < O < Cl < F

NEET-2010, 2005

Ans. (b) : Electron gain enthalpy generally increases in a period from left to right and decrease from top to bottom in a group of periodic table.
Cl and F are belong to 17 group and O and S are belong to 16 group. Cl has higher electron gain enthalpy than F because the incoming electron experience a greater force of repulsion because of small size of F atom. Similarly, in case of O and S. Thus, the correct order of electron gain enthalpy is-
O < S < F < Cl

59. The set of elements that differ in mutual relationship from those of the other sets is

(a) Li-Mg (b) B-Si
(c) Be-Al (d) Li-Na

(JEE Main 2021, 17 March Shift-II)

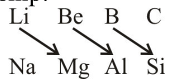
Ans. (d) : Li-Mg, Be-Al and B-Si show as diagonal relationship but Li and Na do not show diagonal relationship as both belongs to some group and not placed diagonally.

60. The set of elements that differ in mutual relationship from those of the other sets is:

(a) Be–Al (b) B-Si
(c) Li-Na (d) Li-Mg

JEE Main 17.03.2021, Shift-II

Ans. (c) : Be-Al, B-Si, Li-Mg have the diagonal relationship whereas Li-Na are of the same group element and have the other properties than diagonal relationship sets. So, Li and Na does not have diagonal relationship.

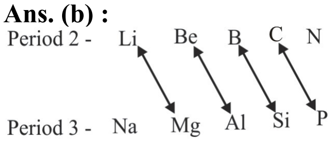


61. From the given pairs of elements, the correct set of elements that does not possess

(a) B – Si, Nb – Ta (b) Li – Al, C – P
(c) Mo – W, B – Si (d) Zr – Hf, Be – Al

TS EAMCET 10.08.2021, Shift-II

Ans. (b) :



62. In general, the properties that decrease and increase down a group in the periodic table, respectively are

(a) electronegativity and atomic radius
(b) electronegativity and electron gain enthalpy
(c) electron gain enthalpy and electronegativity
(d) atomic radius and electronegativity

(JEE Main 2019, 9 Jan Shift-I)

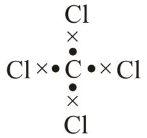
Ans. (a) : Electro negativity is a measure of the tendency of an atom to attract a bonding pair of electron.
On moving to down the group electronegativity decrease and increase down the group atomic radius respectively.
Electron gain enthalpy becomes more negative from left to right in a period.

63. Which of the following has octet around central atom?

(a) PF_5 (b) SF_6
(c) CCl_4 (d) BF_3

JIPMER-2019

Ans. (c) : The molecules that refers to the tendency of an atom to have 8 electrons in the valence shell.



Thus, CCl_4 Molecule has complete the octet around the central atom of chlorine.

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64. Which statement (s) is (are) false for the periodic classification of elements?

(a) The properties of the elements are the periodic functions of their atomic numbers

(b) Non-metallic elements are lesser in number than the metallic elements

(c) The first ionisation energies of the elements along a period do not vary in a regular manner with increase in atomic number

(d) For transition elements, the d-electrons are filled monotonically with increase in atomic number

(e) Both (c) and (d)

Kerala-CEE-2018

Ans. (d) : For transition elements, the d-electrons are not filled monotonically with increase in atomic number.

The first ionization energy of the element along a period vary in a regular manner with increase in atomic number.

65. An element has [Ar]$3d^1$ configuration in its +2 oxidation state. Its position in the periodic table is

(a) period-3, group - 3 (b) period-3, group - 7

(c) period-4, group - 3 (d) period-3, group – 9

AP-EAMCET – 2016

Ans. (c) : Given that an element with electronic configuration [Ar]$3d^1$ in its + 2 oxidation state.

$\therefore$ The atomic number of element

$= Ar + 1 + 2 = 21$

Thus, the element is Scandium. It belong to 4th period and group - 3

66. Identify the most acidic oxide among the following oxides based on their reaction.

(a) SO_3 (b) P_4O_{10}

(c) Cl_2O_7 (d) N_2O_5

AP-EAMCET (Engg.) 2015

Ans. (c) : On going from left to right in a period, the ionisation energy of element generally increases. Hence, their oxides basic to amphoteric to acidic character.

Oxide of more electronegative atom is more acidic in nature.

The oxidation state of oxygen is –2. Let x be the oxidation state of non metal.

For, SO_3 molecule, $x + (-2)3 = 0$ or $x = +6$

For P_4O_{10} molecule, $4(x) + 10(-2) = 0, x = +5$

For, Cl_2O_7 molecule, $2(x) + 7(-2) = 0$ or $x = +7$

For, N_2O_5 molecule, $2(x) + 5(-2) = 0$ or $x = +5$

67. Assertion: Both Be and Al can form complexes such as BeF_4^{2-} and AlF_6^{3-} respectively, BeF_6^{3-} is not formed.

Reason: In case of Be, no vacant d-orbital's are present in its outermost shell.

(a) If both Assertion and Reason are correct and the Reason is the correct explanation of Assertion.

(b) If both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.

(c) If Assertion is correct but Reason is incorrect.

(d) If both the Assertion and Reason are incorrect.

AIIMS-2015

Ans. (a): Be and Al can form complexes such as BeF_4^{2-} and AlF_6^{3-} respectively, BeF_6^{3-} is not formed due to the absence of vacant d-orbital is not enough orbitals to accommodate extra electrons.

Hence, both asseration and reasons are correct and reason is the correct explanation of the assertion.

68. The element, with atomic number 118, will be

(a) alkali (b) noble gas

(c) lanthanide (d) transition element

BITSAT-2015

Ans. (b) : Electronic configuration of element with atomic number 118 will be [Rn]$5f^{14}6d^{10}$ $7s^27p^6$. Since its electronic configuration in the outermost orbit (ns^2np^6) resemble with that of inert or noble gases, therefore it will be noble gas element.

69. The element with atomic number 117 has not been discovered yet. In which family would you place this element if discovered?

(a) Alkali metals (b) Alkaline earth metals

(c) Halogens (d) Noble gases

AIIMS-2014

Ans. (c): The electronic configuration of the element with atomic number 117 (Rn) $5f^{14}$, $6d^{10}$, $7s^2$, $7p^5$.

This element contains 7 electrons in its outermost shell. So, it belong to VII A (17) group of periodic table. It is a halogen family.

70. The number of elements present in the fourth period is

(a) 32 (b) 8

(c) 18 (d) 2

AP-EAMCET (Engg.) 2013

Ans. (c) : For 4th period

$\therefore$ The orbital in 4th period is = 4s, 3d, 4p

And the no. of electron in the orbit is 2, 10, 6

The number of electron present in the fourth period is 18.

71. The screening effect of d-electrons is

(a) Equal to p-electrons

(b) Much more than p-electrons

(c) Same as f-electrons

(d) Less than p-electrons

BITSAT-2013

Ans. (d) : The screening effect of inner electron of the nucleus is due to decrease in ionization potential, therefore the order of the screening effect is

$f < d < p < s$

Hence, the screening effect of d-election is less than p-electron.

72. Identify the wrong statement in the following.

(a) Amongst isoelectronic species, smaller the positive charge on the cation, smaller is the ionic radius

(b) Amongst isoelectronic species, greater the negative charge on the anion, larger is the ionic radius

@apna_pdf

(c) Atomic radius of the elements increases as on moves down the first group of the periodic table.
(d) Atomic radius of the elements decreases as on moves across from left to right in the 2nd period of the periodic table.

NEET-2012

Ans. (a) : The positive charge on the cation increases, the effective nuclear charge increases. Thus, the atomic size decreases. Since the number of the shell increases, So atomic radius increases. Against isoelectronic species, ionic radius increases with increases in negative charge or decrease in positive charge.

73. Properties of elements are periodic function of number of_______ present in the nucleus.
(a) protons (b) electrons
(c) neutrons (d) mesons.

J & K CET-(2012)

Ans. (a) : Properties of elements are periodic function of number of protons present in the nucleus. Number of protons = number of electrons.

- Physical and chemical properties of elements depend on the number of electrons and their arrangement.

Thus, properties of elements are periodic function of number of protons present in the nucleus.

74. As we move from left to right in the 3d-series elements
(a) electropositive character decreases
(b) electropositive character increases
(c) electropositive character decreases and electronegative character increases
(d) electropositive character increases and electronegative character decreases.

COMEDK-2011

Ans. (c) : As we move in the row from left to right, electrons are added to the 3d subshell to neutralize the increase in the positive charge of the nucleus as the atomic number increase so, we move from left to right in 3d series element electropositive character decrease and electronegative character increases.

75. Beryllium and aluminium exhibit many properties which are similar. But, the two elements differ in
(a) forming covalent halides
(b) forming polymeric hydrides
(c) exhibiting maximum covalency in compounds
(d) exhibiting amphoteric nature in their oxides

BITSAT-2011

Ans. (c) : Beryllium and aluminium are S-block element and P-block element respectively.
Exhibiting maximum covalency in compoundly due to diagonal relationship, Be and Al have many similar properties. However they differ in exhibiting maximum covalency.
Maximum covalency of Be = 4
Maximum covalency of Al = 6
This is due to absence of d-orbital in Be.

76. Number of elements presents in the fifth period of Periodic Table is
(a) 32 (b) 10
(c) 18 (d) 8

JCECE - 2010

Ans. (c) : The fifth period is from rubidium (37) to xenon (54). The last electron enters in 5s, 4d or 5p orbitals. Therefore, the fifth period has (2 + 10 + 6) 18 elements.

77. The effective nuclear charge is equal to
(a) Z – S (b) Z + S
(c) A – Z (d) Z + A

SRMJEEE – 2009

Ans. (a) : The effective nuclear charge is the net positive charge experienced by valence electrons.
Z = atomic number
S = Number of shielding electrons

$$\boxed{Z_{eff} = Z - S}$$

78. Lattice energy of an ionic compound depends upon
(a) charge on the ion only
(b) size of the ion only
(c) charge on the ion and size of the ion
(d) packing of its ions only

AP - EAMCET(MEDICAL) - 2009

Ans. (c) : From the Born-Lande equation–

$$U = \frac{N_A M z^+ z^- e^2}{4\pi \in_0 r}\left(1 - \frac{1}{n}\right)$$

Where, U = Lattice energy of crystal
N_A = Avogadro's number
M = Molecular weight
z^+, z^- = Charge of cation and anion
r = Radius of the atom
n = Exponent

From the above equation it is clear that lattice energy depends upon charge on the ion and size of the ion.

79. Beryllium resembles much with :
(a) Zn (b) Al
(c) Li (d) Ra

BITSAT 2009

Ans. (b) : Beryllium resembles with aluminium due to similarity in the size of ions and similarity in electropositive character. This type of resemblance between first elements of a group in second period with second element of the next group is termed as diagonal relationship.

80. Which of the following properties of lithium does not show diagonal relationship with magnesium?
(a) Formation of Li^+ ion
(b) Formation of Li_3N
(c) Solubility of $LiHCO_3$
(d) Thermal decomposition of Li_2CO_3

CG PET -2009

Ans. (a) : Molecular radius of Li is 60 and Mg^{+2} ion is 65.

- Does not solubility of bicarbonates.
- Format with ion and heat to made Li_2CO^3
- Both Li and Mg combine directly with N_2 to give nitride Li_3N_2 and Mg_3N_2
- Bicarbonates of Li and Mg are more soluble in water than carbonates. Whereas carbonates of alkali metals are more soluble.

@apna_pdf

81. Increase in atomic size down the group is due to–

(a) increase in number of electrons
(b) increase in number of protons and neutrons
(c) increase in number of protons
(d) increase in number of protons, neutrons and electrons

BCECE-2008

Ans. (a) : Increase in atomic size down the group is due to increase in number of electrons.
To accommodate these electrons new shells are added to the atom. These new shells take the outermost electrons farther from the nucleus causing atomic size to increase as we go down the group.

82. On moving from left to right in the second period along the periodic table the gram atomic volume of the element

(a) increases with constant velocity
(b) remains unchanged
(c) first increases and then decreases
(d) decreases

CG PET-2007

Ans. (d) : On moving from left to right in the second period of the periodic table the gram atomic valence of the element decreases.
The atomic valence of noble gases is comparatively larger as they have large Van der Waals radii due to completed valence shell, with all electrons paired which causes greater repulsion.

83. Which of the following elements represents highly electropositive as well as highly electronegative character in its period?

(a) Hydrogen
(b) Nitrogen
(c) Fluorine
(d) None

BITSAT-2007

Ans. (a) : First period has H and He only, out of which He is inert, hence H behaves as a highly electropositive as well as electronegative element.

84. The group of elements in which the differentiating electron enters the antepenultimate shell of atoms are called

(a) *f*-block elements
(b) p-block elements
(c) s-block elements
(d) d-block elements

J & K CET-(2007)

Ans. (a) : The group of elements in which the differentiating electron enters the antepenult-s timate shell of atoms are called f-block elements.
Incase of inner transition elements i.e. f-block elements, the last three shell are namely valence, penultimate and penultimate and penultimate shell are incomplete. The inner transition elements the last shell contains two electrons and the penultimate shell may contain electron more than eight or nine and penultimate shell contains more than 18 upto 32 electrons.

85. Pick out the statement(s) which is (are) not true about the diagonal relationship of Li and Mg:

(i) polarizing powers of Li^+ and Mg^{2+} are almost same
(ii) like Li, Mg decomposes water very fast
(iii) LiCl and $MgCl_2$ are deliquescent
(iv) like Li, Mg do not form solid bicarbonates

(a) (i) and (ii)
(b) (ii) and (iii)
(c) only (ii)
(d) only (i)
(e) (ii) and (iv)

Kerala-CEE-2006

Ans. (c) : The diagonal relationship of Li and Mg of the properties are:-
(i) Polarizing powers of Li^+ and Mg^{2+} are almost same
(ii) Li,Mg decomposes water very fast
(iii) LiCl and $MgCl_2$ are deliquescent
(iv) Li,Mg dose not form solid bicarbonates

86. The cause of diagonal relationship is

(a) Similar electronegativities
(b) Similar ionic or atomic radii
(c) Similar polarizing power of ions
(d) All the three

BITSAT-2006

Ans. (d) : Diagonal relationship is formed due to the identical size of ions, we move forward right across a period in the periodic table then the size of the atom reduces and when we move downward across a group then the size of the atom gradually increases.
- Similar electronegativities
- Similar ionic or atomic radii
- Similar polarizing power of ions

87. Which is responsible for the diagonal relation of lithium with magnesium?

(a) Less ionic radii
(b) High polarising power
(c) Approximately equal electronegativity and affinity
(d) All of the above

CG PET -2006

Ans. (d) : The diagonal relationship of lithium with magnesium are–
- Both have almost similar electro negativity
- Both Li and Mg are quite hard They are harder and lighter than other elements in their receptive group.
- Both Lithium and magnesium have small size and high charge density.
- They are low and almost same. Their ionic radii are similar.

88. Diagonal relationship is for:

(a) Li – Na
(b) Be – Mg
(c) Si – C
(d) B – Si

UPTU/UPSEE-2006

Ans. (d) : Diagonal relationships occur because of the direction in the trends of various properties as you move across or down the Periodic table. Many of the chemical properties of an element are related to the size of the atom.
Diagonal relationship is–
Li and Mg, Be and Al, B and Si etc.

89. The stability of ferric ion is due to :

(a) half filled f - orbitals
(b) half filled d- orbitals
(c) completely filled f- orbitals
(d) completely filled d- orbitals

BCECE-2006

@apna_pdf

Ans. (b) : Ferric ion Fe^{3+} has half filled d-orbital.
The electronic configuration of irons is (Ar) $3d^6\ 4s^2$. So, when we say ferric it mean iron loses three electrons, that is it loses two electron from 2s–orbitals and one electron from 3d orbitals. Therefore, ferric ion has d-orbital is filled by 5 electrons that is half filled and half filled orbitals are stable.

90. Following statements regarding the periodic trends of chemical reactivity of the alkali metals and the halogens are given. Which of these statements give the correct picture?
(a) The reactivity decreases in the alkali metals but increases in the halogens with increase in atomic number down the group
(b) In both the alkali metals and the halogens the chemical reactivity decreases with increase in atomic number down the group
(c) Chemical reactivity increases with increase in atomic number down the group in both the alkali metals and halogens
(d) In alkali metals, the reactivity increases but in the halogens it decreases with increase in atomic number down the group

(AIEEE-2006)

Ans. (d) : In alkali metal, we move top to bottom in a group size increases thus, reactivity increases. But in halogen, the reactivity decrease due to decrease in electronegativity and decrease oxidizing ability due to the inert pair effect atomic radius increases from top to bottom in a group which less the attraction of valence electron of other atoms thus, decreasing reactivity.

91. p-orbital in a given shell can accommodate upto–
(a) four electrons
(b) two electrons with parallel spin
(c) six electrons
(d) two electrons with opposite spin

BCECE-2005

Ans. (c) : Any orbital of any subshell can accommodate a maximum of two electrons with opposite spins. 'P' subshell have 3 orbitals (Px, Py, Pz). Each orbital can accommodate two electrons with opposite spin.

Therefore, P-orbitals in a given shell can accommodate upto six electrons.

92. In the periodic table metallic character of elements shows one of the following trend:
(a) Decreases down the group and increases across the period
(b) Increases down the group and decreases across the period
(c) Increases across the period and also down the group
(d) Decreases across the period and also down the group

JCECE - 2005

Ans. (b) : The effective nuclear charge acting on the valence shell electrons increases across a period, the tendency to lose electrons will decreases. Down the group, the effective nuclear charge experienced by valence electrons decrease because the outer most electrons move further away from the nucleus. Therefore, these can be lost easily.
Hence, metallic character decreases across a period and increase down a group.

93. Which of the following is correct?
(a) The number of electrons present in the valence shell of S in SF_6 is 12
(b) The rates of ionic reactions are very slow
(c) According to VSEPR theory, $SnCl_2$ is a linear molecule
(d) The correct order of ability to form ionic compounds among Na^+, Mg^{2+} and Al^{3+} is $Al^{3+} > Mg^{2+} > Na^+$

AP-EAMCET/2005

Ans. (a)
- The number of electrons present in the valence shell of S in SF_6 is 12. Statement is true.
- The rates of ionic reactions are very fast. Statement is false.
- According, to VSEPR theory, $SnCl_2$ is a bent or V-shaped molecule. Statement is false.
- The correct order of ability to form ionic compounds among Na^+, Mg^{2+} and Al^{3+} is $Na^+ > Mg^{2+} > Al^{3+}$. Statement is false.

94. What is the correct relationship between the pH of isomolar solutions of sodium oxide, Na_2O (pH_1), sodium sulphide, Na_2S (pH_2), sodium selenide, Na_2Se (pH_3) and sodium telluride Na_2Te(pH_4)?
(a) $pH_1 > pH_2 > pH_3 > pH_4$
(b) $pH_1 > pH_2 = pH_3 > pH_4$
(c) $pH_1 > pH_2 < pH_3 < pH_4$
(d) $pH_1 > pH_2 < pH_3 \approx pH_4$

NEET-2005

Ans. (a) : The basicity of these oxides decreases, when placed in water, the basicity of solution also decreases.

$Na_2O + 2H_2O \longrightarrow 2NaOH + H_2O$
$Na_2S + 2H_2O \longrightarrow 2NaOH + H_2S$
$Na_2Se + 2H_2O \longrightarrow 2NaOH + H_2Se$
$Na_2Te + 2H_2O \longrightarrow 2NaOH + H_2Te$

Hence, the order of neutralisation of NaOH is $H_2Te > H_2Se > H_2S > H_2O$.
Their aqueous solution have the following order of basic character due to neutralization of NaOH with–
$Na_2O > Na_2S > Na_2Se > Na_2Te$
or $(pH_1) > (pH_2) > (pH_3) > (PH_4)$

95. Which one shows most pronounced inert pair effect?
(a) Si (b) Sn
(c) Pb (d) C

J & K CET-(2004)

Ans. (c) : Inert pair effect is observed in the elements of group 13 up to group 17. It can be defined as the inability of S electron inheavier P-block elements to participate in bonding. The stability of oxidation states two units less than the maximum oxidation of a group increases down the group.
Inert pair effect is a result at poor shielding of d and f-orbital and filling of electron in Al does not involve any d or f-orbital.
Thus, the Pd is most likely to show innert pair effect.

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96. The element with atomic number 12 belongs to --- group and --- period.

(a) IA, third
(b) III A, third
(c) II A, third
(d) II A, second

A.P.EAMCET 2001

Ans. (c) : Given $_{12}Z = 1s^2\ 2s^2\ 2p^6\ 3s^2$
The element is Mg, it belongs to the IIA group and third period.

97. The electronic configuration of group XIII elements is

(a) ns^1np^2
(b) ns^2np^3
(c) ns^2np^2
(d) ns^2np^1

A.P.EAMCET 2000

Ans. (d) : The electronic configuration of group III element is $ns^2\ np^1$
e.g- $_{5}B$, $_{13}Al$, $_{31}Ga$, $_{49}In$, $_{81}Tl$, $_{113}Nh$

98. Which of the following is the atomic number of metal?

(a) 32
(b) 34
(c) 36
(d) 38

AIIMS-2000

Ans. (d): The atomic number 38 is metal and name is Strontium, which is s-block element. All elements of s-block are metals.
On moving down the group, the size of the atom increases due to the increase in the number of shells. Because of that the attraction between the nucleus and the valence electrons decreases.

99. Which group of periodic table contains no metal?

(a) IA
(b) IIIA
(c) VIIA
(d) VIII

AIIMS-1999

Ans. (c): The group VII A of halogens such as fluorine, chlorine, bromine, iodine etc.
The word halogen means salt producing so halogen react with metal to form salt and halogen family has no-metals.
Group IA and III A contain mostly metals and group VIII contains transition elements which are metals.

100. Among the following elements that has the lowest first ionization potential is

(a) nitrogen
(b) oxygen
(c) fluorine
(d) neon

A.P.EAMCET 1994

Ans. (b) : $_7N = 1s^2\ 2s^2\ 2p^3$

$_8O = 1s^2\ 2s^2\ 2p^4$

$_9F = 1s^2\ 2s^2\ 2p^5$

$_{10}Ne = 1s^2\ 2s^2\ 2p^6$

Nitrogen has half-filled orbital and Ne has filled orbital it show stable configuration but Oxygen has less stable configuration and less nuclear charge.

101. Which of the following has the smallest size?

(a) Al^{3+}
(b) F^-
(c) Na^+
(d) Mg^{2+}

NEET-1994

Ans. (a) : The size of cation is small then their neutral atom because it has less electrons while its nuclear charge remains the same. So, the nucleus attracts the electron more towards itself and leads to the decrease in size. Al^{3+} ion has smallest size.

- When an atom losses electrons, it results in the formation of positive ion known as cation.
- When an atom gains electrons, it results in the formation of negative ion known as anion.

102. One of the characteristic properties of non-metals is that they

(a) are reducing agents
(b) form basic oxides
(c) form cations by electron gain
(d) an electronegative

NEET-1993

Ans. (d) : Elements with a high electronegativity are generally non-metals and electrical insulators and tend to behave as oxidation in chemical reactions.
Conversely, elements with a low electronegativity are generally metals and good electrical conductor and tend to behave as reductants in chemical reactions.

103. Which one of the following has minimum value of cation/anion ratio?

(a) NaCl
(b) KCl
(c) $MgCl_2$
(d) CaF_2

NEET-1993

Ans. (c) : The given species potassium (K) has the biggest size. The order of the ionic size is $K^+ > Ca^{2+} > Na^+ > Mg^{2+}$.
Hence, the ratio of cation and anion is Mg^{2+}/Cl^- has minimum value of cation/anion ratio.

104. Which of the following sets has strongest tendency to form anions?

(a) Ga, Ni, Tl
(b) Na, Mg, Al
(c) N, O, F
(d) V, Cr, Mn

NEET-1993

Ans. (c) : Non-metal have very strong tendency to form anion whereas metals have tendency to form cation in group of nitrogen, fluorine and oxygen. All elements are non-metals but in other options metal are present. N, O and F are more electronegative element, so they accept electrons more easily and form negative ions.

105. Which of the following has largest size?

(a) Na
(b) Na^+
(c) Na^-
(d) Can't be predicted.

NEET-1993

Ans. (c) : Na^- is the largest because one extra electron is present which is not attracted strongly by the nucleus and no one electron is remove then the cation are always smaller in size.
Hence, the decreasing order of the size of $Na^- > Na > Na^+$.

106. Na^+, Mg^{2+}, Al^{3+} and Si^{4+} are isoelectronic. The order of their ionic size is

(a) $Na^+ > Mg^{2+} < Al^{3+} < Si^{4+}$
(b) $Na^+ < Mg^{2+} > Al^{3+} > Si^{4+}$
(c) $Na^+ > Mg^{2+} > Al^{3+} > Si^{4+}$
(d) $Na^+ < Mg^{2+} > Al^{3+} < Si^{4+}$

NEET-1993

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Ans. (c) : Atomic radii and atomic size decrease across a period, cations are smaller size. Among isoelectronic ions, the one with the larger positive nuclear charge will have a smaller radius. Hence, the largest species is Na^+ and the smallest one Si^{+4}.
Therefore, the order of their ionic size are–
$Na^+ > Mg^{2+} > Al^{3+} > Si^{4+}$.

107. In the periodic table from left to right in a period, the atomic volume
(a) decrease
(b) increase
(c) remains same
(d) first decrease then increase

NEET-1993

Ans. (d) : In the periodic table the atomic size first decrease from left to right in period, so the atomic volume first decreases and then increase because atomic size in last of any period increases.
The atomic volume of noble gases is comparatively larger as they have large Van der Waals radii due to completed valence shell, with all electrons paired which causes greater repulsion.

3. Atomic and Ionic Radii

108. The correct order of increasing ionic radii is
(a) $Mg^{2+} < Na^+ < F^- < O^{2-} < N^{3-}$
(b) $N^{3-} < O^{2-} < F^- < Na^+ < Mg^{2+}$
(c) $F^- < Na^+ < O^{2-} < Mg^{2+} < N^{3-}$
(d) $Na^+ < F^- < Mg^{2+} < O^{2-} < N^{3-}$

JEE Main-27.06.2022, Shift-II

Ans. (a) : Ionic radii is the distance from the nucleus up to which it has influence on its electron bond.
The ionic radii of isoelectronic species increases with a decreases in the magnitudes of nuclear charge.
So, The correct order of increasing ionic radii is $Mg^{2+} < Na^+ < F^- < O^{2-} < N^{3-}$.

109. Decreasing size of ions is :
(a) $I > I^- > I^+$
(b) $I^- > I > I^+$
(c) $I^+ > I^- > I$
(d) $I > I^+ > I^-$

CG PET -2007, BCECE-2005
MPPET-2000, NEET-1996
PBCET-1986

Ans. (b) : When an atom added electron then the subshell are added and size is increases. When an atom are remove electron then subshell are removed and size is decrease.
So, the decreasing order of size are –
$I^- > I > I^+$

110. The correct sequence which shows decreasing order of the ionic radii of the elements is
(a) $Al^{3+} > Mg^{2+} > Na^+ > F^- > O^{2-}$
(b) $Na^+ > Mg^{2+} > Al^{3+} > O^{2-} > F^-$
(c) $Na^+ > F^- > Mg^{2+} > O^{2-} > Al^{3+}$
(d) $O^{2-} > F^- > Na^+ > Mg^{2+} > Al^{3+}$

JEE Main-04.09.2020, Shift-I
JEE Main-05.09.2020, Shift-II
AIEEE 2010, J&K CET-1997

Ans. (d) :
$$\frac{Z}{e} = \frac{\text{nuclear charge}}{\text{no. of electrons}}$$
When Z/e ratio decrease the size increase for
O^{2-}, $\frac{Z}{e} = \frac{8}{10} = 0.8$
F^-, $\frac{Z}{e} = \frac{9}{10} = 0.9$
Na^+, $\frac{Z}{e} = \frac{11}{10} = 1.1$
Mg^{2+}, $\frac{Z}{e} = \frac{12}{10} = 1.2$
Al^{3+}, $\frac{Z}{e} = \frac{13}{10} = 1.3$
Hence, the decreasing order of ionic radii of the element are–
$$O^{2-} > F^- > Na^+ > Mg^{2+} > Al^{3+}$$

111. The ionic radii (in Å) of N^{3-}, O^{2-}, and F^- respectively are
(a) 1.36, 1.40 and 1.71
(b) 1.36, 1.71 and 1.40
(c) 1.71, 1.40, and 1.36
(d) 1.71, 1.36 and 1.40

CG PET -2018
(JEE Main 2015)
J & K CET-(2003)

Ans. (c) : Z/e increase then the atomic radii decreases. Hence, the ionic radii of N^{3-}, O^{2-} and F^- are 1.71, 1.40 and 1.36 Å respectively.

112. Ionic radii are
(a) inversely proportional to effective number charge
(b) inversely proportional to square of effective nuclear charge
(c) directly proportional to effective nuclear charge
(d) directly proportional to square of effective nuclear charge

JCECE – 2008, NEET-2004
UPTU/UPSEE-2007

Ans. (a) : Ionic radii varies with effective nuclear charge (Z_{eff}) and screening effects.
Ionic radii is inversely proportional to the effective nuclear charge as if the radii increases nuclear attractions decreases gradually.
$$r_{ionic} = \propto \frac{1}{Z_{eff}}$$

113. Due to lanthanoid contraction ……….. elements exhibit similar radii.
(a) Zn and Hg
(b) Zr and Hf
(c) Zr and Y
(d) Ag and Cd

NEET-2021
JCECE - 2018

Ans. (b) : Due to lanthanoid contraction, Zr and Hf elements exhibit similar radii. This contraction came into effect due to the poor shielding of 4f electrons because of the poor shielding effect, the attraction on the electrons by the nucleus increases and hence, radius decreases.

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114. Which of the following orders of ionic radii is correctly represented?

(a) $H^- > H > H^+$ (b) $Na^+ > F^- > O^{2-}$

(c) $F^- > O^{2-} > Na^+$ (d) $Al^{3+} > Mg^{2+} > N^{3-}$

NEET-2014

Karnataka-CET-2018

Ans. (a) : It is known that the radius of cation is always smaller than that of a neutral atom due to decrease in the number of orbits. Where as the radius of anion is always greater than a cation due to decrease in effective nuclear charge hence, the order are-

$H^- > H > H^+$

115. The increasing order of the atomic radii of the following elements is

(A) C (B) O

(C) F (D) Cl

(E) Br

(a) (A) < (B) < (C) < (D) < (E)

(b) (C) < (B) < (A) < (D) < (E)

(c) (D) < (C) < (B) < (A) < (E)

(d) (B) < (C) < (D) < (A) < (E)

(JEE Main 2020, 8 Jan Shift-II)

JCECE-2008

Ans. (b) : On moving from left to right in period atomic radii decrease and moving from top to bottom in a group atomic radii increases.

$\therefore$ Thus, the increasing order of atomic radii are–

F < O<C < Cl < Br

116. The set representing the correct order of ionic radius is

(a) $Li^+ > Be^{2+} > Na^+ > Mg^{2+}$

(b) $Na^+ > Li^+ > Mg^{2+} > Be^{2+}$

(c) $Li^{2+} > Na^+ > Mg^{2+} > Be^{2+}$

(d) $Mg^{2+} > Be^{2+} > Li^+ > Na^+$

UPTU/UPSEE-2015

(AIEEE 2009)

Ans. (b) : Ionic radii increases when moving down the group and its decrease as the positive charge on the element increases due to effective nuclear charge. In the cation, number of electrons are less than number of protons, hence its effective nuclear charge increase and ionic radii decrease.

The correct order of ionic radii–

$$\underset{95}{Na^+} > \underset{76}{Li^+} > \underset{72}{Mg^{2+}} > \underset{31}{Be^{2+}}$$

Ionic radii (pm)

117. The ionic radii of N^{3-},O^{2-} , F^- and Na^+ follow the order

(a) $N^{3-} > O^{2-} > F^- > Na^+$

(b) $N^{3-} > Na^+ > O^{2-} > F^-$

(c) $Na^+ > O^{2-} > N^{3-} > F^-$

(d) $O^{2-} > F^- > Na^+ > N^{3-}$

UPTU/UPSEE-2012

CG PET -2008, 2007

Ans. (a) : When the isoelectronic species the number of electron is increases the effective nuclear charge decrease and size of ion increase.

$$\text{size of ion} \propto \frac{1}{\text{nuclear charge}}$$

Hence, the order are –

$N^{3-}>O^{2-}> F^-> Na^+$

118. Ce^{3+}, La^{3+}, Pm^{3+} and Yb^{3+} have ionic radii in the increasing order as

(a) $La^{3+} < Ce^{3+} < Pm^{3+} < Yb^{3+}$

(b) $Yb^{3+} < Pm^{3+} < Ce^{3+} < La^{3+}$

(c) $La^{3+} < Ce^{3+} < Pm^{3+} < Yb^{3+}$

(d) $Yb^{3+} < Pm^{3+} < La^{3+} < Ce^{3+}$

[BITSAT-2005]

(AIEEE 2002)

Ans. (b) : Ionic radii decrease on moving along a lanthanide series due to lanthanide contraction. As all ion are in +3 oxidation state.

Thus, the ionic radii follow the trend are–

$Yb^{3+} < Pm^{3+} < Ce^{3+} < La^{3+}$

119. The correct order of ionic radius of nitrogen family is

(a) $N^{3-}<P^{3-} <As^{3-}<Sb^{3-}<Bi^{3-}$

(b) $N^{3-}<P^{3-} <Sb^{3-}$

(c) $P^{3-} =As^{3-}>Bi^{3-}$

(d) $N^{3-}> Bi^{3-}>Sb^{3-}$

Manipal-2020

CG PET- 2015

Ans. (a) : On moving down top to bottom in a group atomic radii increase due to new shell are added.

Thus, the order of ionic radius of nitrogen family are –

$N^{3-} < P^{3-} < As^{3-} < Sb^{3-} < Bi^{3-}$

120. The correct order of radii is

(a) N < Be < B (b) $F^- < O^{2-} < N^{3-}$

(c) Na < Li < K (d) $Fe^{3+} < Fe^{2+} < Fe^{4+}$

BITSAT 2011

J & K CET-(2004)

Ans. (b) : Effective nuclear charge (i.e. Z/e ratio) decreases from F^- to N^{3-}. Hence, the radii follows the order : $F^- < O^{2-} < N^{3-}$. Z/e for F^- = 9/10 = 0.9, for O^{2-} = 8/10 = 0.8, for N^{3-} = 0.7

121. The ions O^{2-}, F^-, Na^+, Mg^{2+} and Al^{3+} are isoelectronic. Their ionic radii show :

(a) A decrease from O^{2-} to F^- and then increase from Na^+ to Al^{3+}

(b) A significant increase from O^{2-} to Al^{3+}

(c) A significant decrease from O^{2-} to Al^{3+}

(d) An increase from O^{2-} to F^- and then decrease from Na^+ to Al^{3+}

BITSAT 2013, NEET-2003

Ans. (c) : Amongst isoelectronic species, ionic radii of anion is more than that of cations. Further size of anion increase with increase in –ve charge and size of cation decrease with increase in +ve charge. Hence, ionic radii decreases from O^{2-} to Al^{3+}.

122. The radii of F, F^- O and O^{2-} are in the order

(a) $O^{2-} > F^- > O > F$ (b) $O^{2-} > F^- > F > O$

(c) $F^- > O^{2-} > F > O$ (d) $O^{2-} > O > F^- > F$

BITSAT 2005

AP EAMCET (Medical) -1998

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Ans. (a): F, F^-, O and O^{2-} are of the same period. As the number of anions increases of isolated atom, the size of anion increases because of extra addition of electron in outer orbital. The size of anions are in the order–

$$O^{2-} > F^- > O > F$$

123. Which of the following options represents the correct ionic radii in Å of N^{3-}, O^{2-} and F^-, respectively?

(a) 1.71, 1.36 and 1.40 (b) 1.36, 1.40 and 1.71
(c) 1.71, 1.40 and 1.36 (d) 1.40, 1.36 and 1.71

TS-EAMCET (Engg.), 06.08.2021

Ans. (c):

Species (ion)	–	Ionic radii (Å)
N^{3-}	–	1.71
O^{2-}	–	1.40
F^-	–	1.36

124. The ionic radius of Na^+ ions is 1.02 Å. The ionic radii (in Å) of Mg^{2+} and Al^{3+}, respectively, are

(a) 1.05 and 0.99 (b) 0.72 and 0.54
(c) 0.85 and 0.99 (d) 0.68 and 0.72

[JEE Main-2021, 18 March Shift-I]

Ans. (b) : Radius (r) $\propto \frac{1}{Z_{\text{effective}}}$

Where Z = Atomic number

Na^+ Mg^{2+} Al^{3+}
Z = 11 Z = 12 Z = 13

Each have 10 electron.

Therefore, the ionic radii of Mg^{2+} and Al^{3+} are 0.72 and 0.54 respectively.

125. Effective nuclear charge is Maximum in case of______

(a) Lithium (b) Beryllium
(c) Oxygen (d) Fluorine

AP EAPCET 24.08.2021 Shift-II

Ans. (d) : On going from left to right in a period effective nuclear charge is maximum. So, the fluorine (F) has maximum effective nuclear charge.

The effective nuclear charge is the net positive charge experienced by valence electrons.

$$Z_{\text{eff.}} = Z - S$$

Where Z = Atomic number
S = Number of shielding electrons.

126. Which among the following property increases, as we move down group–I of the periodic table?

(a) Electronegativity (b) Ionic radius
(c) Melting point (d) Ionization enthalpy

AP EAPCET-6 Sep. 2021, Shift-II

Ans. (b) : In periodic table when we move down the group ionic radius increases due to the formation of new shells. As atomic number increases, the number of shells increases that's why atomic radius of ionic radius also increases.

127. Among the following ions, the one with the highest value of ionic radius is

(a) O^{2-} (b) Mg^{2+}
(c) L^+ (d) L^-

TS EAMCET 10.08.2021, Shift-II

Ans. (a) : decreasing order of ionic radius of given species is–

$$O^{2-} > F^- > Li^+ > Mg^{+2}$$

On increasing –ve charge among the electronic species, ionic radius increases.

128. Identify the correct order of ionic radii of the given species:

(a) $Mn^{7+} > V^{5+} > Sc^{3+} > K^+ > S^{2-}$
(b) $S^{2-} > K^+ > Sc^{3+} > V^{5+} > Mn^{7+}$
(c) $S^{2-} > K^+ > V^{5+} > Sc^{3+} > Mn^{7+}$
(d) $K^+ > S^{2-} > Sc^{3+} > V^{5+} > Mn^{7+}$

AP EAPCET 25.08.2021, Shift-II

Ans. (b) : Ionic radii is the distance between the nucleus and the electron in the outermost shell of an ions. Increasing the electron on an atom, increases the ionic radii. Decrease the e^- on an atom will be decrease ionic radii. So the order is–

$$S^{2-} > K^+ > Sc^{3+} > V^{5+} > Mn^{7+}$$

129. Assertion (A) : Beryllium and aluminum forms Be F_4^{2-} and Al F_6^{3-} Reason(R) : Both B^{2+} and Al^{3+} have almost same ionic radius

The correct option among the following is

(a) (A) is true, (R) is true and (R) is the correct explanation for (A)
(b) (A) is true, (R) is true but (R) is not the correct explanation for (A)
(c) (A) is true but (R) is false
(d) (A) is false but (R) is true

TS EAMCET 10.08.2021, Shift-I

Ans. (a) : Beryllium and aluminum forms BeF_4^{-2} and AlF_6^{3-} and Be^{+2} and Al^{+3} have almost same ionic radius due to about same electronegativity, polarizing power and charge/radius radio, of their ion.

130. Which among the following compound shows the highest lattice energy?

(a) LiF (b) CsF
(c) NaF (d) KF

AP EAPCET 23-08-2021 Shift-I

Ans. (a) : According to Born-Lande equation-

$$U = \frac{N_A M z^+ z^- e^2}{4\pi\varepsilon_0 r}\left(1 - \frac{1}{n}\right)$$

Lattice energy is inversely proportional to radius of ion. So, smaller the size of ions, larger the magnitude of charges, and having the highest lattice energy. Hence, LiF has maximum lattice energy.

131. The ions S^{2-}, Cl^-, K^+, Ca^{2+} are iso-electronic. Their ionic radii show______

(a) A decrease from S^{2-} to Cl^- and then increase from K^+ to Ca^{2+}
(b) An increase from S^{2-} to Cl^- and then decrease from K^+ to Ca^{2+}
(c) A significant decrease from S^{2-} to Ca^{2+}
(d) A significant increase from S^{2-} to Ca^{2+}

AP EAPCET 23-08-2021 Shift-I

Ans. (c) : The ions S^{2-}, $C\ell^-$, K^+, Ca^{2+} are iso-electronic and their ionic radii decreases S^{2-} to Ca^{2+} respectively.

Hence, correct option is (c).

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132. The ionic radii of F^- and O^{2-} respectively are 1.33 Å and 1.4 Å while the covalent radius of N is 0.74Å. The correct statement for the ionic radius of N^{3-} from the following is

(a) it is smaller than F^- and N
(b) it is bigger than O^{2-} and F^-
(c) it is bigger than F^- and N, but smaller than of O^{2-}
(d) it is smaller than O^{2-} and F^-, but bigger than of N

(JEE Main 2021, 25 July Shift-II)

Ans. (b) : The ionic radii of F^- and O^{2-} respectively are $1.33\ \overset{o}{A}$ and $1.4\ \overset{o}{A}$ while the covalent radius of N is $0.74\ \overset{o}{A}$, the ionic radius of N^{3-} is bigger than O^{2-} and F^-. The increasing order of ionic radii are $F^- < O^{2-} < N^{3-}$.

133. The correct order of ionic radii for the ions, P^{3-}, S^{2-}, Ca^{2+}, K^+, Cl^- is

(a) $P^{3-} > S^{2-} > Cl^- > K^+ > Ca^{2+}$
(b) $Cl^- > S^{2-} > P^{3-} > Ca^{2+} > K^+$
(c) $P^{3-} > S^{2-} > Cl^- > Ca^{2+} > K^+$
(d) $K^+ > Ca^{2+} > P^{3-} > S^{2-} > Cl^-$

(JEE Main 2021, 27 Aug Shift-II)

Ans. (a) : For the isolectronic species ionic radii increases on adding the electron in shell are increase but the on removing the electron the ionic radii decreases. Hence, the decreasing order of ionic radii are–

$$P^{3-} > S^{2-} > Cl^- > K^+ > Ca^{2+}$$

134. In general, the property (magnitudes only) that shows an opposite trend in comparison to other properties across a period is

(a) electronegativity
(b) electron gain enthalpy
(c) ionisation enthalpy
(d) atomic radius

(JEE Main 2020, 2 Sep Shift-I)

Ans. (d) : Electronegativity, Electron gain enthalpy and Ionisation enthalpy increases across a period but atomic radius decreases.

135. The difference between the radii of 3rd and 4th orbits of Li^{2+} is ΔR_1. The difference between the radii of 3rd and 4th orbits of He^+ is ΔR_2. Ratio $\Delta R_1 : \Delta R_2$ is

(a) 3 : 2 (b) 8 : 3
(c) 2 : 3 (d) 3 : 8

[JEE Main 2020, 5 Sep Shift-I]

Ans. (c) : Given that

$$\Delta R_1 = (R_4 - R_3)_{Li} + 2 = \frac{0.529}{3}(4^2 - 3^2)$$
$$= \frac{0.529}{3} \times 7$$
$$\Delta R_2 = (R_4 - R_3)_{He} + 2 = \frac{0.529}{2}(4^2 - 3^2)$$
$$= \frac{0.529}{2} \times 7$$
$$\therefore \frac{\Delta R_1}{\Delta R_2} = \frac{0.529 \times 7}{3} \times \frac{2}{0.529 \times 7} \text{ or } \frac{\Delta R_1}{\Delta R_2} = \frac{2}{3}$$

136. Two metals A and B having similar ionic radii, react with oxygen to give only monoxides and react with nitrogen to give nitrides. Then, A and B respectively are

(a) Li and Na (b) Na and Ca
(c) Li and Mg (d) Na and Be

AP EAMCET (Engg.) 17.09.2020 Shift-I

Ans. (c) : Li^+ among group - 1 metals and Mg^{2+} of group - 2 metals have similar ionic radii, because they are diagonally present in the periodic table. The stable monoxides (only) of Li and Mg are Li_2O and MgO respectively.

137. The atomic radius of Ag is closest to

(a) Hg (b) Au
(c) Ni (d) Cu

(JEE Main 2020, 7 Jan Shift-I)

Ans. (b) : The atomic radius of Ag is closest to Au because of lanthanide contraction, an increase in effective nuclear charge and so, the size of Au instead of being greater as is expected turns out be similar to that of Ag.

138. Which of the following statement is correct about "shielding effect" ?

1. It is effective, when the orbitals in the inner shells are completely filled.
2. Inner shells do not show any effect.
3. With increase of shielding down the group, ionisation energy increases.
4. With increasing nuclear charge, the shielding effect increases.

(a) 1 (b) 2
(c) 3 (d) 4

AP EAMCET (Engg.) 18.09.2020, Shift-I

Ans. (a) : 1. Shielding effect is effective, when orbitals in the inner shells are completely filled. So, statement (1) is correct.

2. Inner shells are show effect. So, statement 2 is incorrect.
3. Shielding effect as well as ionisation energy decrease down the group. So, statement 3 is incorrect.
4. With increase in nuclear charge, shielding effect decreases. So, statement 4 is incorrect.

139. Find the correct order of the given elements with respect to their size

(a) $Zn > Fe > Fe^{2+} > Fe^{3+}$
(b) $Fe^{2+} > Fe^{3+} > Zn > Fe$
(c) $Fe > Fe^{2+} > Fe^{3+} > Zn$
(d) $Zn > Fe^{3+} > Fe^{2+} > Fe$

AP EAMCET (Engg.) 21.09.2020, Shift-II

Ans. (a) : Zn atomic radii is 137 pm.
Fe atomic radii is 126 pm.
Fe^{3+} ionic radius is 63 pm.
Fe^{2+} has an ionic radius of 77 pm.
Thus, the correct order of their size is–

$$Zn > Fe > Fe^{2+} > Fe^{3+}$$

Hence, the correct option is (a).

140. The correct order of the atomic radii of C, Cs, Al and S is

(a) C < S < Al < Cs (b) C < S < Cs < Al
(c) S < C < Cs < Al (d) S < C < Al < Cs

(JEE Main 2019, 11 Jan Shift-I)

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Ans. (a) : On moving from left to right in a period atomic radii decreases and the moving from top to bottom in a group atomic radii increases.

$\therefore$ The order of increasing atomic radii are–

$\underset{170}{C} < \underset{180}{S} < \underset{184}{Al} < \underset{300}{Cs}$

Atomic radii (pm)

141. For which of the following ionic species radius would be maximum?

(a) C^{4-} (b) N^{3-}

(c) O^{2-} (d) Mg^{2+}

AIIMS 25 May 2019 (Evening)

Ans. (a) : Among the isoelectronic species ionic radius increase with increase in negative charge or decrease in positive charge.

Therefore, the order of ionic radius maximum in C^{4-} and increasing order of ionic radius are–

$Mg^{2+} < O^{2-} < N^{3-} < C^{4-}$

142. The correct order of atomic radii is

(a) Ho > N > Eu > Ce (b) N > Ce > Eu > Ho

(c) Eu > Ce > Ho > N (d) Ce > Eu > Ho > N

(JEE Main 2019, 12 Jan Shift-II)

Ans. (c) : The atomic radii follows the order

$\underset{199pm}{Eu} > \underset{183pm}{Ce} > \underset{176pm}{Ho} > \underset{70pm}{N}$

143. Which has least covalent radius?

(a) Mn (b) Cu

(c) Zn (d) Ni

AIIMS 26 May 2019 (Morning)

Ans. (d): Covalent radius of an atom denotes half of the internuclear distance between the atoms of the monoatomic species.

It is different from ionic and atomic radius. It depends on the bond order of the compound formed by the covalent bonding.

Hence, the covalent radius in Pm are–

$\underset{125}{Ni} < \underset{128}{Cu} < \underset{137}{Zn} = \underset{137}{Mn}$

So, the least covalent radius is Ni.

144. The increasing order of size for the ionic species Na^{+}, F^{-}, O^{2-}, Mg^{2+} is

(a) $Na^{+} < F^{-} < O^{2-} < Mg^{2+}$

(b) $Mg^{2+} < Na^{+} < F^{-} < O^{2-}$

(c) $O^{2-} < Mg^{2+} < Na^{+} < F^{-}$

(d) $O^{2-} < F^{-} < Mg^{2+} < Na^{+}$

Assam CEE-2019

Ans. (b) : Ionic size increase with the addition of electrons and ionic size decreases with the loss of electrons. It has high inter electrons repulsion due to which it has the minimum size. The increasing order of ionic size is $Mg^{2+} < Na^{+} < F^{-} < O^{2-} < N^{3-}$.

They are iso-electronic species with same number of electrons. Higher is the atomic number higher will be the effective nuclear charge, lower will be the size.

145. Which set of elements have nearly the same atomic radii?

(a) Fe, Co, Ni, Cu (b) F,Cl, Br, I

(c) Na, K, Rb, Cs (d) Li, Be, B, C

CG PET -2019

Ans. (a) : Fe, Co, Ni and Cu are belong to the 3rd transition series in the same period. The atomic radii are not vary because of the extra screening by the 3d electrons with increasing by the additional protons. This is repel already present 1s electron. Hence, repulsion will increase the atomic radius.

In Fe, Co, Ni and Cu have nearly balance each other keeping the atomic radius same.

146. What is the correct increasing order of ionic or atomic radii in the following?

(a) $Si^{4+} < P^{5+} < S^{6+} < Cl^{7+}$

(b) $P^{5+} < Si^{4+} < Cl^{7+} < S^{6+}$

(c) $Cl^{7+} < S^{6+} < P^{5+} < Si^{4+}$

(d) $S^{6+} < P^{5+} < Cl^{7+} < Si^{4+}$

J & K CET-(2018)

Ans. (c) : For

$Si = 14, Si^{4+} = 10e^{-}$

$P = 15, P^{+5} = 10e^{-}$

$S = 16, S^{+6} = 10e^{-}$

$Cl = 17, Cl^{+7} = 10e^{-}$

Ionic radii $\propto \dfrac{1}{\text{charge}}$

Greater the charge ionic radii decrease

Hence, the increasing order of ionic radii are-

$Cl^{7+} < S^{6+} < P^{5+} < Si^{4+}$

147. The energy and radius of electron present in second orbit of He^{+} respectively are

(a) -1.09×10^{-18} J, 105.8 pm

(b) -8.72×10^{-18} J, 211.6 pm

(c) -4.36×10^{-18} J, 52.9 pm

(d) -2.18×10^{-18} J, 105.8 pm

AP EAMCET-2017

Ans. (d): For He^{+} : Z = 2

For n = 2 $E_n = -2.18 \times 10^{-18} \dfrac{Z^2}{n^2}$

$E_n = -2.18 \times 10^{-18} \times \dfrac{4}{4}$

$E_n = -2.18 \times 10^{-18}$ Joule

And $r_n = 52.9 \times \dfrac{n^2}{Z}$ pm

$r_n = 52.9 \times \dfrac{4}{2} = 105.8$ pm

Hence, the option (d) is correct.

148. The set representing the right order of ionic radius is

(a) $Li^{+} > Na^{+} > Mg^{2+} > Be^{2+}$

(b) $Mg^{2+} > Be^{2+} > Li^{+} > Na^{+}$

(c) $Na^{+} > Mg^{2+} > Li^{+} > Be^{2+}$

(d) $Na^{+} > Li^{+} > Mg^{2+} > Be^{2+}$

TS EAMCET-2017

Ans. (d) : On going down the group size increases and charge of cation increases size decreases.

$Na^{+} > Li^{+} > Mg^{2+} > Be^{2+}$

149. Atomic radius (pm) of Al, Si, N and F respectively is

(a) 117, 143, 64, 74 (b) 143, 117, 74, 64

(c) 143, 47, 64, 74 (d) 64, 74, 117, 143

TS EAMCET-2017

@apna_pdf

Ans. (b) : Nitrogen and Fluorine belong to second period. Al and Si are belong to 3rd period. The size of element decreases from left to right in a period.
Hence the decreasing order of atomic radius is –

$\underset{143}{\text{Al}} > \underset{117}{\text{Si}} > \underset{74}{\text{N}} > \underset{64}{\text{F}}$ (pm)

150. The ion having the highest mobility in aqueous solution is

(a) Ba^{2+} (b) Mg^{2+}
(c) Ca^{2+} (d) Be^{2+}

CG PET -2017

Ans. (a) : Larger the size of cation, less hydrated. Hence, it show higher mobility in aqueous solution. Among the given species Ba^{2+} ion has largest. size, so hydrate to smaller extent and show highest mobility.

$Be^{2+} < Mg^{2+} < Ca^{2+} < Ba^{2+}$

151. The ionic species having the largest size is

(a) $Li^+(g)$ (b) $Rb^+(aq)$
(c) $Li^+(aq)$ (d) $Cs^+(aq)$

CG PET -2017

Ans. (c) : Concept used

(i) In gaseous state, more the value of $\frac{Z}{e}$, smaller is the size of ion.
(ii) In aqueous solution i.e. in hydrated- state, Smaller the gaseous ion, more it get hydrated and therefore more is its size. Among given options Li^+ (g) has smallest, size, so it hydrates to large extent and its size becomes largest. Therefore, Li(aq) has the largest, size.

152. Arrange the following as per increasing order of ionic size $Mg^{2+}, O^{2-}, Na^+, F^-, N^{3-}$

(a) $N^{3-} < O^{2-} < F^- < Na^+ < Mg^{2+}$
(b) $O^{2-} < F^- < N^3 < Mg^{2+} < Na^+$
(c) $Na^+ < Mg^{2+} < O^{2-} < N^{3-} < F^-$
(d) $Mg^{2+} < Na^+ < F^- < O^{2-} < N^{3-}$

CG PET -2017

Ans. (d) : All the given ions are isoelectronic as they contain same number of electrons. For isoelectronic species,

$$\text{Ionic radius} \propto \frac{1}{\text{atomic number}}$$

Ion	N^{3-}	O^{2-}	F^-	Na^+	Mg^{2+}
atomic number	7	8	9	11	12

Hence, the correct increasing order of ionic size is
$Mg^{2+} < Na^+ < F^- < O^{2-} < N^{3-}$

153. The atom of largest size among the following is

(a) Li (b) At
(c) I (d) Be

J & K CET-(2016)

Ans. (a) : Atom	Li	Be	I	At
Atom radii (pm)	152	112	113	140

154. Which of the following pairs has the same size?

(a) Fe^{2+}, Ni^{2+} (b) Zr^{4+}, Ti^{4+}
(c) Zr^{4+}, Hf^{4+} (d) Zn^{2+}, Hf^{4+}

COMEDK-2015

Ans. (c) : Zr^{4+} and Hf^{4+} belonging to the same group of second and third transition series is due to the effect of lanthanide contraction.

155. Atomic radii of which metals are same?

(a) Cr, Mn, Cu (b) Cr, Fe, Co
(c) Sc, Ti, Zn (d) V, Ni, Cr

CG PET- 2015

Ans. (a) : Atomic radius is inversely proportional to the effective nuclear charge.
On moving from left to right in a period the effective nuclear charge increases, the number of electron in the 3d sub-shell will increases. This repel the already present 4s electrons. Hence, Cr, Mn and Cu are nearly balance the atomic radius same.

156. Decrease in ionic size in a period is observed in

(a) actinides (b) lanthanides
(c) both (a) and (b) (d) transition elements

SRMJEEE – 2014

Ans. (c) : Actinides and Lanthanides decrease in ionic size in a period is observed because increase in atomic number and the atomic size increases which attracts the outermost shell more effectively then they gradual decrease in atomic and ionic radii.

157. The increasing order of the atomic radius of Si, S, Na, Mg, Al is

(a) S < Si < Al < Mg < Na
(b) Na < Al < Mg < S < Si
(c) Na < Mg < Si < Al < S
(d) Na < Mg < Al < Si < S

AP-EAMCET (Engg.) - 2014

Ans. (a) : All these elements belong to the third period of periodic table, on moving from left to right in a period, effective nuclear charge increase due to atomic radius decreases.
The order is Na > Mg > Al > Si > S

158. Which of the following series of elements have nearly the same atomic radii?

(a) F, Cl, Br, l (b) Na, K, Rb, Cs
(c) Li, Be, B, C (d) Fe, Co, Ni, Cu

JCECE - 2014

Ans. (d) : These are transition metals with the $(n-1)d^{1-10}ns^{1-2}$ configuration. The atomic and ionic radii of transition elements in a given series show a decreasing trend for first five elements and then becomes almost constant for next five elements.

159. Atomic number of Na = 11; Mg = 12; Al = 13. Among Na^+, Na, Mg, Mg^{2+} and Al^{3+}, the smallest and the biggest are respectively

(a) Na; Na^+ (b) Mg^{2+}; Na
(c) Na^+; Mg^{2+} (d) Al^{3+}; Na

SRMJEEE – 2013

Ans. (d) : Number of positive charge on element increases, size decreases. Hence the order of increasing size $Al^{+3} < Mg^{2+} < Na^+ < Na$
Smallest size Al^{+3} and biggest size Na.

160. The correct order of atomic radius of Li, Be and B is

(a) B > Be > Li (b) B > Li > Be
(c) Li > B > Be (d) Li > Be > B

AP EAMCET (Medical) - 2013

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Ans. (d) : In the period, when we move left to right then the size of atomic radius decreases and there is the one electron add in the same shell due to this enhanced nuclear charge. The electrons of all the shells are pulled little closer to the nucleous thereby making each individual shell smaller and smaller. Thus, the correct decreasing order of atomic radius is: Li > Be > B.

161. Which of the following is correct?
(a) Radius of $Ca^{2+} < Cl^{-} < S^{2-}$
(b) Radius of $Cl^{-} < S^{2-} < Ca^{2+}$
(c) Radius of $S^{2-} = Cl^{-} = Ca^{2+}$
(d) Radius of $S^{2-} < Cl^{-} < Ca^{2+}$

WB-JEE-2012

Ans. (a) : For the given species are isoelectronic having the same number of electron are present.

$$\text{Ionic radii} \propto \frac{1}{Z_{eff}}$$

Hence, the increasing order of radius are-

$$Ca^{2+} < Cl^{-} < S^{2-}$$

162. Consider the following ions:
1. Na^{+}
2. Al^{3+}
3. Si^{4+}
In naturally occurring zeolites which of the above ions are present?
(a) 1 and 2 only (b) 1 and 3 only
(c) 2 and 3 only (d) 1, 2 and 3

SCRA 2012

Ans. (d) : Natural zeolites are non-porus, amorphous and durable. Na^{+}, Al^{3+}, and Si^{4+} are some of the naturally occurring zeolites.

163. Consider the following statements.
I. The radius of an anion is larger than that of the parent atom.
II. The ionization energy generally increases with increasing atomic number in a period.
III. The electronegativity of an element is the tendency of an isolated atom to attract an electron.
Which of the above statements is/are correct?
(a) only I (b) only II
(c) I and II (d) II and III

AIIMS-2012

Ans. (c): Ionisation energy is increases from left to right in a period generally due to increase in the nuclear charge and decrease in the atomic radii in a period. The radius of an anion is larger than that charge decrease when an electron is added to an atom. The anion becomes larger than the corresponding atom.

The electronegativity of an element is the tendency of an atom in a compound to attract a pair of bonded electrons towards itself. The tendency to attract an electron of an isolated atom is measured by electron affinity.

164. Among the elements Ca, Mg, P and Cl, the order of increasing radii is
(a) Mg < Ca < Cl < P (b) Cl < P < Mg < Ca
(c) P < Cl < Ca < Mg (d) Ca < Mg < P < Cl

VITEEE- 2012

Ans. (b) : Atomic radii increases, as the number of shells increases. Thus, on moving down a group atomic radii increases.

The electronic configuration of the given element is

$_{12}Mg = [Ne]3s^{2}$

$_{20}Ca = [Ar]4s^{2}$

$_{15}P = [Ne]3s^{2}3p^{3}$

$_{17}Cl = [Ne]3s^{2}3p^{5}$

On the other hand, on increasing the number of electron in the same shell, the atomic radii decreases because effective nuclear charge is increases.

In Mg, P and Cl, the number of electrons are increasing in the same shell, thus the order of their atomic radii is

Cl < P < Mg

In case of Ca, the electron is entering in higher shell.

So, its atomic radii is highest.

Thus, the order of radii is

Cl < P < Mg < Ca

165. The increasing order of the ionic radii of the given isoelectronic species is
(a) $Cl^{-}, Ca^{2+}, K^{+}, S^{2}$ (b) $S^{2-}, Cl^{-}, Ca^{2+}, K^{+}$
(c) $Ca^{2+}, K^{+}, Cl^{-}, S^{2-}$ (d) $K^{+}, S^{2-}, Ca^{2+}, Cl^{-}$

(AIEEE 2012)

Ans. (c) : The species (atoms/molecules) is negatively charged, as an additional electron occupies an outer orbital, there is increased in electron electron repulsion because the protons in the ion cannot pull the extra electron towards the nucleus then decreased effective nuclear charge.

Therefore, the ionic radii increased. The increasing order of the ionic radii of the given isoelectromic species are-

$$Ca^{2+}, K^{+}, Cl^{-}, S^{2-}$$

166. Which of the following is the largest in size?
(a) Cl^{-} (b) S^{2-}
(c) Na^{+} (d) F^{-}

J & K CET-(2011)

Ans. (b) : All these ion contain 18 electron each so these are isoelectronic. For isoelectronic ions smaller the positive nuclear charge greater is the size of the ion decrease and greater the negative charge nuclear charge decrease hence the size of ion is large.

So, S^{2-} has largest in size.

167. There is a general understanding of ionic radius based on the nuclear charges and the number of electrons surrounding the nucleus which generally works very well. Which one of the following represents the correct decreasing order of ionic radius for C^{4-}, N^{3-}, O^{2-} and F^{-}?
(a) $C^{4-} > N^{3-} > O^{2-} > F^{-}$ (b) $F^{-} > O^{2-} > N^{3-} > C^{4-}$
(c) $O^{2-} > N^{3-} > C^{4-} > F^{-}$ (d) $F^{-} > N^{3-} > C^{4-} > O^{2-}$

UPTU/UPSEE-2011

Ans. (a) : For the given species are isoelectronic having the same number of electron are present. The ionic radii are decrease with the increase in the magnitude of nuclear charge because the force of attraction by the nucleus on the electrons also increases. Thus, the correct decreasing order of ionic radii.

$$C^{4-}, N^{3-}, O^{2-}, F^{-}$$

@apna_pdf

168. Which ion has the lowest radius from the following ions?

(a) Na^+ (b) Mg^{2+}

(c) Al^{3+} (d) Si^{4+}

JCECE - 2011

Ans. (d) : Ionic radii varies inversely with nuclear charge. Higher the nuclear charge, smaller is the ionic radii. Since, Si^{4+} has the highest nuclear charge among the given, so it has lowest ionic radii.

169. Which of the following sets will have highest hydration enthalpy and highest ionic radius?

(a) Na and Li (b) Li and Rb

(c) K and Na (d) Cs and Na

AMU – 2010

Ans. (b) : Smaller the size, greater is the hydration enthalpy. So, Li will have highest hydration enthalpy. Down the group ionic radius increases, so Rb will have highest ionic radius.

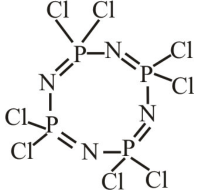
170. What type of structure does $(NPCl_2)_4$ Have?

(a) Linear (b) Hexagonal

(c) Cyclic (d) Polymeric

AMU – 2010

Ans. (c) : Phosphonitrilic compounds are known as phosphazenes. Their general formula is $(NPCl_2)_n$.



171. Which one of the following ions has the highest value of ionic radius?

(a) O^{2-} (b) B^{3+}

(c) Li^+ (d) F^-

BITSAT 2009

Ans. (a) : The ionic radii follows the order

$O^{2-} > F^- > Li^+ > B^{3+}$

172. Atomic radii of Ti, Zr and Hf vary

(a) Ti> Zr > Hf (b) Ti < Zr < Hf

(c) Ti < Hf < Zr (d) Ti < Zr=Hf

CG PET -2009

Ans. (d) : As we move down a group from top to bottom, radii increase but Zr and Hf have almost same radius due to poor shielding of f-orbitals. The atomic radii of 4d and 5d transition element are nearly same. This similarity in size is consequence of lanthanide contraction. Because of this lanthanide contraction the radii of HF becomes nearly equal to that of Zr.

Hence, the order are–

Ti < Zr = Hf

173. The atom of smallest atomic radius among the following is

(a) Na (b) K

(c) Br (d) Li

J & K CET-(2009)

Ans. (c) : When on moving in period from left to right atomic radius decreases. While in a group atomic radius increases from top to bottom. The radius of alkali metal is metallic radius and that of halogens is cavalent radius and metallic radius > covalent radius. Thus Br has the smallest atomic radius.

Atom	Na	K	Br	Li
Atom size(pm)	186	226	114	152

174. Difference between S and S^{2-} as S^{2-} has

(a) larger radii and larger size

(b) smaller radii and larger size

(c) larger radii and smaller size

(d) smaller radii and smaller size

BCECE-2008

Ans. (a) : The radii of anion is always larger than the atomic radii of its original atom. In an anion as electron are added to the neutral atom the nuclear charge acts more electron so that each electron is held less tightly and electron clouds are expand.

Thus, S^{2-} has larger radii and larger size.

175. Al^{3+} has a lower ionic radius than Mg^{2+} because

(a) Mg atom has less number of neutrons than Al

(b) Al^{3+} has a higher nuclear charge than Mg^{2+}

(c) their electronegativities are different

(d) Al has a lower ionisation potential than Mg atom.

SRMJEEE – 2007

Ans. (b) : Al^{3+} has a lower ionic radius than Mg^{2+} because Al^{3+} has higher nuclear charge than Mg^{2+}.

176. Which is the correct order of size of O^-, O^{2-}, F and F^-?

(a) $O^{2-} > F^- > O^- > F$ (b) $O^{2-} > F^- > F > O^-$

(c) $O^- > O^{2-} > F > F^-$ (d) $O^{2-} > O^- > F^- > F$

SRMJEEE – 2007

Ans. (d) : As negative charge of ions increases, outer electron will be at a greater distance from the nucleus, hence the greater in size.

The order of size of given ions is $O^{2-} > O^- > F^- > F$.

177. Increase in atomic size down the group is due to

(a) increase in number of electrons

(b) increase in number of protons and neutrons

(c) increase in number of protons

(d) increase in number of protons, neutrons and electrons

UP CPMT-2007

Ans. (a) : In a given group, atomic size increases due to addition of extra shell which outweighs the effect of increased nuclear charge. Number of electron increase with increases in addition of extra shell.

Hence, increase in atomic size down the group is due to increase in number of electron.

178. Which of the following has largest ionic radius?

(a) Cs^+ (b) Li^+

(c) Na^+ (d) K^+

BCECE-2006

Ans. (a) : Atomic and ionic radii increase from top to bottom in a group due to adding of shell at every step. Therefore, Cs^+ ion has largest ionic radius among the given ions.

179. Atomic radii of F and Ne, in Å, are given by :

(a) 0.72, 0.71 (b) 0.72, 1.6

(c) 1.6, 1.58 (d) 0.71, 0.72

BCECE-2006

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Ans. (b) : Atomic radii is the total distance from the nucleus of an atom of the outermost orbital of its electron.

On moving from left to right in a period generally atomic radii decrease due to increase in the effective nuclear charge with increase in atomic number.

And on moving down in the group shells are increases resulting in a large size.

Thus, the atomic radii of fluorine and neon in are 0.75Å and 1.60 Å respectively.

180. Consider the following abbreviations for hydrated alkali ions.
$X=[Li(H_2O)_n]^+$; $Y=[K(H_2O)_n]^+$; $Z=[Cs(H_2O)_n]^+$
Which is the correct order of size of these hydrated alkali ions?

(a) $X > Y > Z$ (b) $Z > Y > X$
(c) $X = Y = Z$ (d) $Z > X > Y$

J & K CET-(2006)

Ans. (a) : For the given hydrated alkali ions–

$X= [Li(H_2O)_n]^+$
$Y= [K(H_2O)_n]^+$
$Z= [Cs(H_2O)_n]^+$

Hydrated ion radii $\propto$ solution $\propto \frac{\text{charge}}{\text{radius}}$

181. The ionic radii $(\overset{o}{A})$ of C^{4-} and O^{2-} respectively are 2.60 and 1.40. The ionic radius of the isoelectronic ion N^{3-} would be

(a) 2.6 (b) 1.71
(c) 1.4 (d) 0.95

J & K CET-(2006)

Ans. (b) : For the ionic radii of isoelectronic ions decrease with the increase in the magnitude of the nuclear charge.

So, decreasing order of ionic radii is

$C^{4-} > N^{3-} > O^{2-}$
2.60 1.71 1.40(pm)

182. The most probable radius (in pm) for finding the electron in He^+ is

(a) 0.0 (b) 52.9
(c) 26.5 (d) 105.8

AIIMS-2005

Ans. (c) : Given that :
For He^+ (Z) = 2
Number of shell (n) = 1
we know that

Bohr's radius $(r_n) = \frac{59.2n^2}{Z}$ pm

Where n = number of shell
Z = atomic number

$r_n = \frac{59.2\times1^2}{2} = 26.45$ pm

183. Identify the correct order in which the ionic radius of the following ions increases:
(I) F^- (II) Na^+ (III) N^{3-}

(a) III, I, II (b) I, II, III
(c) II, III, I (d) II, I, III

AP-EAMCET (Engg.)-2005

Ans. (d) : The given species are F^- (I), Na^+ (II) and N^{3-} (III). These are iso-electronic species. As the –ve charge are increases in the element then the size of anion increases. More the –ve charge more will be size of element. Hence the correct increasing order of ionic sizes are- II < I < III

184. Which of the following order is correct for the size of Fe^{3+}, Fe and Fe^{2+} ?

(a) $Fe < Fe^{2+} < Fe^{3+}$ (b) $Fe^{2+} < Fe^{3+} < Fe$
(c) $Fe < Fe^{3+} < Fe^{2+}$ (d) $Fe^{3+} < Fe^{2+} < Fe$

AP-EAMCET (Engg.)-2004

Ans. (d) : The species are Fe^{3+}, Fe and Fe^{2+}. The atom contains more the +ve charge, less the size of metal. The more electrostatic force act in small size of metal. Hence, the correct order of ionic sizes are – $Fe^{3+} < Fe^{2+} < Fe$.

185. Which of the following has largest size?

(a) Al (b) Al^+ (c) Al^{2+} (d) Al^{3+}

CG PET -2004

Ans. (a) : The atom contain more the +ve charged less the size of metal. The more electrostatic force act in small size of metal. Hence, the largest size is Al.

So, the decreasing order of size are –
$Al > Al^+ > Al^{2+} > Al^{+3}$

186. Which one of the following ions has the highest value of ionic radius ?

(a) Li^+ (b) B^{3+} (c) O^{2-} (d) F^-

(AIEEE 2004)

Ans. (c) : Z/e ratio increases the size decreases and when Z/e ratio decrease the size increases.

$Z/e = \frac{\text{nuclear charge}}{\text{no. of electrons}}$

For Li^+, $Z/e = \frac{3}{2} = 1.5$

For B^{3+}, $Z/e = \frac{5}{2} = 2.5$

For O^{2-}, $Z/e = \frac{8}{10} = 0.8$

For F^-, $Z/e = \frac{9}{10} = 0.9$

Therefore, O^{2-} has highest value of ionic radius

187. The atomic size of cerium and promethium is quite close, due to:

(a) they are in same period in periodic table
(b) their electronic configuration is same
(c) f-electrons have poor shielding effect
(d) nuclear charge is higher on cerium than promethium

JCECE - 2004

Ans. (c) : For the lanthanide is the contraction of the atomic size with increase in atomic number called as lanthanide contraction while moving along the lanthanide series from Ce^{58} to Lu^{71}, a regular decrease in the size of the atom/ion and an increase in atomic number. This decrease in size is called as lanthanide contraction. Lanthanide contraction take place due to imperfect shielding of electron which increase by one by one more sub shell so, due to f-electrons have shielding effect.

@apna_pdf

188. Consider the ions K^+, S^{2-}, Cl^- and Ca^{2+}. The radii of these ionic species follow the order:

(a) $Ca^{2+} > K^+ > Cl^- > S^{2-}$

(b) $Cl^- > S^{2-} > K^+ > Ca^{2+}$

(c) $Ca^{2+} > Cl^- > K > S^{2-}$

(d) $K^+ > S^{2-} > Cl^- > Ca^{2+}$

(e) $S^{2-} > Cl^- > K^+ > Ca^{2+}$

Kerala-CEE-2004

Ans. (e) Ionic radii $\propto \dfrac{1}{\text{charge}}$

The charge of species is increases then the ionic radii will be decreases hence the decreasing order of the ionic radii will be-

$S^{2-} > Cl^- > K^+ > Ca^{2+}$

189. Which one of the following is expected to have largest size?

(a) F^- (b) O^{2-}

(c) Al^{3+} (d) N^{3-}

UPTU/UPSEE-2004

Ans. (d) : Radius $\propto \dfrac{1}{Z}$

All the ions are isoelectronic but they have different size due to different values of Z. In, Na^+, O^{2-}, N^{3-}, F^-, the number of electron 10.

Thus greater the value of $\dfrac{e}{Z}$ greater the size of iso-electronic species. Hence N^{3-} is largest in size.

190. The radius of hydrogen atom is 0.53 Å. The radius of $_3Li^{2+}$ is of

(a) 1.27 Å (b) 0.17 Å

(c) 0.57 Å (d) 0.99 Å

UP CPMT-2003

Ans. (b) :

Radius of n^{th} orbit $= \dfrac{n^2}{Z} \times 0.53$

where n = number of orbit

and Z = atomic number = 3

$\therefore$ In $_3Li^{2+}$, no. of electrons = 1

$\therefore$ Radius$= \dfrac{(1)^2 \times 0.53}{3}$

$= \dfrac{0.53}{3} = 0.17\,\overset{o}{A}$

191. Which of thr following is thr smallest anion?

(a) O^{2-} (b) S^{2-}

(c) Cl^- (d) Br^-

J & K CET-(2002)

Ans. (a) : O^{2-} is belong the second period and S^{2-}, Cl^- belong the third period and Br^- belong to the fourth period on moving from top to bottom in a group atomic radii increase.

Hence, the O^{2-} is the smallest anion.

192. Which of the following has least ionic radius?

(a) I^+ (b) I^{3+} (c) I^{5+} (d) I^{7+}

J & K CET-(2001)

Ans. (d) : Ionic radii $\propto \dfrac{1}{\text{charge}}$

More is the positive charge smaller the size of ion.

So, the least ionic radius is I^{7+}.

193. Of the metals Be, Mg, Ca and Sr of group 2 in the periodic table, the least ionic chloride will be formed by

(a) Be (b) Ca (c) Mg (d) Sr

J & K CET-(2000)

Ans. (a) : Beryllium chlorides are covalent in nature. This is due to the small size and high charge density of Be^{2+} ion i.e., it has high polarising power. However, the halides of the other alkaline earth metals are ionic solids.

194. O^{2-} and Si^{4+} are isoelectronic ions. If the ionic radius of O^{2-} is 1.4 Å, the ionic radius of Si^{4+} will be

(a) 1.4 Å (b) 0.41 Å

(c) 2.8 Å (d) 1.5 Å

A.P.EAMCET 1999

Ans. (b) : Given that, O^{2-} and Si^{4+} are isoelectronic ions i.e. 10 e^-.

Nuclear charge $\propto \dfrac{1}{\text{ionic radius}}$

$\therefore$ Nuclear charge for Si is larger, so it should be less than 1.4Å.

195. Of the following, the one with largest size is

(a) Cl^- (b) Ar

(c) K^+ (d) Ca^{2+}

A.P.EAMCET 1997

Ans. (a) : Cl^-, Ar, K^+ and Ca^{2+} have isoelectronic species and each have $18e^-$. The size of atom decreases with increase in nuclear charge. The Cl^- ion has the least nuclear charge among the given. Hence, it has largest size.

196. Which of the following, the one with largest size is:

(a) Cl^- (b) Ar

(c) K^+ (d) Ca^{2+}

AP – EAMCET - (Medical)-1997

Ans. (a) : Chloride ion has more ionic radius than Ar, K^+ and Ca^{2+}. When the electrons are added in the outer most orbit, the attractive force of the nucleus on the electron decreases. So that after adding electron or in case of –ve ion the ionic radius increases.

197. The pair of elements that have similar chemical properties are

(a) beryllium and boron

(b) aluminium and magnesium

(c) carbon and nitrogen

(d) lithium and magnesium

A.P.EAMCET 1996

Ans. (d) : Lithium and magnesium are similar chemical properties, since they have same electronegativity. Lithium and magnesium show diagonal relationship.

@apna_pdf

198. If a neutral atoms is converted into a cation, then its
(a) atomic weight increases
(b) size increases
(c) atomic weight decreases
(d) size decreases

AIIMS-1996

Ans. (d): A cation is formed when a neutral atom loses electrons from the outermost shell.
Cation with a more positive charge has less ionic radii because the more nuclear charge is experienced by the electron. Anion has more negative charge having the more ionic radii.
When cation is formed, there is no change in the atomic number of the element, only the number of electron change. Hence the neutral atom is converted into cation, there is a decreases in size.

199. In the P^{3-}, S^{2-} and Cl^- ions, the increasing order of size is
(a) $S^{2-} < Cl^- < P^{3-}$
(b) $Cl^- < S^{2-} < P^{3-}$
(c) $S^{7-} < P^{3-} < Cl^-$
(d) $P^{3-} < S^{2-} < Cl^-$

AIIMS-1996

Ans. (b): We know that phosphorus belong to VA group, sulphur belongs to VIA group and chlorine belong to VII A group.
The atomic size is decrease from left to right in a period.
In isoelectronic species, the size of ions decreases as nuclear charge or atomic weight increases.
Therefore, $Cl^- < S^{2-} < P^{3-}$

200. The radius of hydrogen atom in the ground state is 0.53 Å. The radius of Li^{2+} ion (atomic number = 3) in a similar state is
(a) 0.53 Å
(b) 1.06 Å
(c) 0.17 Å
(d) 0.236 Å

NEET-1995

Ans. (c) : Radius of Hydrogen atom in the ground state is 0.53 Å
∴ Atomic number of Li is 3

$$\because \text{Radius of } Li^{2+} \text{ ion} = \frac{r \times n^2}{2}$$

$$= \frac{0.53 \times 1^2}{3} = 0.17\text{Å}$$

201. Which one of the following is the largest ion?
(a) Na^+
(b) Mg^{2+}
(c) O^{2-}
(d) F^-

A.P.EAMCET 1994

Ans. (c) : Size of ion $\propto \dfrac{1}{\text{Nuclear Charge}}$
The radius of ion depend on the effective nuclear charge, more the charge more heavily the electrons are attracted towards the centre and lesser in the size.
O^{2-} has least nuclear charge and have largest size.

202. Kr nucleus has a ….. radius than that of Ba.
(a) Lesser
(b) Greater
(c) Same
(d) None of these

A.P.EAMCET 1992

Ans. (a) : Atomic radius decrease in a period from left to right. So, the Kr nucleus has lesser radius than that of Ba.

203. Which of the following does not represent the correct order of the property indicated?
(a) $Sc^{3+} > Cr^{3+} > Fe^{3+} > Mn^{3+}$ – ionic radii
(b) $Sc < Ti < Cr < Mn$ – density
(c) $Mn^{2+} > Ni^{2+} > Co^{2+} < Fe^{2+}$ – ionic radii
(d) $FeO < CaO < MnO < CuO$ – basic nature

VITEEE, 2014

Ans. (a) : The correct order of ionic radii is
$Cr^{3+} > Mn^{3+} > Fe^{3+} > Sc^{3+}$.

204. Which has the smallest size?
(a) Na^+
(b) Mg^{2+}
(c) Al^{3+}
(d) P^{5+}

JEE Main, 30.11.2020

Ans. (d) : The smallest size is P^{5+} because having maximum nuclear charge per electron. When nuclear charge increases then atomic size decreases.

4. Electro Negativity

205. Correct order of electronegativeity is:
(a) F > O > Cl = N
(b) F > Cl > O > N
(c) Cl > F > O < N
(d) None of these

CG PET-22.05.2022

Ans. (a) : Electronegativity – Electronegativity is the tendency of an atom in a molecule to attract electrons toward itself.
- We know that electronegativity simply increases from left to right in a period and decreases from to down in a group.

So, option (a) is correct.
F > O > Cl = N
Therefore, electronegativity of Cl & N are 3 (same).

206. The electronegativity of the following elements increases in the order
(a) C, N, Si, P
(b) N, Si, C, P
(c) Si, P, C, N
(d) P, Si, N, C

Kerala CEE-2018, Karnataka CET-2017
Assam CEE-2014, UPCPMT-2012
BITSAT 2005
J&K CET-1999

Ans. (c) : Si and P are in the 3rd period while C and N are in the 2nd period. Elements in 2nd period have higher electronegativities than those in the 3rd period. Since N has smaller size and has higher nuclear charge than C, its electronegativity is higher than that of C. Similarly, the electronegativity of P is higher than that of Si. Thus, the overall order is : Si, P, C, N.

207. Pauling's electronegativity values for elements are useful in predicting
(a) polarity of the molecules
(b) position in the EMF series
(c) coordination numbers
(d) dipole moments

BCECE-2011
UPTU/UPSEE-2004

@apna_pdf

Ans. (a) : Pauling electronegativity values for element are useful in predicting of polarity of molecules. Pauling introduced the electronegativity idea that the ionic character of a bond varies with the difference in electronegativity. A large difference in electronegativity leads to a bond with high degree of polar character.

208. Which of the following indicates the correct variation in electronegativities?

(a) $F > N < O > C$ (b) $F > O > N > C$
(c) $F < N < O < C$ (d) $F > N > O < C$

CG PET -2018
UPTU/UPSEE-2005

Ans. (b) : On moving from left to right in a 2nd period electronegativity increases.

Element	C	N	O	F
EN, Value	2.5	3.0	3.5	4

Hence, the order of EN are-
$F > O > N > C$

209. Pauling's equation for determining the electronegativity of an element is

(a) $X_A - X_B = 0.208\sqrt{\Delta}$
(b) $X_A + X_B = 0.208\sqrt{\Delta}$
(c) $X_A - X_B = 0.208\Delta^2$
(d) $X_A - X_B = \sqrt{\Delta}$

J & K CET-(2006)
UPTU/UPSEE-2010

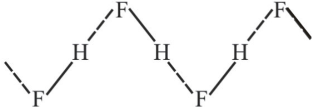
Ans. (a) : According to Pauiling equation.
$X_A–X_B= 0.208[E_{A–B}–(E_{A–A}\times E_{B–B})^{1/2}]^{1/2}$
$X_A – X_B = 0.208\sqrt{\Delta}$
Where, Δ is the difference of bond dissociation energies of A-A and B-B bonds.
X_A and X_B are the electronegativities of A and B respectively.
The factor 0.208 arises from the conversion of Kcals to electron volt.

210. Given below are two statements: One is labelled as Assertion (A) and the other is labelled as Reason (R).
Assertion (A) : Dipole - dipole interactions are the only non-covalent interactions, resulting in hydrogen bond formation.
Reason (R) : Fluorine is the most electronegative element and hydrogen bonds in HF are symmetrical.
In the light of the above statements, choose the most appropriate answer from the options given below.

(a) A is false but R is true.
(b) Both A and R are true and R is the correct explanation of A.
(c) A is true R is false.
(d) Both A and R are true but R is not the correct explanation of A.

(JEE Main 2021, 26 Feb. Shift-II)

Ans. (a) : Dipole -dipole are not only the interact ion responsible for hydrogen bond formation ion-dipole can also be responsible for hydrogen bond formation.
F is most electronegative element and HF in solid phase has symmetrical Hydrogen bonding the strongest bond are formed by F-atoms



Symmertical H-bonds are present

211. Which of the following is not true for oxidation?

(a) Addition of oxygen
(b) addition of electronegative element
(c) removal of hydrogen
(d) removal of electronegative element

Kerala-CEE-29.08.2021

Ans. (d) : In the oxidation reaction, addition of oxygen and removal of hydrogen takes place. As we know, oxygen is more electronegative atom if we remove any electronegative atom then this process is termed reduction.

212. The correct increasing order of the electronegativity is

(a) $B < C < S < Cl$ (b) $B < S < C < Cl$
(c) $B < C < Cl < S$ (d) $C < B < S < Cl$

TS-EAMCET (Engg.), 05.08.2021 Shift-II

Ans. (a) : When we move left to right in the period then electronegative increases whereas electronegativity decreases down the group. Hence, the correct order will be–

$\boxed{B < C < S < Cl}$

213. The electronegativity order of the following elements is

(a) $N > S > Te > I$ (b) $I > N > S > Te$
(c) $N > I > S > Te$ (d) $N > S > I > Te$

TS-EAMCET (Engg.), 07.08.2021 Shift-II

Ans. (c) :

Element	–	Electronegativity
N	–	3.04
I	–	2.66
S	–	2.58
Te	–	2.1

Thus, electronegativity order is $N > I > S > Te$.

214. $HClO_4$ is a stronger acid than H_2SO_4 due to which of the following reasons?

(i) Oxidation state of Cl in $HClO_4$ is +7 and that of S in H_2SO_4 is +6
(ii) Cl is more electronegative then S
(iii) ClO_3 part of $HClO_4$ can break O-H bond more easily to liberate a proton than SO_3 is dibasic
(iv) ClO_3 part of $HClO_4$ can break O-H bond more easily to liberate a proton than SO_3 part in H_2SO_4

(a) (i), (ii) and (iii) only
(b) (i), (ii), and (iv) only
(c) (i), (iii), and (iv) only
(d) (ii), (iii), (iv) only

AP EAPCET 24.08.2021 Shift-II

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Ans. (b) : In $HClO_4$ Oxidation state of Cl is + 7 and in H_2SO_4 Oxidation state of S is + 6, Cl is more electronegative than S. $HClO_4$ is mono acidic where as H_2SO_4 is dibasic ClO_3 part of $HClO_4$ can break O–H bond more easily to liberate a proton than SO_3 part in H_2SO_4.
So, the option (b) is correct.

215. Given that ionization potential and electron gain enthalpy of chlorine are 13 eV and 4 eV respectively. The electronegativity of chlorine on Mulliken scale approximately equals to
(a) 8.5 eV (b) 6.0 eV
(c) 3.0 eV (d) 1.5 eV

AP EAPCET 19-08-2021 Shift-I

Ans. (c) : Mulliken defined the electro negativity of an atom as the arithmetic mean of its ionization energy and electron.

i.e. $X_A = \frac{\text{Ionisation Potential} + \text{Electron Affinity}}{2}$

Given that, I.P. = 13eV, E.A = 4eV
The values are in the form of e.V so he formula will be-

$$X_{Cl} = \frac{(I.P)_{Cl} + (E.A)_{Cl}}{5.6}$$

$$X_{Cl} = \frac{13eV + 4eV}{5.6}$$

$$X_{Cl} = \frac{170eV}{5.6} = 3.03 \text{ eV}$$

216. The electronegativity of the given elements increases in the order__________
(a) C, N, Si, P (b) N, Si, C, P
(c) Si, P, C, N (d) P, Si, N, C

AP EAPCET 20.08.2021 Shift-II

Ans. (c): Electro negativity of given element is–
Si = 1.9
P = 2.19
C = 2.55
N = 3.04
Therefore the increasing order is – Si < P < C < N.

217. Assertion: Cl, Br and I show disproportionation, but F doesn't.
Reason: This is because it is the most electronegative element of the group.
(a) If both Assertion and Reason are correct and Reason is the correct explanation of Assertion.
(b) If both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.
(c) If Assertion is correct but Reason is incorrect.
(d) If both the Assertion and Reason are incorrect.

AIIMS 25 May 2019 (Evening)

Ans. (a) : Cl, Br and I show disproportionation but fluorine (F) does not show disproportionation tendency since it can only take up electron (oxidation state = –1) and cannot lose electron. This is because it is the most electronegative element of the group.

218. Which pair of elements has maximum electro negativity difference?
(a) Li & F (b) Na & F
(c) Na & Br (d) Na & Cl

AIIMS 26 May 2019 (Evening)

Ans. (b): Among the following Li and Na are the most electropositive and F, Cl and Br are most electronegative.
So, the electronegative of the species are-

Atom	F	Cl	Br	I	Li	Na
EN Value	4	3	2.8	2.5	1	0.9

The difference in electronegativity are.
(i) F – Li = 4 – 2.5 = 1.5
(ii) F – Na = 4 – 0.9 = 3.1
(iii) Br – Na = 2.8 – 0.9 = 1.9
(iv) Cl – Na = 3 – 0.9 = 2.1
Hence, the Na and F pairs of elements has maximum electronegativity difference.

219. The correct option with respect to the Pauling electronegativity values of the elements is
(a) P > S (b) Si < Al
(c) Te > Se (d) Ga < Ge

(JEE Main 2019, 11 Jan Shift-II)

Ans. (d) : When moving from left to right in period electronegativity increases.
Si > Al, S > P, Ge > Ga
and moving from top to bottom in group electronegativity decreases.
Se > Te

220. Bond between A and B can b represented by :

A – B, A^+B^-, A^-B^+
(I) (II) (III)

If A is more electronegative than B, then least contribution to the actual structure comes from:
(a) I
(b) II
(c) III
(d) All the structures have equal contribution

Manipal-2019

Ans. (b) : A polar covalent bond is formed between the two element of different electronegativities. The polarity of a bond depends on the electronegativity difference.
Hence, the A is more electronegative than B, then least contribution to the actual structure comes from the II.

221. Two elements A and B have electronegativities 1.2 and 3.0 respectively. The nature of bond between A and B would be
(a) ionic (b) covalent
(c) co-ordinate (d) metallic

BITSAT 2017

Ans. (a) : ∵ Difference of electronegativity between 'A' and 'B' = 3.0 – 1.2 = 1.8. A bond having electronegativity difference greater than 1.65 is ionic nature.
Hence, bond between 'A' and 'B' would be of ionic nature.
While a covalent bond consists of the mutual sharing of one or more pairs of electrons between two atoms.
And co-ordinate is a covalent bond that consists of a pair of electrons supplied by only one of the two atoms it joins.

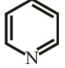
222. Among Me_3N, C_5H_5N and MeCN (Me = methyl group) the electronegativity of N is in the order
(a) MeCN > C_5H_5N > Me_3N
(b) C_5H_5N > Me_3N > MeCN

@apna_pdf

(c) $Me_3N > MeCN > C_5H_5N$
(d) Electronegativity same in all

WB-JEE-2017

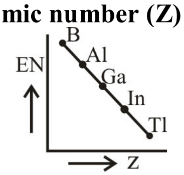
Ans. (a) : In $Me_3N \Rightarrow$ N is sp^3 hybrid
In $C_5H_5N \Rightarrow$ N is sp^2 hybrid.

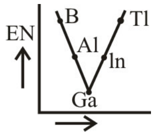


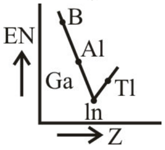
In MeCN $\Rightarrow$ N is sp-hybrid
Therefore, the electronegativity of element depend on s-character, s-character is increase then electronegativity increases.

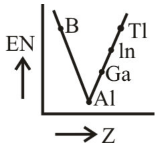
$MeCN > C_5H_5N > Me_3N$

223. Which one of the following correctly represents the variation of electronegativity (EN) with atomic number (Z) of group 13 elements?

(a)


(b)


(c)


(d)


AP EAMCET (Engg.) -2014

Ans. (d) : The electronegativity of group 13 element decreases from B to Al and then increase from Al to Te because of the discrepancies in the atomic size of the elements.

224. The correct order of electronegativities of N, O, F and P is

(a) F > O > P > N
(b) F > O > N > P
(c) N > O > F > P
(d) F > N > P > O

Karnataka-CET-2012

Ans. (b) : In a period, electronegativity increases from left to right.

F > O > N

In a group, electronegativity decreases down the group.
Hence, N > P
So, the order of electronegativity are-

F > O > N > P
4 3.5 3 2.19

225. Indicate the pair whose one member has the highest and other has the lowest electronegativity

(a) I and F
(b) Fr and Li
(c) K and Cs
(d) F and Fr

CG PET- 2011

Ans. (d) : Francium (Fr) has least electronegative element due to its large size.
Fluorine (F) is the highest electronegative element due to its small size.
Therefore, F and Fr are the pair whose one member has the highest and other has lowest electronegativity.

226. The property of attracting electrons by the halogen atoms in a molecule is called

(a) ionization potential
(b) electron affinity
(c) electronegativity
(d) electronic attraction

JCECE - 2010

Ans. (c) : The property of attracting electrons by an atom of a molecule is called electronegativity. However electron affinity is the amount of energy liberated when an electron is added to an isolated gaseous atom.
Ionisation energy, also called ionization potential, the amount of energy required to remove an electron from an isolated atom or molecule.

227. Which one of the following is maximum electronegative?

(a) Lead
(b) Silicon
(c) Carbon
(d) Tin

CG PET -2008

Ans. (c) : For the given elements are present in group–14 on moving down a group from top to bottom, the electronegativity decreases. Thus, the carbon has most electronegative than other given element.

228. The electronic configuration of most electronegative elements is–

(a) $1s^2, 2s^2, 2p^5$
(b) $1s^2, 2s^2, 2p^4, 3s^1$
(c) $1s^2, 2s^2, 2p^6, 3s^1, 3p^1$
(d) $1s^2, 2s^2, 2p^6, 3s^2, 3p^5$

BCECE-2007

Ans. (a) : The given electronic configuration the most electronegative element is $1s^2$, $2s^2$ $2p^5$ are fluorine. Fluorine is the most electronegative element in the periodic table.

229. Which of the following is second most electronegative element?

(a) Chlorine
(b) Oxygen
(c) Sulphur
(d) Fluorine

UP CPMT-2007

Ans. (b) : The tendency of an atom in a compound to attract a pair of bonded electron towards itself is known as electronegativity of the atom.
Fluorine is most electronegative element. After fluorine, the most electronegative element is oxygen as per Pauling's scale of electronegativity.

x_F=4.0, x_{Cl}=3.0, x_O= 3.5, x_s=2.5

230. Observe the following statements

I. The physical and chemical properties of elements are periodic functions of their electronic configuration.
II. Electronegativity of fluorine is less than the electronegativity of chlorine.
III. Electropositive nature decreses from top to bottom in a group.

The correct answer is

(a) I, II and III are correct
(b) only I is correct
(c) only I and II are correct
(d) only II and III are correct

A.P.EAMCET 2006

Ans. (b) : The physical and chemical properties of element are periodic functions of their electronic configuration.

- Electronegative of fluorine is greater than chlorine.
- Electropositive nature increase on top to bottom in a group.

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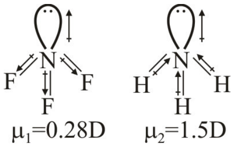
231. The electro-negativity difference between N and F is greater than that between N and H yet the dipole moment of NH_3 (1.5 D) is larger than that of NF_3 (0.2D). This is because

(a) in NH_3 the atomic dipole and bond dipole are in the opposite directions whereas in NF_3 these are in the same direction
(b) in NH_3 as well as in NF_3 the atomic dipole and bond dipole are in the same direction
(c) in NH_3 the atomic dipole and bond dipole are in the same direction whereas in NF_3 these are in opposite directions
(d) in NH_3 as well as in NF_3 the atomic dipole and bond dipole are in opposite directions.

NEET-2006

Ans. (c) : Electronegativity of N is greater than that of H but in NF_3 electronegativity of F is greater than that of N. So, in NH_3 the atomic dipole and bond-dipole are in the same direction whereas in NF_3 these are in opposite direction.



232. Which one of the following has the highest electronegativity?

(a) Br (b) C*l*
(c) P (d) Si

UPTU/UPSEE-2004

Ans. (b) : In a period moving from left to right then the electronegativity increases due to increase in effective nuclear charge-

Cl > P > Si

On moving from top to bottom in a group electronegativity decrease Cl > Br.
Hence, Cl has highest electronegativity.

233. Which of the following equation is used in Pauling's scale of electronegativity ?

(a) $x_A = 0.187\,(IE + EA) + 0.17$
(b) $x_A - x_B = 0.182 \left[E_{A-B} - \sqrt{(E_{A-A} \times E_{B-B})}\right]^{1/2}$
(c) $x_A = \dfrac{0.359 Z_{eff}}{r_A^2} + 0.744$
(d) None of the above

JCECE - 2004

Ans. (b) : According to Pauiling scale-

$$X_A - X_B = 0.182\left[E_{A-B} - \sqrt{E_{A-A} \times E_{B-B}}\right]^{\frac{1}{2}}$$

234. Which carbon is more electronegative?

(a) sp^3-hybridized carbon
(b) sp-hybridized carbon
(c) sp^2-hybridized carbon
(d) Always same irrespective of its hybrid state
(e) None of the above

Kerala-CEE-2004

Ans. (b) Electronegativity is defined as the relative tendency of an atom or species to attract towards it and we know that attract the electron, positive charge is required that comes from the nucleus. In sp hybridized carbon two orbitals are involved in hybridization among only one is s. The percentage of s-character it will be equal to 50%. For sp^2 hybridised the percentage of s-character will be 33.3% and for sp^3 hybridised the percentage of s-character will be 25%. Hence, the sp-hybridsed carbon is more electronegative.

235. Which one of the following represents the correct order of electronegativity?

(a) P > O > N (b) N > P > O
(c) O > N > P (d) N > O > P

A.P.EAMCET 2002

Ans. (c) : Electro-negativity is defined as the ability of an atom to attract shared electrons in a covalent bond. The correct order of electro-negativity is O > N > P.

236. Which one of the following is most basic?

(a) Cl^- (b) F^-
(c) I^- (d) Br^-

AMU 2002

Ans. (b) : In halides, electronegativity of the element plays an important role in determining the basicity. According to Bronsted Lowry concept, bases are proton acceptor and acid a proton donor. Down the group, size of the halides increase. So electronegativity or the ability to pull electrons towards itself decrease. So fluorine with its high electronegativity is a strong base.

237. In X – H .... Y, X and Y both are electronegative elements. Then

(a) electron density on X will increase and on H will decrease
(b) in both electron density will increase
(c) in both electron density will decrease
(d) on X electron density will decrease and on H increases

NEET-2001

Ans. (a) : For X–H ------ Y, 'H' is directly bonded to 'X' and there is a hydrogen, bond between 'H' and 'Y' As 'X' and 'Y' are electronegative active element that pull electron density towards themselves.
Therefore, the electron density on X increases on 'H' electron density decreases.

238. Let electronegativity, ionization energy and electron affinity be represented as EN, IP and EA respectively. Which one of the following equation is correct according to Mulliken?

(a) $EN = IP \times EA$ (b) $EN = \dfrac{IP}{EA}$
(c) $EN = \dfrac{IP + EA}{2}$ (d) $EN = IP - EA$

A.P.EAMCET (Engg.)-2001

Ans. (c) : Given,
Electronegativity = EN
Ionisation energy = IP
Electron affinity = EA
Mulliken has defined electronegativity as the average of ionization potential and electronegativity.

$$EN = \frac{IP + EA}{2}$$

239. Which one of the following would you expect to have highest electronegativity ?

@apna_pdf

(a) Mg (atomic number 12)
(b) S (atomic number 16)
(c) B (atomic number 5)
(d) Te (atomic number 52)

A.P.EAMCET 1995

Ans. (b) : Electronegativity decreases from top to bottom in a group and left to right increase in period. So, the sulphur has highest electronegative than Mg, B and Te.

240. The most electronegative element is

(a) nitrogen (b) oxygen
(c) fluorine (d) chlorine

A.P.EAMCET 1992

Ans. (c) : The most electronegative element is fluorine. The tendency of an atom in a molecule to attract the shared pair of electron towards itself is known as electronegativity.

241. If the ionization energy and electron affinity of an element are 275 and 86 kcal mol^{-1} respectively, then electronegativity of the element on the Mulliken scale is

(a) 2.8 (b) 0.0
(c) 4.0 (d) 2.6

Ans. (a) : Given that
Ionisation energy (I.E) = 275 Kcal/mol
Electron affinity (E.A) = 86 Kcal/mol
According to Mulliken, electronegativity of an atom is average of IE and E.A.

$$EN = \frac{IE + EA}{2}$$

If IE and E.A are in K.cal.mol^{-1}.

$$EN = \frac{IE + EA}{125} = \frac{275 + 86}{125} = 2.88.$$

5. Ionization Energy

242. Gadolinium has a low value of third ionisation enthalpy because of

(a) high basic character
(b) small size
(c) high exchange enthalpy
(d) high electro negativity

NEET-17.07.2022

Ans. (c) : Gadolinium has a low value of third ionization enthalpy because of high exchange enthalpy. In case of third ionization enthalpy electron will be removed from 5d and resulting configuration will be more stable electronic configuration.

243. The correct order of electron gain enthalpies of Cl, F, Te and Po is:

(a) F < Cl < Te < Po (b) Po < Te < F < Cl
(c) Te < Po < Cl < F (d) Cl < F < Te < Po

JEE Main-25.06.2022, Shift-II

Ans. (b) : The correct order of electron gain enthalpies of Cl, F, Te and Po is –
Po < Te < F < Cl
Table of electron gain enthalpies are given below –

Element	Electron Gain Enthalpies (kJmol^{-1})
Po	–174
Te	–190
F	–328
Cl	– 349

244. Elements X, Y and Z have atomic number 19, 37 and 55 respectively. Which of the following statements is true about them ?

(a) Z would have the highest ionization potential
(b) Y would have the highest ionization potential
(c) Their ionization potential would increase with increasing atomic number
(d) Y would have an ionization potential between those of X and Z

Karnataka CET-17.06.2022, Shift-II

Ans. (d) : Given that, X, Y and Z have atomic number 19, 37 and 55 respectively.
Then X = $_{19}$K = ionization potential = 4.3407 eV.
Y = $_{37}$Rb = ionization potential = 4.17771 eV.
Z = $_{55}$Cs = ionization potential = 3.8939 eV.
Therefore,

$$\text{Ionization potential of } (_{37}\text{Rb}) = \frac{\text{I.P.of (Cs)} + \text{I.P.of (K)}}{2}$$

$$\text{By symbolic, } Y = \frac{X + Z}{2}$$

So, Y would have an ionization potential between those of X and Z.

245. Given below are two statements. One is labelled as. Assertion A and the other is labelled as Reason R

Assertion A: The first ionization enthalpy for oxygen is lower than that of nitrogen.

Reason R: The four electrons in 2p orbital's of oxygen experience more electron- electron repulsion

In the light of the above statements. Choose the correct answer from the options given below.

(a) Both A and R are correct and Rj is the correct explanation of A
(b) Both A and R correct but R is NOT the correct explanation of A
(c) A is correct but R is not correct
(d) A is not correct but R is correct

JEE Main-29.06.2022, Shift-II

Ans. (b) : The first ionization enthalpy for oxygen is lower than that of nitrogen because as you move from left to right the atomic size decreases. So, ionization enthalpy will be increased.
In case, four electrons in 2p-orbital's of oxygen greater electron-electron repulsion.
As a result there is strong inter-electronic repulsion in the relatively small 2p-orbital of oxygen and thus the incoming electron does not experience much net attract force from the nucleus to hold the incoming electron.

246. The ionisation potential of which element is highest?

(a) H (b) He
(c) Ar (d) F

CG PET-22.05.2022

Ans. (b) : The ionization potential of He element is highest because ionization potential (Energy) decreases as move from down a group and increases as move from left to right across a period.
So, inert gas has highest ionization potential.

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247. The correct order of 2nd ionisation energy for the elements carbon, nitrogen, oxygen and fluorine is–

(a) F > O > N > C (b) C > N > O > F
(c) O > F > N > C (d) O > N > F > C

BCECE-2016
Assam CEE-2014
WB JEE-2010
UPTU/UPSEE-2004

Ans. (c) : The electronic configuration of element after removal of first electron.

$O^+ =$	$1s^2$	$2s^2$	$2p^3$
$F^+ =$	$1s^2$	$2s^2$	$2p^4$
$N^+ =$	$1s^2$	$2s^2$	$2p^2$
$C^+ =$	$1s^2$	$2s^2$	$2p^1$

Therefore, the second ionization potential of oxygen is more as it acquires a half filled stable configuration so it energy requires a lot of energy to remove from the oxygen.

So, the correct order of second ionization potential is-
O > F > N > C

248. The set representing the correct order for first ionisation potential is

(a) K > Na > Li (b) Be > Mg > Ca
(c) B > C > N (d) Ge > Si > C

Tripura JEE-2019
Manipal-2017
JIPMER-2008
JCECE – 2007

Ans. (b) : On moving down the group top to bottom ionisation energy decreases due to the size increase. Hence, the correct order of first ionisation energy–
Be > Mg > Ca

249. The correct order in which the first ionization potential increases is

(a) Na, K, Be (b) K, Na, Be
(c) K, Be, Na (d) Be, Na, K

WB JEE-2015
MHT CET-2014
Karnataka CET, 2008

Ans. (b) : The first ionization potential generally increases in a period from left to right and decreases in a group from up to down. Thus, the correct order of first ionization potential is
K < Na < Be

250. The first ionization potential of Na, Mg and Si are respectively 496, 737 and 786 kJ mol^{-1}. The ionization potential of Al will be closer to

(a) 760 kJ mol^{-1} (b) 575 kJ mol^{-1}
(c) 801 kJ mol^{-1} (d) 419 kJ mol^{-1}

AMU-2014
CGPET-2010
J&K CET-2000

Ans. (b) : The ionization energy of Mg will be larger than that of Na due to fully filled configuration. The ionization energy of Al will be smaller than that of Mg due to one electron extra than the stable configuration but smaller than Si due to increase in effective nuclear of Si. Hence, the ionization potential of Al will be 760 kJ/mole.

251. The decreasing order of the ionization potential of the following elements is

(a) Ne > Cl > P > S > Al > Mg
(b) Ne > Cl > P > S > Mg > Al
(c) Ne > Cl > S > P > Mg > Al
(d) Ne > Cl > S > P > Al > Mg

JEE Main-27.07.2021, Shift-II
BITSAT 2016, CG PET -2005

Ans. (b) : On moving from left to right in a period ionization potential increases. On moving from top to bottom in a group ionization potential decreases. Rare gases are more ionization potential than full filled orbital than half-filled orbital. Hence, the order is Ne > Cl > P > S > Mg > Al.

252. In which of the following arrangements, the order is NOT according to the property indicated against It

(a) Li < Na < K< Rb:
Increasing metallic radius
(b) I<Br<F<CI:
Increasing electron gain enthalpy
(c) B<C<N<O
Increasing first ionization enthalpy
(d) $Al^{3+} < Mg^{2+} < Na^+ < F^-$
Increasing ionic size

NEET-I, 2016
AIIMS-2015, 2005

Ans. (c): When we move from B to O in periodic table first ionization enthalpy increases due to the attraction of nucleus towards the outer most of electron. Hence, the order is- B < C < N < O : increasing first ionization enthalpy.

253. In the following, the element with the highest ionization energy is

(a) [Ne] $3s^2 3p^2$ (b) [Ne] $3s^2 3p^3$
(c) [Ne] $3s^2 3p^2$ (d) [Ne] $3s^2 3p^4$

JIPMER-2010
JCECE - 2009
NEET-2009

Ans. (b) : The given electronic configuration [Ne] $3s^2$ $3p^3$ are half-filled electronic configuration on removing the one electron the amount of energy is required to high. So, it has highest ionisation energy.

254. For the second period elements the correct increasing order of first ionization enthalpy is

(a) Li < Be < B < C < O < N < F < Ne
(b) Li < Be < B < C < N < O < F < Ne
(c) Li < B < Be < C < O < N < F < Ne
(d) Li < B < Be < C < N < O < F < Ne

J & K CET-(2015)
JEE Main-2013, NEET-2009

Ans. (c) : When we move from left to right in a period ionisaiton energy increase. Be has full filled 2s subshell so the ionisation energy is maximum in comparison to B, N is half filled 2p orbital so ionisation energy is maximum in comparison to oxygen atom. Thus, order of first ionisation enthalpy is-
Li < B < Be < C < O < N < F < Ne

255. What will be the order of Ist ionisation energy?

(a) Li > Na > K (b) K > Li < Na
(c) Na > Li > K (d) Li > K > Na

UPTU/UPSEE-2015
JIPMER-2006

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Ans. (a) : On moving from top to bottom in a group ionisation energy decreases because atomic size increases and due to lessening of the nucleus by inner electrons. This means that Li will be having highest ionisation energy and K will be having the lowest energy.
So, the ionisation energy of Li, Na and K are 520 kJ/mole, 496 kJ/mole and 419 kJ/mole respectively.

256. Generally, the first ionization energy increases along a period. But there are some exceptions. One which is not an exception is
(a) N and O (b) Na and Mg
(c) Mg and Al (d) Be and B

KARNATAKA-CET, 2010
Karnataka-CET-2011

Ans. (b) : Na belongs to IA group and Mg belongs to IIA group. On moving form left to right in a period, first ionization energy increases, thus, IE of Mg is greater than the IE of Na.
IE order Mg > Na

257. The correct of ionisation energy of C, N, O, F is
(a) $F < O < N < C$ (b) $F < N < C < O$
(c) $C < N < O < F$ (d) $C < O < N < F$

KARNATAKA-CET, 2009
Karnataka-CET-2012

Ans. (d) : Ionisation energy generally increases from left to right in a period but ionization energy of nitrogen is greater than oxygen dud to stable p^3 configuration. Hence, the order is as
$C < O < N < F$

258. The one electron species having ionization energy of 54.4 eV is:
(a) H (b) He^+
(c) B^{4+} (d) Li^{2+}
(e) Be^{2+}

UPTU/UPSEE-2016
Kerala-CEE-2004

Ans. (b) We know that,

$$E(\text{ionisation energy}) = \frac{-13.6\times z^2}{n^2}\text{eV}$$

Where, z = atomic number
n = shell
For, He^+, z = 2, n = 1

$$\therefore \quad E = \frac{-13.6\times 2^2}{1^2}$$
$$= -13.6 \times 4$$
$$= -54.4 \text{ eV}$$

259. Which element has the highest first ionization potential?
(a) N (b) Ne
(c) He (d) H
(e) Li

Manipal-2020
Kerala-CEE-2018

Ans. (c) : On moving from up to down in a group ionization potential decrease and across a period ionisation energy increase. He is small size and fully filled inert gas configuration. Therefore, He has the highest first ionization potential.

260. With which of the following electronic configuration an atom has the lowest ionisation enthalpy?
(a) $1s^2 2s^2 2p^3$ (b) $1s^2 2s^2 2p^6 3s^1$
(c) $1s^2 2s^2 2p^6$ (d) $1s^2 2s^2 2p^5$

WB JEE-2011
NEET-2007

Ans. (b) : The given electronic configuration has $1s^2 2s^2 2p^6 3s^1$. On removing the one electron easily due to form stable noble gas configuration. Hence, the electronic configuration $1s^2$, $2s^2$, $2p^6$, $3s^1$ has lowest ionisation enthalpy.

261. Proper decreasing order of first ionization potential of the elements Be, B, C and Li will be which one of the following?
(a) $C > B > Be > Li$ (b) $C > Be > B > Li$
(c) $B > C > Be > Li$ (d) $Be > Li > B > C$

Tripura JEE-2022
JIPMER-2012

Ans. (b) : When we move from left to right in a period, ionisation enthalpy increase. Be has full filled 2s-subshell then the Boron atom. Therefore, the order is-
$C > Be > B > Li$

262. The first ionisation potenital (in eV) of N and O atoms are
(a) 14.6, 13.6 (b) 13.6,14.6
(c) 13.6, 13.6 (d) 14.6, 14.6

CG PET- 2016, 2013

Ans. (a) : The electronic configuration of nitrogen and oxygen are-

N -	$1s^2$	$2s^2$	$2p^3$
O -	$1s^2$	$2s^2$	$2p^4$

When oxygen loses one electron it will attain half-filled configuration.
So, it can lose an electron easily but nitrogen has already in a half filled configuration and hence losing an electron will require more energy than that of oxygen.
Therefore, the first ionization potential of N and O atoms are 14.6 and 13.6 respectively.

263. Four successive members of the first row transition elements are listed below with their atomic numbers. Which one of them is expected to have the highest third ionisation enthalpy?
(a) Vanadium (Z=23) (b) Manganese (Z=25)
(c) Chromium (Z=24) (d) Iron (Z=26)

CG PET -2007
NEET-2005

Ans. (b) : The electronic configuration of Mn is-
$_{25}Mn = 1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 4s^2, 3d^5$
Third electron which is removed in third ionization potential belong to $3d^5$ subshell. The $3d^5$ subshell has highest stability because of it is a half-filled subshell so, Mn shows highest third ionization potential.

264. The second ionization enthalpies of Li, Be, B and C are in order
(a) Li >B>C>Be (b) Li >C>B>Be
(c) Be >C>B>Li (d) B >C>Be>Li

CG PET -2017
J & K CET-(2011)

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Ans. (a) : The ionization enthalpy depend on the following factors:
(i) Half- filled or full filled atomic orbitals are more stable than other incomplete orbital.
(ii) Smaller the size of atom/ion, more is the ionization energy. (I.E.) For 2nd I.E. all elements have M^+ configuration

	Total no. of electrons	**Outermost configuration**
$Li^+(Z=3)$	2	$1s^2$ (fully filled)
Be^+ (Z=4)	3	$2s^1$ (has more size) than carbon)
$B^+(Z=5)$	4	$2s^2$ (fully filled)
$C^+(Z=6)$	5	$2s^2 2p^1$ (Smaller size)

Hence, correct, order for 2nd I.E. is

$$Li^+ > B^+ > C^+ > Be^+$$

or $$Li > B > C > Be^+$$

265. Which element has maximum first ionisation potential?
(a) Cs (b) F
(c) Na (d) He

CG PET- 2015
J&K CET-2001

Ans. (d) : On moving from left to right in a period generally ionisation energy increases helium (He) is stable configuration is remove one electron from filled s-subshell. The required is more due to filled 1s orbital. Hence, the first ionisaiton energy is maximum in He.

266. The increasing order of the first ionisation enthalpies of the elements B, P, S and F (lowest first) is
(a) F < S < P < B (b) P < S < B < F
(c) B < P < S < F (d) B < S < P < F

UPTU/UPSEE-2017
(AIEEE 2006)

Ans. (d) : On moving from left to right in a period ionisaiton energy increase but on moving from top to bottom in group ionisation energy decreases. Phosphorous (P) has half-filled configuration, it has higher IE_1 than of S-atom.
Hence, the correct order of first ionisation energy is

$$\underset{800}{B} < \underset{999.4}{S} < \underset{1012}{P} < \underset{1680.8\ kJ/mole}{F}$$

267. A sudden large jump between the values of second and third ionization energies of elements would be associated with which of the following electronic configurations?
(a) $1s^2\ 2s^2\ 2p^6\ 3s^1$ (b) $1s^2\ 2s^2\ 2p^6\ 3s^2 3p^1$
(c) $1s^2\ 2s^2\ 2p^6\ 3s^1\ 3p^2$ (d) $1s^2\ 2s^2\ 2p^6\ 3s^2$

J & K CET-(2004), NEET-1993

Ans. (d) : The sudden large jump between the value of second and third ionisaiton energies of an element. Because after losing two electron it has acquired stable configuration. Thus, in order to remove third electron much higher energy is needed. Therefore, the electronic configuration is $1s^2\ 2s^2\ 2p^6\ 3s^2$.

268. First ionisation potential of Be and B will be
(a) 8.8 and 8.8 (b) 6.6 and 6.6
(c) 6.6 and 8.8 (d) 8.8 and 6.6

CG PET -2007
NEET-1998

Ans. (d) : Ionization potential increase from left to right in a period but in case of Be and B. Beryllium is having more ionization potential than boron to completely filled s-orbital in beryllium.
So, the first ionization potential of Be and B will be 8.8 and 6.6 respectively.

269. Which of the order for ionization energy is correct?
(a) Be < B< C<N<O (b) B < Be< C<O<N
(c) Be > B> C>N>O (d) B < Be< N<C<O

AIIMS-2013
NEET-2001

Ans. (b): The energy required to remove the most loosely bound electron from an isolated gaseous atom is called the ionization energy. The ionization potential decreases as the size of the atom decrease. Atom will fully or partly filled orbitals have high ionization potential.
Hence, the order-

B < Be < C < O < N

270. Which one of the following order is correct for the first ionization energies of the elements?
(a) B < Be < N < O (b) Be < B < N < O
(c) B < Be < O < N (d) B < O < Be < N

VITEEE- 2009
JIPMER-2004

Ans. (c) : Along a period first ionization energy increases. Thus, the first IE of the elements in second period should follow the order Be < B < N < O
The first IE of these elements follows the order B < Be < O < N The lower IE of B than that of Be is because in B ($1s^2$, $2s^2\ 2p^1$), electron is to be removed from 2p which is easy while in Be ($1s^2$, $2s^2$), electron is to be removed from 2s which is difficult. The low IE of O than that of N is because of the half-filled 2p orbitals in N ($1s^2$, $2s^2\ 2p^3$).

271. Which of the following elements has the lowest ionisation potential?
(a) Sodium (b) Potassium
(c) Rubidium (d) Cesium

AMU–2003
J & K CET-(2008)

Ans. (d) : The ionization energy decreases on moving down the group
As we go down in a group, the nuclear charge increases.
(2) As we go down in a group the atomic size increases. due to the addition of a new shell to each element.
(3) As we go down in a group , the number of inner electrons increases . This increases the shielding effect on outer electrons.
The combined effect of the increases in atomic size, and the shielding effect more than the effect of the increases of the nuclear charge. These effects act in such a way that the force of attraction between the nucleus, and the outermost electron decreases as we go down the group.

272. Identify the elements X and Y using the ionisation energy values given below.

	Ionisation energy (Ist)	**kJ/mol (IInd)**
X	**495**	**4563**
Y	**731**	**1450**

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(a) X = Na, Y = Mg (b) X = Mg, Y = F
(c) X = Mg, Y = Na (d) X = F, Y = Mg

(JEE Main 2021, 16 March Shift-II)

Ans. (a) : The electronic configuration of Na = [Ne] $3s^1$ ionisatin energy of sodium is very low but second ionisation energy is very high due to stable noble gas configuration of Na^+.
The electronic configuration of Mg = $[Ne]3s^2$ first and second ionisation energy is low.

273. The first ionisation energy of magnesium is smaller as compared to that of elements X and Y, but higher than that of Z. The elements X, Y and Z, respectively, are
(a) chlorine, lithium and sodium
(b) argon, lithium and sodium
(c) argon, chlorine and sodium
(d) neon, sodium and chlorine

(JEE Main 2021, 18 March Shift-II)

Ans. (c) : On moving from left to right in a 3rd period ionisaiton energy increases.
Ionisation energy of the 3rd period are-
Na < Al < Mg < Si < S < P < Cl < Ar
Hence, the element X, Y and Z are argon, chlorine and sodium respectively.

274. Electromagnetic radiation of wavelength 663 nm is just sufficient to ionise the atom of metal A. The ionisation energy of metal A in kJ mol^{-1} is ....(Rounded off to the nearest integer) [$h = 6.63 \times 10^{-34}$ J-s, $c = 3.00 \times 10^8$, ms^{-1}, $N_A = 6.02 \times 10^{23}$ mol^{-1}]

[JEE Main 2021, 25 Feb Shift-II]

Ans. (180) : Given that, $h = 6.63 \times 10^{-34}$ J.sec,
$c = 3 \times 10^8$ m/sec, $N_A = 6.02 \times 10^{23}$ mol^{-1}
$N = 663$ nm $= 663 \times 10^{-9}$ m

$\therefore$ Ionisation energy of atom of metal A = $\dfrac{hc}{\lambda}$

$$= \frac{6.63\times10^{-34}\times3\times10^{8}}{663\times10^{-9}}$$

$= 3 \times 10^{-19}$ Joule
Since, Ionisation energy per mole
$= 3\times10^{-19} \times 6.02\times10^{23}$
= 180. 6kJ/mole
= 180 kJ/mole

275. The third ionisation enthalpy is highest in
(a) Alkali metals (b) Alkaline earth metals
(c) Chalcogens (d) Pnictogens

Kerala-CEE-29.08.2021

Ans. (b) : Alkaline earth metals acquired the outer two electron in s-orbital. After removing of two electron from alkaline earth's metal, they get the stable configuration. So more energy required for the removing of electron. Hence, alkaline earth metals have the highest third ionization enthalphy.

276. Choose the correct option regarding the following statements :
Statement-1: Nitrogen has lesser electron gain enthalpy than oxygen.
Statement-2: Oxygen has lesser ionization enthalpy than nitrogen.
(a) Statement - 1 is correct. Statement -2 is wrong
(b) Both statement 1 and 2 are wrong
(c) Both statement 1 and 2 are correct
(d) Statement -1 is wrong. Statement -2 is correct.

AP EAPCET 19-08-2021, Shift-II

Ans. (c) :
Electronic configuration of $_7N = 1s^2, 2s^2, 2p^3$
↑ | ↑ | ↑

Electronic configuration of $_8O = 1s^2, 2s^2, 2p^4$
⇅ | ↑ | ↑

N has lesser electron gain enthalpy because the extra addition of one electron in 2p orbital is very energy consuming.
Oxygen has lower ionisation enthalpy than nitrogen because by removing one electron from 2p - orbital, oxygen acquires stable configuration i.e. $2p^3$.On the other hand, in case nitrogen it is not easy to remove one of the three 2p electronic due to its stable configuration.

277. Which order among the following is incorrect?
(a) $NH_3 < PH_3 < AsH_3$: (Acidic nature)
(b) Li < Be < B < C : IE_1 (ΔH_1)
(c) $Al_2O_3 < MgO < Na_2O < K_2O$: (Basic Nature)
(d) $Li^+ < K^+ < Cs^+$: (Ionic radius)

AP- EAPCET- 07-09-2021, Shift-I

Ans. (b) : Ionization enthalpy is defined as the amount of energy an isolated gaseous atom. Atom would take to lose an electron in its ground state.
So the correct order is-

Li	<	B	<	Be	<	C
520		801		899		1086 kJ/Mole (ΔH_1)

278. The successive ionization energies of an element in kJ. mol^{-1} are 1060, 1900, 2920, 6280 and 21200. This element would belong to group-____
(a) V (b) VI
(c) VII (d) IV

AP- EAPCET- 07-09-2021, Shift-I

Ans. (a) : The successive ionization energies of an element in $kJmole^{-1}$ are 1060,1900, 2920, 6280 and 21200. The element belong to group V.

279. Starting from the 1st, the successive ionization potentials of an element are respectively 5.98, 18.8, 28.4, 120.1, 154eV. The elements is
(a) B (b) Al
(c) P (d) Mg

TS EAMCET 05.08.2021, Shift-I

Ans. (b) : The amount of energy required to remove an electron from an isolated gaseous atom in its gaseous state.
$I.E_1 = 5.98$ eV
$I.E_2 = 18.8$ eV
$I.E_3 = 28.4$ eV
$I.E_4 = 120.1$ eV
$I.E_5 = 154$ eV
Hence, the ionization potential difference between $I.E_3$ and $I.E_4$ is maximum. So, the element is Al.

280. The first ionization energies (in kJ mol^{-1}) of four consecutive elements of the second period are given in the options. The first ionization energy of nitrogen is

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(a) 1086 (b) 1402
(c) 1681 (d) 1314

TS EAMCET 04.08.2021, Shift-I

Ans. (b) : The amount of energy required to remove an electron from an isolated atom or molecules is called ionization energy. The first ionization energy of nitrogen is 1402 kJ/mole energy.

281. Match List-I with List-II

List-I Electronic configuration of elements		List-II $\Delta_i H$ in kJ mol^{-1}	
(a)	$1s^2\ 2s^2$	(i)	801
(b)	$1s^2\ 2s^2 2p^4$	(ii)	899
(c)	$1s^2\ 2s^2\ 2p^3$	(iii)	1314
(d)	$1s^2\ 2s^2 2p^1$	(iv)	1402

Choose the most appropriate answer from the options given below:

(a) (a) → (i), (b) → (iv), (c) → (iii), (d) → (ii)

(b) (a) → (iv), (b) → (i), (c) → (ii), (d) → (iii)

(c) (a) → (ii), (b) → (iii), (c) → (iv), (d) → (i)

(d) (a) → (i), (b) → (iii), (c) → (iv), (d) → (ii)

JEE Main 26.02.2021, Shift-I

Ans. (c) : Ionisation energy in second period.

$Be(1s^2\ 2s^2)$ = 899 kJ/mole
$O(1s^2\ 2s^2\ 2p^4)$ = 1314 kJ/mole
$N(1s^2\ 2s^2\ 2p^3)$ = 1402 kJ/mole
$B(1s^2\ 2s^2\ 2p^1)$ = 801 kJ/mole

282. The correct order for the increasing ionization enthalpies for the following is:

(i) $1s^2\ 2s^2\ 2p^6\ 3s^2$ (ii) $1s^2\ 2s^2\ 2p^6\ 3s^1$
(iii) $1s^2\ 2s^2\ 2p^6$ (iv) $1s^2\ 2s^2\ 2p^2$
(v) $1s^2\ 2s^2\ 2p^1$

Options:

(a) (ii)<(iii)<(i)<(v)<(iv)
(b) (ii)<(i)<(iii)<(v)<(iv)
(c) (ii)<(i)<(v)<(iv)<(iii)
(d) (ii)<(i)<(iv)<(v)<(iii)

AP EAPCET-6 Sep. 2021, Shift-II

Ans. (c) Mg (12): $1s^2, 2s^2, 2p^6, 3s^2$
Na (11): $1s^2, 2s^2, 2p^6, 3s^1$
Ne (10): $1s^2, 2s^2, 2p^6$
C (6): $1s^2, 2s^2, 2p^2$
B (5): $1s^2, 2s^2, 2p^1$

The correct order for increasing ionization enthalpies are:–

$\boxed{\text{(ii)<(i)<(v)<(iv)<(iii)}}$

Na<Mg<B<C<Ne

283. If the successive ionization energies of an element A are 165, 190, 550 and 595 kcal. respectively. then the ground state electronic configuration of element A is ______.

(a) $[Ne]\ 3s^2\ 3p^2$ (b) $[He]\ 2s^1$
(c) $[He]\ 2s^2\ 2p^2$ (d) $[Ne]\ 3s^2$

AP EAPCET 24.08.2021, Shift-I

Ans. (d) : The given ionization energies are –

$\Delta_1H = 165$ Kcal
$\Delta_2H = 190$ Kcal
$\Delta_3H = 595$ Kcal

Δ_1H and Δ_2H are less that indicates that there are two valence electrons and they are in p-orbital from given options the only satisfying option is $1s^2\ 2s^2\ 2p^6\ 3s^2$ or $[Ne]\ 3s^2$.

284. Match the following?

property	metal
(a) Element with highest second ionization enthalpy (is) (Δ_1H_2)	(i) Co
(b) Element with highest third ionization enthalpy (Δ_1H_3)	(ii) Cr
(c) M in $[M(CO)_6]$	(iii) Cu
(d) element with highest heat of atomization (Δ_1H)	(iv) Zn
	(v) Ni

(a) (a → iii), (b → i), (c → v), (d → iv)
(b) (a → iii), (b → iv), (c → ii), (d → v)
(c) (a → iv), (b → i), (c → ii), (d → iii)
(d) (a → v), (b → iv), (c → i), (d → iii)

AP EAPCET 20.08.2021 Shift-II

Ans. (b): Element with highest second ionization enthalpy (Δ_1H_2) = Cu

Element with highest third ionization enthalpy(Δ_1H_3) = Zn

Element with highest heat of atomization (Δ_1H) is Ni and $[M(CO)_6]$ metal is Cr.

285. The first ionization enthalpies of Mg and Al can be expected to be______

(a) IE_1 (Mg) = 577.5 kJ. mol^{-1}, IE_1 (Al) = 577.5 kJ. mol^{-1}
(b) IE_1 (Mg) = 577.5 kJ. mol^{-1}, IE_1 (Al) = 737.7 kJ. mol^{-1}
(c) IE_1 (Mg) = 737.7 kJ. mol^{-1}, IE_1 (Al) = 737.7 kJ. mol^{-1}
(d) IE_1 (Mg) = 737.7 kJ. mol^{-1}, IE_1 (Al) = 577.5 kJ. mol^{-1}

AP EAPCET 20.08.2021 Shift-II

Ans. (d): Ionization enthalpy is defined by the amount of energy an isolated gaseous atom would take to lose an electron in its ground state.

(i) $Mg \longrightarrow Mg^+ + e^-$
$I{\cdot}E_1(Mg) = 737.7$ kJ mole^{-1}
(ii) $Al \longrightarrow Al^+ + e^-$
$I{\cdot}E_1(Al) = 577.5$ kJ mole^{-1}

286. Identify the incorrect order corresponding the mentioned property?

(a) $Al_2O_3 < MgO < Na_2O < K_2O$: Basicity
(b) $NH_3 < PH_3 < AsH_3$: Acidity
(c) $Li^+ < Na^+ < K^+ < Cs^+$: Ionic radius
(d) Li < Be < B < C : First Ionization enthaply

AP EAPCET 24.08.2021 Shift-II

Ans. (d) : Option (1), (2) and (3) are correct. Ionization enthalpy defined as the amount of energy an isolated gaseous atom would take to lose an electron in its ground state.

So, the order is –

Li < B < Be < C (for first ionization energy)

520, 801, 899, 1086, kJ/ mole.

287. Identify the elements X and Y using the ionisation energy values given below:

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Ionization energy (kJ/mol)

	1st	**2nd**
X	**495**	**4563**
Y	**731**	**1450**

(a) X = Na; Y = Mg (b) X = Mg; Y = Na
(c) X = F; Y = Mg (d) X = Mg; Y = F

JEE Main 16.03.2021, Shift-II

Ans. (a) : As we know, first ionization energy is always less than second ionization energy. After removal of one electron from outer orbit, it's attains the stable noble gas configuration i.e

$Na^+ \rightarrow [Ne], 3s^0$

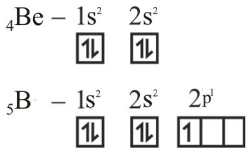
due to which ionization energy of Na^+ is very low but second ionization energy is very high.

$Mg \rightarrow [Ne]\ 3s^2$, The first and second ionization enthalpy of Mg is low but the third ionization enthalpy is very high due to noble gas configuration.

288. Assertion (A): The first ionization energy of Be is greater than that of B.
Reason (R): 2p orbital has lower energy than 2s orbital.
(a) Both A and R are true and R is a correct explanation for A
(b) Both A and R are true but R is not a correct explanation for A
(c) A is true R is false
(d) A is false, R is true

AP EAPCET 23-08-2021 Shift-I

Ans. (c) : Electronic configuration of-



Ionisation energy is defined by the atom which required minimum energy to remove the one electron in outer shell.

So, Be has stable subshell to remove one electron is maximum in comparison to B.

Now, according to Aufbau principle.

$1s^2\ \ 2s^2\ \ 2p^6\ \ 3s^2\ \ 3p^6$ ....

So, the energy of 2s is lower than 2p.

So, the option (c) is correct.

289. The second ionisation energies of Li, Be, B and C are in the order ....
(a) Li > C > B > Be (b) Li > B > C > Be
(c) Be > C > B > Li (d) B > C > Be > Li

AP EAMCET (Engg.) 21.09.2020, Shift-I

Ans. (b) : The second ionisation energy is the energy required to remove an electron from a 1^+ cation in the gaseous state.

$$X^+(g) \rightarrow X^{2+}(g) + e^-$$

Just like the first ionisation energy, the second ionisation energy is affected by size, effective nuclear charge, and electron configuration. Li has highest IE_2 than because the second electron remove from stable noble gas configuration and B has higher IE_2 than C due to the extra stability of the $2s^2$ subshell in the B^+ ion. Therefore, the order is Li > B > C > Be

Hence, the correct option is (b).

290. Which element of the 3d-series has highest third ionisation enthalpy ?
(a) Mn (b) Zn
(c) Fe (d) Cu

AP EAMCET (Engg.) 21.09.2020, Shift-II

Ans. (b) : The electronic configuration of zinc metal is

$Zn = [Ar]3d^{10}, 4s^2$

The third ionisation enthalpy of Zn means removal of electron from the stable configuration of $3d^{10}$. The metal having the highest third ionisation enthalpy is Zn. Hence, the correct option is (b).

291. B has a smaller first ionisation enthalpy than Be. Consider the following statements:
(I) It is easier to remove 2p electron than 2s electron
(II) 2p electron of B is more shielded from the nucleus by the inner core of electrons than the 2s electrons of Be
(III) 2s electron has more penetration power than 2p electron
(IV) atomic radius of B is more than Be
(atomic number B = 5, Be = 4)
The correct statements are
(a) (I), (II) and (III) (b) (II), (III) and (IV)
(c) (I), (III) and (IV) (d) (I), (II) and (IV)

(JEE Main 2020, 9 Jan Shift-II)

Ans. (a) : Boron (B) has a smaller first ionisation energy than Be because Be has a stable complete electronic configuration so, it requires to more energy to remove the first electron from it.
(i) It is easier to remove 2p electron than 2s electron.
(ii) 2p electron of B is more shielded from the nucleus by the inner core of electrons than the 2s electrons of Be.
(iii) 2s electron has more penetration power than 2p electron.

292. The first and second ionisation enthalpies of a metal are 496 and 4560 kJ mol^{-1}, respectively. How many moles of HCl and H_2SO_4, respectively, will be needed to react completely with 1 mole of the metal hydroxide?
(a) 1 and 2 (b) 1 and 1
(c) 2 and 0.5 (d) 1 and 0.5

(JEE Main 2020, 9 Jan Shift-II)

Ans. (d) : Given that, $IE_2 > IE_1$, So the element belong the first group.

Therefore, this element will be a monovalent and thus forms a monoacidic base of the type MOH.

$MOH + HCl \rightarrow MCl + H_2O$

$2MOH + H_2SO_4 \rightarrow M_2SO_4 + 2H_2O$

So, from the above equation we can say that 1 mole of metal hydroxide required 1 mole of HCl and 0.5 mole of H_2SO_4.

293. The first ionisation energy (in kJ/mol) of Na, Mg, Al and Si respectively, are:
(a) 496, 577, 737, 786 (b) 786, 737, 577, 496
(c) 496, 577, 786, 737 (d) 496, 737, 577, 786

(JEE Main 2020, 8 Jan Shift-I)

Ans. (d) : Ionisaiton energy is directly proportional to the effective nuclear charge (Zeff). As the size of atom increase Zeff also increase i.e. ionisaiton energy also increase.

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Ionisation energy $\propto$ Zeff

Ionisation energy is the amount of energy required to remove the outer shell electron of an atom.

Thus, the correct order of ionization energy are-

Na = 496, mg = 737, Al = 577, Si = 786

294. The third ionisation enthalpy is minimum for:

(a) Mn (b) Ni

(c) Co (d) Fe

(JEE Main 2020, 8 Jan Shift-I)

Ans. (d) : The electronic configuration of Fe is

$_{26}Fe = [Ar]\ 3d^6\ 4s^2$

In Fe three electron are removed the electron will be attain a stable configuration i.e., $_{26}Fe^{3+} = [Ar]\ 3d^5$

So, the ionization energy will be least as compared to others, so, the third ionization enthalpy is minimum is Fe.

295. The correct order of the first ionisation enthalpies is

(a) Mn < Ti < Zn < Ni (b) Ti < Mn < Zn < Ni

(c) Zn < Ni < Mn < Ti (d) Ti < Mn < Ni < Zn

(JEE Main 2019, 10 April Shift-II)

Ans. (d) : When we move from left to right in a period ionisation enthalpies increases

Species	Ti	Mn	Ni	Zn
Ionisation enthalpy (kJ/mole)	656	717	736	906

296. In comparison to boron, beryllium has

(a) lesser nuclear charge and lesser first ionisation enthalpy

(b) greater nuclear charge and lesser first ionisation enthalpy

(c) greater nuclear charge and greater first ionisation enthalpy

(d) lesser nuclear charge and greater first ionisation enthalpy

(JEE Main 2019, 12 April Shift-II)

Ans. (d) : The first ionisation of beryllium is greater than that of boron because beryllium has a stable complete electronic configuration ($1s^2\ 2s^2$) so it requires more energy to remove the first electron from it.

Thus, the nuclear charge of boron is greater than nuclear charge of Beryllium (Be)

297. Assertion: Ionisation enthalpy of beryllium is higher than that of boron.

Reason: Across the period, from left to right, ionisation enthalpy decreases.

(a) If both Assertion and Reason are correct and Reason is the correct explanation of Assertion.

(b) If both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.

(c) If Assertion is correct but Reason is incorrect.

(d) If both the Assertion and Reason are incorrect.

AIIMS 26 May 2019 (Morning)

Ans. (c): According to periodic trends, boron should have a higher ionization energy but because its valence shell $2p^1$ is Shielded by the 2s electron, less energy is required to remove the 2p electrons from a boron atom than is required to remove the 2s electron from a beryllium atom.

298. Assertion: Li has high ionisation enthalpy, while Li is the strongest reducing agent in aqueous medium.

Reason : Li has high oxidation potential.

(a) If both Assertion and Reason are correct and Reason is the correct explanation of Assertion.

(b) If both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.

(c) If Assertion is correct but Reason is incorrect.

(d) If both the Assertion and Reason are incorrect.

AIIMS 26 May 2019 (Evening)

Ans. (a): Li has high ionization energy, while Li is the strongest reducing agent in aqueous medium because of large amount of hydration energy is realized and on account of large amount of hydration energy molecules it strongest reducing agent and Li has high oxidation potential.

299. The element having greater difference between its first and second ionization energies, is:

(a) Ca (b) Sc

(c) Ba (d) K

(JEE Main 2019, 9 April Shift-I)

AIIMS 25 May 2019 (Morning)

Ans. (d): Alkali metal have high difference in the first and second ionization energy and they achieve stable noble gas configuration offer first ionization. First ionization energy is the energy required to remove an electron from an atom in the gaseous state.

The second ionization energy is defined as the energy needed to remove one mole of 1^+ ions in the gaseous state to form one mole of 2^+ ions in the gaseous state.

The value of 2nd I.E. are-

For Ca, $I.E_2 = 1145.4$ kJ/mole

Sc, $I.E_2 = 1235.0$ kJ/mole

K, $I.E_2 = 3052.0$ kJ/mole

Ba, $I.E_2 = 965.2$ kJ/mole

Hence, potassium (K) has highest ionization energy.

300. The first ionization enthalpy of the following elements are in the order:

(a) C < N < Si < P (b) P < Si < N < C

(c) P < Si < C < N (d) Si < P < C < N

Karnataka-CET-2019

Ans. (d) : When moving from left to right in a period ionization energy increase and moving from top to bottom in a group ionization energy decreases.

Therefore nitrogen has higher ionization energy and silicon has lower ionization energy so, the first ionization enthalpy order of the element are-

Si < P < C < N

301. Which of the following has highest second ionisation energy :

(a) Chromium (b) Calcium

(c) Iron (d) Cobalt

Manipal-2019

Ans. (a) : The electronic configuration of Cr is

$_{24}Cr = 1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 4s^1, 3d^5$

After ionisation of one electron then the electronic configuration is-

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$Cr^+ = 1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 4s^0, 3d^5$
It has half-filled stable configuration. So, the second ionisation of Cr will require much greater ionisation energy than the expected one.

302. The second ionisation energy of the following elements follows the order
(a) Zn > Cd > Hg (b) Zn > Cd > Hg
(c) Cd > Hg < Zn (d) Zn < Cd < Hg

WB-JEE-2019

Ans. (a) : From moving top to bottom in a group ionisation energy decrease due to nuclear charge increases, atomic size increase and the number of shells increases. Thus the electron are loosely held with the nucleus.
The order of ionisation energy is–
Zn > Cd > Hg

303. The successive ionization energies in kJ/mol of an element P are 740, 1500, 7000, 10500, 13600, 18000 and 21700. Which ion is the most likely to be formed when P reacts with chloride?
(a) p^{2-} (b) p^+
(c) p^{2+} (d) p^{3+}

COMEDK 2018

Ans. (c) : After losing two electrons, there is sudden huge increase in IE from 1500 to 7000 kJ/mol. It means that after losing two electrons, some stable configuration is achieved. So, element P forms P^{2+} ion.

304. Assertion: Second ionization enthalpy will be higher than the first ionization enthalpy.
Reason: Ionization enthalpy is quantitative measure of the tendency of an element to lose electron.
(a) If both Assertion and Reason are correct and the Reason is the correct explanation of Assertion.
(b) If both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.
(c) If Assertion is correct but Reason is incorrect.
(d) If both the Assertion and Reason are incorrect.

AIIMS-27 May, 2018

Ans. (b): Second ionization enthalpy will be highest than first ionization energy because after removal of first electron. The nuclear charge increases and electrons are held more tightly by the nucleus. This is makes the removal of second electrons difficult and thus, requires more energy.

305. Amongst the elements with following electronic configurations, which one of them may have the highest ionization energy?
(a) $Ne[3s^2 3p^2]$ (b) $Ar[3d^{10} 4s^2 4p^3]$
(c) $Ne[3s^2 3p^1]$ (d) $Ne[3s^2 3p^3]$

BITSAT 2018

Ans. (d) : The smaller the atomic size, larger is the value of ionization potential. Further the atoms having half filled or fully filled orbitals are comparatively more stable, hence more energy is required to remove the electron from such atoms.

306. What will be ionization energy of Be atom? Consider the first ionization energy of H atom as 13.6 eV.
(a) –217.6 eV (b) 54.4 eV
(c) 108.8 eV (d) 4 eV

J & K CET-(2018)

Ans. (a) : According to Bohr's model of energy

$$E = -13.6 \times \frac{z^2}{n^2}$$

Where, E = Energy of electron
n = Shell
Z = Atomic number

$$\text{Ionisation energy of } 1^{st} \text{ orbit of Be} = \frac{-13.6 \times 4^2}{1^2}$$
$$= -13.6 \times 16$$
$$= -217.6 \text{ eV}$$

So, Ionisation energy = 217.6 eV

307. The ionisation energy of nitrogen is larger than that of oxygen because :
(a) the size of nitrogen atom is smaller
(b) there is greater attraction of electrons towards the nucleus
(c) half-filled p-orbitals of nitrogen have extra stability
(d) None of the above

Manipal-2017

Ans. (c) : The electronic configuration of nitrogen and oxygen are-
$_7N$ - $1s^2, 2s^2, 2p^3$
$_8O$ - $1s^2, 2s^2, 2p^4$
Thus, the ionisation energy of nitrogen is larger than that of oxygen because of half-filled p-orbitals of nitrogen have extra stability.

308. The first four ionization enthalpy values of an element are 191 kcal mol^{-1}, 578 kcal mol^{-1}, 872 kcal mol^{-1} and 5962 kcal mol^{-1} . The number of valence electrons in the element is
(a) 1 (b) 2
(c) 3 (d) 4

CG PET -2017

Ans. (c) : In the given statement, first three I.E. values are low, but 4^{th} I.E. value is quite high and cannot be achieved (i.e.5962 kcal/mol)
∴ Only three electrons are possible in the valence shell.
So, possible valency is (3).

309. First and second ionisation enthalpies of Mg are 737.76 and 1450.73 J mol^{-1} respectively. The energy required to convert all the atoms of magnesium to magnesium ions present in 24g of magnesium vapours is
(a) 24 kJ (b) 2.188 kJ
(c) 12 kJ (d) 4.253 kJ

CG PET- 2016

Ans. (b) : Given that,
$Mg(g) + \Delta H_1 \rightarrow Mg^+(g) + e^-$;735.76 kJ/mole
$Mg^+(g) + \Delta H_2 \rightarrow Mg^{+2}(g)\ e^-$; 1450.73 kJ/mole
∴ Total amount of energy needed to convert Mg(g) atom into $Mg^{+2}(g)$ ions = $\Delta H_1 + \Delta H_2$
$= 737.76 + 1450.73$
$= 2188.49$ kJ/mole

$$\text{Since, 24g of Mg} = \frac{24}{1000}\text{ kg} = \frac{24}{24 \times 1000}\text{ mole}$$
$$= 10^{-3} \text{ mole}$$

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∴ Amount of energy needed to ionize 10^{-3} mole of Mg vapours = 2188.49 × 10^{-3}
= 2.188 kJ

310. Elements which have relatively high ionisation energy and occur as sulphides are
(a) halogens (b) transition elements
(c) alkali metals (d) metalloids.
SRMJEEE-2016

Ans. (d) : Metalloids have high ionisation energy and occur as sulphides.

311. The correct decreasing order of first ionisation enthalpies of five elements of the second period is
(a) Be >B>C>N>F (b) N >F>C>B>Be
(c) F >N>C>Be>B (d) N >F>B>C>Be
AIIMS-2016

Ans. (c): The ionization enthalpy of B is lower than that of Be. This is because electronic configuration of ($1s^2$, $2s^2$, $2p^1$) is less stable than that of Be($1s^2$, $2s^2$) which has completely filled orbitals. The 2p orbital of B is not strongly attracted by the nucleus as the 2s electron of Be. Thus, the increasing order of first ionization enthalpies of element is-
F > N > C > Be > B

312. The second ionisation enthalpy of which of the following alkaline earth metals is the highest?
(a) Ba (b) Mg
(c) Ca (d) Sr
(e) Be
Kerala-CEE-2016

Ans. (e) : Ionization energy increase on decreasing the size of atom.

$$\text{Ionisation energy} \propto \frac{1}{\text{size}}$$

The second ionisation energy of Be is the enthalpy change when 1 mole of gaseous ion of an element each with a single positive charge each lose an electron to form gaseous ion each with a double positive charge ie. Be^{+2} due to less size and high ionisation potential.

313. Which of the following atoms has the highest first ionisation energy?
(a) Na (b) K
(c) Sc (d) Rb
(JEE Main 2016)

Ans. (c) : Order of ionisation energy is Sc > Na > K > Rb. It is poor shielding effect and removal of one electron from 4s orbital is difficult as compared to 3s-orbital.

314. The ionization energy of hydrogen atom in the ground state is
(a) 13.6 MeV (b) 13.6 eV
(c) 13.6 Joule (d) Zero
NDA (II)-2017

Ans. (b) Ionization energy is the amount of energy required to remove an electron from an isolated atom or molecule. The ionization energy of hydrogen atom in the ground state is 13.6 eV.

315. Highest energy will be absorbed to eject out the electron in the configuration.
(a) $1s^2 2s^2 2p^1$ (b) $1s^2 2s^2 2p^3$
(c) $1s^2 2s^2 2p^2$ (d) $1s^2 2s^2 2p^4$
JIPMER-2016

Ans. (b) : The electronic configuration $1s^2$ $2s^2$ $2p^3$ having a half-filled electronic configuration which is stable. If one electron is removed then the high amount of energy is required.

316. For one of the element various successive ionisation enthalpies (in kJ mol^{-1}) are given below.

IE	1st 577.5	2nd 1810	3rd 2750	4th 11,580	5th 14,820

The element is
(a) Si (b) P
(c) Al (d) Mg
Karnataka-CET-2015

Ans. (c) : For the given third ionisation energy is 2750 KJ and fourth ionisation energy is 11580 KJ. Therefore, the fourth ionisaiton energy is much higher, it means removal of the 4th electron is from the stable configuration, so the element is aluminum.

317. The correct order of first ionization enthalpies of the following elements is
(a) Be > Mg > Ca > Sr > Ra > Ba
(b) Ra > Ba > Sr > Ca > Mg > Be
(c) Be > Mg > Ca > Sr > Ba > Ra
(d) Ra > Sr > Ba > Mg > Ca > Be
(e) Be > Mg > Ca > Ra > Ba > Sr
Kerala-CEE-2015

Ans. (a) : On moving from up to down in a group ionization energy decrease due to effective nuclear charge increase. So, the correct order of first ionization enthalpies of the element is-
Be > Mg > Ca > Sr > Ra > Ba

318. The energy required to excite the electron in the atom from n = 1 to n = 2, when the ionization enthalpy of hydrogen atom is 1.312 × 10^6J/mole will be (in the unit of 10^5).
(a) 8.53 (b) 7.51
(c) 8.92 (d) 9.86
BCECE-2015

Ans. (d) : Given that, I.E. = 1.312 × 10^6

$$IE = E_\infty - E_1$$
$$1.312 \times 10^6 = 0 - E_1$$
$$E_1 = -1.312 \times 10^6 \text{ J/mole}$$
$$\therefore \quad E_2 = \frac{1.312\times10^6 \times (1)^2}{2^2} = \frac{-1.312\times10^6}{4}$$
$$E_2 = -3.28 \times 10^5 \text{ J/mole}$$
$$\Delta E = E_2 - E_1$$
$$= -3.28 \times 10^5 - (-1.312 \times 10^6)$$
$$= 9.86 \times 10^5 \text{ J/mole.}$$

319. Atomic numbers of vanadium, chromium, nickel and iron are 23, 24, 28 and 26 respectively. Which one of these is expected to have the highest second ionization enthalpy?
(a) Cr (b) V
(c) Fe (d) Ni
COMEDK 2014

Ans. (a) : Second ionization enthalpy of Cr is highest because after the removal of 1st electron, Cr acquires a stable half-filled d^5 configuration thus, removal of 2nd electron is very difficult.

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320. Ionization energy and electron affinity are defined at

(a) enthalpy (b) spontaneity
(c) equilibrium (d) absolute zero.

J & K CET-(2014)

Ans. (d) : The electron affinity of an atom or molecule is defined as the amount of energy released when an electron is attached to a neutral atom or molecule in the gaseous state to form a negative ion. The ionisation enthalpy is defined as the change of electron as negative sign when energy released overall say that electron affinity and ionisation energy are defined at absolute zero.

321. The incorrect statements among the following is

(a) the first ionization potential of Al is less than the first ionization potential of Mg
(b) the second ionization potential of Mg is lower than the second ionization potential of Na
(c) the first ionization potential of Na is less than the first ionization potential of Mg
(d) the third ionization potential of Mg is greater than the third ionisation potential of Al

UPTU/UPSEE-2014

Ans. (b) : Ionisation energy is the energy required to remove one electron from the atom. The second ionization potential indicates the energy required to remove another electron after the first ionization.
Hence, the second ionization potential of Mg is higher than the second ionization potential of Na.

322. The correct order of ionization energies is

(a) Cu > Ag > Au (b) Cu > Au > Ag
(c) Au > Cu > Ag (d) Ag > Au > Cu

UPTU/UPSEE-2013

Ans. (c) : These element belong to the 11 group of Periodic tables. As we move down the group, ionization energy decreases, but due to f-electrons and its ionization energy becomes high so, the order of ionization energies is-

Au > Cu > Ag

323. When the first ionization energies are plotted against atomic number, the peaks are occupied by

(a) Alkali metals (b) Rare gases
(c) Halogens (d) Transition elements

BITSAT 2013

Ans. (b) : Rare gases; as the electron is to be removed from stable configuration.

324. Which of the following represents the correct order of increasing first ionization enthalpy for Ca, Ba, S, Se and Ar ?

(a) Ca < S < Ba < Se < Ar
(b) S < Se < Ca < Ba < Ar
(c) Ba < Ca < Se < S < Ar
(d) Ca < Ba < S < Se < Ar

(JEE Main 2013)

Ans. (c) : Ionisation energy of element increases across a period in the periodic table because the electrons are held tightly by the higher effective nuclear charge.
The ionisation energy of the elements decreases on moving down the group because the electrons are held in lower energy orbitals away from the nucleus.
Ar is higher ionisation energy because it is a noble gas and Ba has the lowest ionization energy as it in six period of element.
So, the increasing order of first ionisation energy are-

Ba < Ca < Se < S < Ar

325. Which of the following elements has highest ionisation potential?

(a) B (b) C
(c) N (d) O

MPPET - 2012

Ans. (c) : Amount of energy required to remove an e^- from the valence shell called ionisation energy. Nitrogen has greater ionization energy than oxygen because nitrogen has half filled stable configuration than the other element so removal of electron required the more energy hence highest ionisation potential.

326. The atomic number of the element with highest ionization energy among the following is

(a) Z = 16 (b) Z= 14
(c) Z=13 (d) Z= 15

COMEDK 2012

Ans. (d) : For element with Z = 15, electronic configuration is $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p_x^1 3p_y^1 3p_z^1$.
Due to exactly half filled configuration of 3p orbital, the element will have the highest ionization energy.

327. A large increase from the first to the second ionisation energy of an element 'A' can be seen if its electronic configuration is

(a) $1s^22s^22p^63s^1$ (b) $1s^22s^22p^63s^2$
(c) $1s^22s^22p^5$ (d) $1s^22s^22p^63s^23p^2$

SRMJEEE – 2012

Ans. (a) : Element with electronic configuration $1s^2\ 2s^2\ 2p^6\ 3s^1$ have large increase in first ionization energy to second ionisation energy due to stable configuration.

328. Among the following the elements of highest first ionization enthalpy is

(a) C (b) F
(c) Be (d) N
(e) Ne

Kerala-CEE-2012

Ans. (e) : Ne has high ionisation enthalpy because noble gases have completely filled valence shells that are highly stable, a high amount of energy would be required to remove even a single electron from the valence shell of a noble gas. It can difficult to remove an electron from any of the noble gases.

329. If the first ionization energy of H atom is 13.6 eV, then the second ionization energy of He atom is

(a) 27.2 eV (b) 40.8 eV
(c) 54.4 eV (d) 108.8 eV

WB-JEE-2012

Ans. (c) : We know that,

$$E = -13.6\times\frac{Z^2}{n^2}\text{ eV}$$

For second ionisation energy

$$E = -13.6\times\frac{2^2}{1^2}$$

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$= -13.6 \times 4$
$= -54.4$ eV
Hence, the second ionization energy of He atom is 54.4 eV.

330. Which one of the following does not correctly represent the correct order of the property indicated against it?
(a) Ti < V < Cr < Mn; increasing number of oxidation states
(b) $Ti^{3+} < V^{3+} < Cr^{3+} < Mn^{3+}$; magnetic moment
(c) Ti < V < Cr < Mn : increasing 2nd ionization
(d) Ti < V < Mn < Cr : increasing 2nd ionization enthalpy

(NEET-Mains 2012)

Ans. (c) : The increasing order of second ionisation energy is Cr > Mn > V > Ti
(A) Ti < V < Cr < Mn has increasing oxidation state
(B) $Ti^{3+} < V^{3+} < Cr^{3+} < Mn^{3+}$ has magnetic moment increases
(C) Ti < V < Mn < Cr has increasing 2nd ionisation enthalpy

331. Which one of the following electronic configuration corresponds to the highest value of ionisation potential?
(a) $[Xe]6s^2$
(b) $[Ar]\ 4s^2\ 3d^{10}$
(c) $1s^2$
(d) $[Rn]7s^2 6d^1 5f^{14}$

UP CPMT-2012

Ans. (c) : $1s^2$ has the highest value of ionisation potential, because the outermost electrons are very close to nucleus.

332. On adding $AlCl_3$ to water
(a) the ionisation of water increases
(b) the ionisation of water decreases
(c) the ionisation of water remains constant
(d) the ionic product of water increases

UP CPMT-2011

Ans. (a) : $AlCl_3$ gives Al^{3+} ions which combine with OH^- ions given by H_2O so that dissociation equilibrium of H_2O shifts in forward direction i.e. ionisation of water increases.

333. Which one of K, I, Cl and Li will display the highest first ionisation energy?
(a) K
(b) I
(c) Cl
(d) Li

UPTU/UPSEE-2011

Ans. (c) : On moving down a group the valence shell becomes for away from the nucleus and thus, nuclear attraction towards valence electron decreases which results in decreases in ionisation energy. Thus, chlorine has the highest first ionisation energy among all the given elements.

334. The correct decreasing order of first ionisation enthalpies of five elements of the second period is
(a) Be > B > C > N > F
(b) N > F > C > B > Be
(c) F > N > C > Be > B
(d) N > F > B > C > Be
(e) F > C > N > B > Be

Kerala-CEE-2011

Ans. (c) : We move from left to right in a period the ionisation enthalpy increase with increasing atomic number.
In Be and B, Be has full-filled 2s-subshell has extra ionisation energy than boron. As a result the 2p electron of B is not strongly attracted by the nucleus of 2s-electron of Be. So, the decreasing order of first ionisation energy of element are-
F > N > C > Be > B

335. Which one of the following is correct order of second ionisation potential of Na, Ne, Mg and Al?
(a) Al < Na < Mg < Ne
(b) Ne < Al < Na < Mg
(c) Mg < Al < Ne < Na
(d) Na < Mg < Ne < Al

AP-EAMCET- (Engg.)-2011

Ans. (c) : $Na^{+2} - 1s^2\ 2s^2\ 2p^5$
$Ne^{+2} - 1s^2, 2s^2, 2p^4$
$Mg^{+2} - 1s^2, 2s^2, 2p^6, 3s^0$
$Al^{+2} - 1s^2, 2s^2, 2p^6, 3s^1$
Thus, the ionization energy decreases as the size of the atom increases. Since, Mg^{+2} is stable electronic configuration. Hence the ionization energy ($I.E_2$) is the highest than other species.
$IE_2 \Rightarrow$ Mg < Al < Ne < Na.

336. Assertion: Element has a tendency to lose the electron(s) to attain the stable configuration.
Reason: Ionization enthalpy is the energy released to remove and electron from an isolated gaseous atom in its ground state.
(a) If both Assertion and Reason are correct and the Reason is the correct explanation of Assertion.
(b) If both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.
(c) If Assertion is correct but Reason is incorrect.
(d) If both the Assertion and Reason are incorrect.

AIIMS-2011

Ans. (c): The element has tendency to lose the electrons to attain the stable configuration. The atom with one valence electron will lose one electron to form a stable configuration.
Ionization enthalpy is the energy required to remove an electron from an isolated gaseous atom in its ground state. Energy is required to overcame the attraction between nucleus and valence electron.

337. Which element is expected to have lowest first ionization energy?
(a) Sr (b) As (c) Xe (d) S

J & K CET-(2010)

Ans. (a) : The electronic configuration of given element are-
$_{38}Sr = [Kr]\ 5s^2$
$_{33}As = [Ar]\ 3d^{10}\ 4s^2\ 4p^3$
$_{54}Xe = [Kr]\ 3d^{10}\ 5s^2\ 5p^6$
$_{16}S = [Ne]\ 3s^2\ 3p^4$
When the distance from outer electron from nucleus increases, it becomes very easy to remove an electron. Therefore, the ionisaiton energy decrease. So, Sr is lowest first ionisation energy among the given.

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338. Which of the following relation is correct?
(a) Ist IE of C > Ist IE of B
(b) Ist IE of C < Ist IE of B
(c) IInd IE of C > IIst IE of B
(d) Both (b) and (c)

JIPMER-2010

Ans. (a): The electronic configuration of carbon is $1s^2\ 2s^2\ 2p^2$ and electronic configuration of boron is $1s^2\ 2s^2\ 2p^1$
If one electron is removed easily due to stable configurations. Ionisation energy is minimum but in carbon one electron is removed due to high ionisation energy.

339. The incorrect order of second ionization energies in the following is
(a) Rb > K
(b) Na > Mg
(c) Cr > Mn
(d) S > P

AP- EAMCET(Medical) -2010

Ans. (a): As we know that ionisation energies decreases down the group due to increase of size of metal and increases left to right in periodic table. Rb and K are belongs to the 1st group of the periodic table. The correct order of second ionisation energy will be K>Rb.
The correct order is given as follows –
Na > Mg (Third period metal)
Cr > Mn (Fourth period metals)
S > P (Third Period metal)

340. Which of the following statement is correct about ionization potential?
(a) It is independent of atomic radii.
(b) It remains constant with change in atomic radii.
(c) It increases with an increase in atomic radii.
(d) It decreases with an increased in atomic radii.

AIIMS-2010

Ans. (d): The ionization energy is the energy to remove an electron from the neutral atom. On moving across a row with decrease in atomic radii.
The ionization potential decreases with increase in atomic radii.

341. Assertion (A) K, Rb and Cs form superoxide's. Reason (R) the stability of the superoxide's increases from 'K' to 'Cs' due to decrease in lattice energy.
The correct answer is
(a) Both **(A)** and **(R)** are true and **(R)** is the correct explanation of **(A)**
(b) Both **(A)** and **(R)** are true but **(R)** is not the correct explanation of **(A)**
(c) **(A)** is true but **(R)** is not true
(d) **(A)** is not true but **(R)** is not true

AP EAMCET (Engg.)-2009

Ans. (c): R$^+$, Rb$^+$ and Cs$^+$ are large cations and superoxide ion is bigger than oxide and peroxide ions because of the higher lattice energies, a large cation Stabilizes a large anion, hence these metals form super oxides.
As, we move down the group, the size of an atom from K to Cs increases so, lattice energy decreases, therefore the stability of superoxide also decreases.

342. The successive ionisation energies of an element are 800, 2,000, 3,600, 25,000 and 32,000 kJ/mol. The number of valence electrons are
(a) 5
(b) 2
(c) 3
(d) 4

BCECE-2009

Ans. (c) : Let the element is Z.

$$Z \xrightarrow[800]{IE_1} Z^{+} \xrightarrow[2000]{IE_2} Z^{2+} \xrightarrow[3600]{IE_3} Z^{3+}$$

$$Z^{+5} \xleftarrow[32000]{IE_5} Z^{4+} \xleftarrow[25000]{IE_4}$$

Thus, Z^{3+} has stable inert gas configuration as there is high jump after IE$_3$. So, the valence electrons are 3.

343. Which one of the following order is correct for the first ionisation energies of the elements?
(a) B < Be < N < O
(b) Be < B < N < O
(c) B < Be < O <N
(d) B < O < Be < N

AP EAMCET (Engg.)-2009

Ans. (c): Ionisation energy of B than that of Be because B($1s^2$, $2s^2$, $2p^2$) electron is to removed from 2p orbitals while Be($1s^2$, $2s^2$) electron is to be removed from 2s is difficult due to filled s-orbitals. The ionization energy of oxygen is lower than N due to half filled 2p orbitals in N($1s^2$, $2s^2$, $2p^3$)
Therefore, the increasing order are-
B < Be < O < N

344. The pair of elements having approximately equal ionization potential is
(a) Al, Ga
(b) Al, Si
(c) Al, Mg
(d) Al, B

UPTU/UPSEE-2009

Ans. (a) : The pair of elements having approximately equal ionisaiton energy is Al and Ga. Ionisation energy increases with a decreases in atomic size and due to the increase in the shielding effect of inner electrons.

345. The ionisation energy of nitrogen is larger than that of oxygen because of
(a) greater attraction of electons by the nucleus
(b) the size of the nitrogen atom being smaller
(c) the half-filled p-orbitals possess extra stability
(d) greater penetration effect.

SRMJEEE – 2008

Ans. (c) : The ionisation energy of nitrogen is larger than of oxygen because of nitrogen has half-filled p-orbital is more stable thus, it is difficult to remove an electron from it. Hence nitrogen has larger ionisation energy than oxygen.

346. The first ionization potential of Al, as compared to that of Mg is :
(a) Greater
(b) Lower
(c) The same
(d) Twice as much

BITSAT 2008

Ans. (b) : The first ionization potential of Al is lower than that of Mg because valence shell configuration of Mg is $3s^2$ and of Al is $3s^2$, $3p^1$. As s-orbital is close to nucleus than p-orbital. So removal of 1st e^- from Mg is difficult and require more energy as compare to Al.

347. The first ionization energy of oxygen is less than that of nitrogen. Which of the following is the correct reason for this observation?
(a) Lesser effective nuclear charge of oxygen then nitrogen
(b) Lesser atomic size of oxygen than nitrogen

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(c) Greater interelectron repulsion between two electrons in the same p-orbital counter balances the increase in effective nuclear charge on moving from nitrogen to oxygen
(d) Greater effective nuclear charge of oxygen than nitrogen
(c) Higher electronegativity of oxygen than Nitrogen

Kerala-CEE-2008

Ans. (c): The first ionization energy of oxygen is less than that of nitrogen because we move from left to right in a period atomic size decrease and ionization energy will be increased due to greater effective nuclear charge of oxygen than nitrogen.

348. The correct order of decreasing second ionization enthalpy of Ti (22), V(23), Cr (24) and Mn (25) is
(a) Mn > Cr > Ti > V
(b) Ti > V > Cr > Mn
(c) Cr > Mn > V > Ti
(d) V > Mn > Cr > Ti

(NEET-2008)

Ans. (c) : The electronic configuration are follow as-

Cr - $1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 4s^1, 3d^5$
Mn - $1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 4s^2, 3d^5$
V - $1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 4s^2, 3d^3$
Ti - $1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 4s^2, 3d^2$

The value of the second ionisation energy of Cr is more due to Cr^+ has $3d^5$ configuration which is extra energy is required than the Mn.
So, the order of 2nd ionisation energy is-
Cr > Mn > V > Ti

349. The comparatively high b.pt. of HF is due to
(a) high reactivity of fluorine
(b) small size of hydrogen atom
(c) formation of hydrogen bonds and consequent association
(d) high IE of fluorine

MHT CET-2007

Ans. (c) : Intermolecular hydrogen bonding is found in $(HF)_n$ due to higher electronegativity of fluorine atoms

H——F– – –H——F– – –H

Hydrogen bonding

Hydrogen bonding is associated of HF molecule. So, the high boiling point of HF is due to formation of hydrogen bonds and consequent association.

350. Highest ionizing power is exhibited by
(a) α-rays
(b) β-rays
(c) γ-rays
(d) X-rays

UP CPMT-2007

Ans. (a) : Highest ionizing power is exhibited by α-rays. This is 100 times greater than β-rays and 10,000 times greater than γ-rays. This is due to high kinetic energy of α–particle.

351. Ionisation energy decreases down the group due to
(a) increase in charge
(b) increase in atomic size
(c) decrease in atomic size
(d) decrease in shilding effect

UP CPMT-2007

Ans. (b) : Ionisation energy is defined as the energy required to remove an electron from the outermost orbit of an isolated gaseous atom in its ground state.

$$A \rightarrow A^+ + e^- \qquad \text{[first IE]}$$

Ionisation energy decrease in a group as the atomic number increases. It is based on the fact that we move down a group, the size of atom increases, and the outer electrons became further away from the nucleus thus reducing the force of attraction and hence ionization energy decreases with increase in the atomic size.

352. Which of the following has lowest ionization energy?
(a) Oxygen
(b) Nitrogen
(c) Fluorine
(d) Sulphur

UP CPMT-2007

Ans. (d) : Ionisation energy is defined as the energy required to remove an electron from the outermost orbit of an isolated gaseous atom in its ground state.
As down the group, the number of inner shells increase. Therefore, ionization energy decrease due to screening effect.
Among oxygen, nitrogen, fluorine and sulphur, the lowest ionization energy is of sulphur. As their first ionization values indicated below.
N= 1402. 1kJ/mil, O= 1313.7 kJ/mol
F= 1680.8kJ/mol, S= 999.4 kJ/mol

353. The successive ionization energy values for an element 'X' are given below :
(i) 1st ionisation energy = 410 kJ mol^{-1}
(ii) 2nd ionisation energy = 820 kJ mol^{-1}
(iii) 3rd ionisation energy = 1100 kJ mol^{-1}
(iv) 4th ionisation energy = 1500 kJ mol^{-1}
(v) 5th ionisation energy = 3200 kJ mol^{-1}
Find out the number of valence electron for the atom 'X'.
(a) 4
(b) 3
(c) 5
(d) 2
(e) 1

Kerala-CEE-2006

Ans. (a) : According to the given species there is a large jump from first to second ionization energy. The second ionisation energy is more indicate that its than the first ionisation energy. It stable electronic configuration after the removal of one electron. Hence, the number of valence electron is 1. This indicates that element 'x' belong to alkali matal group, so, the valence electron of the x is 4.

354. First inonisation potential is highest for
(a) Na
(b) Mg
(c) Al
(d) None of these

CG PET -2006

Ans. (b) : The electronic configuration of Mg is $1s^2, 2s^2, 2p^6, 3s^2$
Mg has stable electronic configuration due to full filled of 3s orbital. Hence, the amount of energy require to remove the electron is high.

355. Element having maximum ionization energy
(a) Na
(b) Li
(c) K
(d) Rb

UP CPMT-2005

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Ans. (b) : The ionisation enertgy is amount of energy required to take out most loosely bonded electron from an isolated gaseous atom. The ionisation energy decreases down the group.

∵ the choices given are all members of group (Na, Li, K, Rb)

∴ the first member (Li) will have maximum ionization energy.

356. Assertion: First ionization energy for nitrogen is lower than oxygen.
Reason: Across a period effective nuclear charge decreases.

(a) If both Assertion and Reason are correct and the Reason is a correct explanation of the Assertion.
(b) If both Assertion and Reason are correct but Reason is not a correct explanation of the Assertion.
(c) If the Assertion is correct but Reason is incorrect.
(d) If both the Assertion and Reason are incorrect.
(e) If the Assertion is incorrect but the Reason is correct.

AIIMS-2005

Ans. (e): When on moving from left to right in a period atomic number and nuclear charge increase and size decrease, as a result ionization energy increase, But the element of IIA and VA group on the account of their half-filled and completely filled orbitals respectively have stable configuration.

357. The order of first ionization energies of the elements Li, Be, B, Na is:

(a) Li > Be > B > Na
(b) Be > B > Li > Na
(c) Na > Li > B > Be
(d) Be > Li > B > Na
(e) B > Be > Li > Na

Kerala-CEE-2005

Ans. (b) : The electronic configuration of the given species are-

Be = $1s^2\ 2s^2$
B = $1s^2\ 2s^2\ 2p^1$
Li = $1s^2\ 2s^1$
Na = $1s^2\ 2s^2\ 2p^6\ 3s^1$

In Be has stable electronic configuration with fully filled 2s-subshell has extra ionisation energy in compared to other element. Thus, the correct order of ionisation energy is-

Be > B > Li > Na

358. Which among the following elements have lowest value of IE_1?

(a) Pb
(b) Sn
(c) Si
(d) C

UP CPMT-2004

Ans. (b) : Ionisation energy decreases down the group due to increase in size but ionization energy of Sn is less than that of Pb due to the effective shielding of the valence electrons by the intervening d and f- electrons.

Element	C	Si	Ge	Sn	Pb
IE (kJ/mol)	1086	786	761	708	715

359. The first ionisation potential is maximum for

(a) B
(b) N
(c) O
(d) Be

UP CPMT-2004

Ans. (b) : The first ionisation potentials generally increases when we move from left to right in a period. But elements with stable configurations have higher ionization potentials than expected.

IInd period	Be	B	C	N	O
Valence shell configuration	$2s^2$	$2s^2,2p^1$	$2s^2,2p^2$,	$2s^2,2p^3$	$2s^2,2p^4$

All the given options are of second period. Among them oxygen is expected to have highest ionization potential, but nitrogen ($2s^2,2p^3$) has higher ionisation potential due to its more stable configuration as compared to oxygen ($2s^2,2p^4$).

360. Ionisation depends upon

(a) Pressure
(b) Volume
(c) Dilution
(d) None of these

UP CPMT-2004

Ans. (c) : Ionisation of strong electrolyte increases with dilution.

Ionisation of electrolytes also depend on concentration temperature, nature of solute and nature of solvent.

361. The energy of last element of Li will be:

(a) –30.6 eV
(b) –13.6 eV
(c) –24.6 eV
(d) –28.6 eV

JCECE - 2004

Ans. (a) : We know that,

$$E = -13.6\ \frac{Z^2}{n^2}\ \text{eV}$$

For Li, Z = 3, n = 2

Hence, the energy of last element of Li will be

$$E = \frac{-13.6\times3^2}{2^2} = \frac{-13.6\times9}{4} = -30.6\ \text{eV}$$

362. Which of the following has maximum ionization energy?

(a) Cesium
(b) Fluorine
(c) Xenon
(d) Nitrogen

JCECE - 2004

Ans. (b) : Ionisation energy is the amount of energy required to take out most lossely bonded electron from isolated gaseous atom on moving left to right in a period ionisation energy increase and on a group decreases. Therefore, fluorine has maximum ionisation energy.

363. Which of the following is a favourable factor for cation formation?

(a) High electronegativity
(b) High electron affinity
(c) Low ionization potential
(d) Smaller atomic size

A.P.EAMCET 2004

Ans. (c) : The low ionization potential energy mean that electron can be easily lost and cation formation is easier or elements with a low ionization potential tend to be reducing agents and form cations.

364. The first ionisation potentials of four consecutive elements, present in the second period of the periodic table, are 8.3, 11.3, 14.5 and 13.6 eV respectively. Which one of the following is the first ionisation potential (in eV) of nitrogen?

(a) 13.6
(b) 11.2
(c) 8.3
(d) 14.5

AP-EAMCET (Engg.)-2004

@apna_pdf

Ans. (d) : The atomic number of nitrogen is 7. The electronic configuration of ${}_7N$ is $1s^2, 2s^2, 2p^3$
It is clear that N has half filled configuration which is stable. The removal of electron from outer shell of nitrogen is very tedious and consuming high amount of energy. Hence, the first ionisation potential energy of nitrogen has more in values i.e. 14.5 eV.

365. The highest first ionisation potential is of :
(a) carbon
(b) boron
(c) oxygen
(d) nitrogen
BCECE-2004

Ans. (d) : First ionization energy is the amount of energy required to remove one mole of electron from a gaseous atom under standard condition.
It is easy to remove one of the electron than the unpaired electron in nitrogen. Hence, nitrogen has highest first ionization potential.

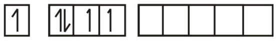
366. The atomic numbers of vanadium (V), chromium (Cr), manganese (Mn) and iron (Fe) are, respectively 23, 24, 25 and 26. Which one of these may be expected to have the highest second ionisation enthalpy?
(a) V
(b) Cr
(c) Mn
(d) Fe
(AIEEE 2003)

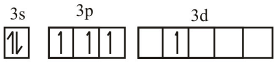
Ans. (b) : The electronic configuration are-
${}_{23}V = 1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2\ 3d^3$
${}_{24}Cr = 1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^1\ 3d^5$
${}_{25}Mn = 1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2\ 3d^5$
${}_{26}Fe = 1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2\ 3d^6$
The chromium it loses one electron to form $[Ar]\ 3d^5\ 4s^0$ in which 3d subshell is half-filled and stable when another electron is removed, it is removed from half-filled 3d subshell is lost. This requires more energy.

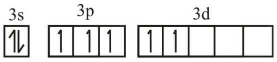
367. Which one of the following is correct about stability of the given ions?
(a) $Pb^{2+} > Pb^{4+}$
(b) $Pb^{4+} > Pb^{2+}$
(c) $Si^{2+} > Si^{4+}$
(d) $Sn^{4+} > Sn^{2+}$
AP EAMCET- 2003

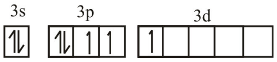
Ans. (a) : On going from top to bottom in a group, the stability of lower oxidation state increases due to inert pair effect. So, the correct order is $Pb^{2+} > Pb^{4+}$.

368. Which of the following has maximum energy?

(a)


(b)


(c)


(d)


AIIMS-2002

Ans. (c): The energy of orbital in increasing order are-
$s < p < d < f$
The energy is excited state is more than ground state.
Hence, the option (c) is correct.

369. The correct order of decreasing first ionization potential is
(a) Ca > K > Rb > Cs
(b) Cs > Rb > K > Ca
(c) Ca > Cs > Rb > K
(d) K > Rb > Cs > Ca
UP CPMT-2001

Ans. (a) : Ionisation potential $\propto \frac{1}{\text{Atomic size}}$
The atomic size increases down the group but decreases in a period.
∴ The correct order of decreasing first ionization potential is Ca > K > Rb > Cs.

370. Sodium forms Na^+ ion but it does not form Na^{2+} because of
(a) very low value of I^{st} and II^{nd} I.E
(b) very high value of I^{st} and II^{nd} I.E
(c) high value of I^{st} I.E. and low value of II^{nd} I.E.
(d) low value of I^{st}. I.E. and high value of II^{nd} I.E.
AIIMS-2001

Ans. (d): Sodium has one valence electron sodium from a Na^+ ion by losing its valence electron and attains the stable electronic configuration of Ne with a completed octet. This energy requires less energy. The removal of second electron will break this stable electronic configuration and requires high energy. Sodium forms Na^+ ions but does not form Na^{+2} because of the low value of $(I.E)_1$ and high value of $(I.E)_2$.

371. Ionic radius (in Å) of As^{3+}, Sb^{3+} and Bi^{3+} follow the order
(a) $As^{3+} > Sb^{3+} > Bi^{3+}$
(b) $Sb^{3+} > Bi^{3+} > As^{3+}$
(c) $Bi^{3+} > As^{3+} > Sb^{3+}$
(d) $Bi^{3+} > Sb^{3+} > As^{3+}$
A.P.EAMCET 2001

Ans. (d) : Ionic radii increases in a group from top to bottom due to increase in atomic number .
$Bi^{3+} > Sb^{3+} > As^{3+}$

372. The electronic configuration of elements A, B, and C are [He] $2s^1$, [Ne] $3s^1$ and [Ar] $4s^1$ respectively, which one of the following order is correct for the first ionization potentials (in kJ mol^{-1}) of A, B and C?
(a) A > B > C
(b) C > B > A
(c) B > C > A
(d) C > A > B
A.P.EAMCET 2001

Ans. (a) : Given that
Electronic configuration of element
A = [He] $2s^1$ = Li
B = [Ne] $3s^1$ = Na
C = [Ar] $4s^1$ = K
Element A to C has increasing atomic size but ionization potential decreases in the same order.
A > B > C

373. The electronic configuration of elements A, B and C are [He]$2s^1$, [Ne]$3s^1$ and [Ar]$4s^1$ respectively, which one of the following protentials is correct for the first ionization potentials (in KJ mol^{-1}) of A, B and C?
(a) A > B > C
(b) C > B > A
(c) B > C > A
(d) C > A > B
AP EAMCET (Engg.) 2001

Ans. (a) : Given that

$$\left.\begin{array}{r} A = [He]1s^1 = Li \\ B = [Ne]1s^1 = Na \\ C = [Ar]1s^1 = K \end{array}\right| \text{I.P. decreases} \downarrow$$

@apna_pdf

$$\text{Size} \propto \frac{1}{\text{Ionisation potential}}$$

Order of ionization potential-

K < Na < Li

C < B < A

374. Which of the following has the highest first IP?

(a) Al (b) Si

(c) K (d) P

A.P.EAMCET 2000

Ans. (d) : The amount of energy required to remove electron from an isolated atom or molecule. Phosphorus has highest first ionisation potential due to half filled orbitals. It has stable configuration than other.

Electronic configuration of phosphorus.

$P = 1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^3$

375. Which of the following species has the highest ionization potential?

(a) Li^+ (b) Mg^+

(c) Al^+ (d) Ne

A.P.EAMCET 1998

Ans. (a) : $Li^+ = 1s^2$

$Mg^+ = 1s^2\ 2s^2\ 2p^6\ 3s^1$

$Al^+ = 1s^2\ 2p^2\ 2p^6\ 3s^2$

$Ne = 1s^2\ 2s^2\ 2p^6$

$Li^+ = 1s^2$

Both Li^+ and Ne have noble gas configuration but due to small size and higher nuclear charge per electron in Li^+, it has higher ionisation energy.

376. Which of the following has the highest first ionization potential?

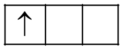
(a) Boron (b) Nitrogen

(c) Oxygen (d) Carbon

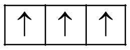
AP EAMCET (Medical) -1998

Ans. (b): The electronic configuration of non-metals are given below–

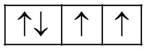
Boron $({}_5B) = 1s^2, 2s^2, 2p^1$



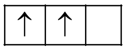
Nitrogen $({}_7N) = 1s^2, 2s^2, 2p^3$



Oxygen $({}_8O) = 1s^2, 2s^2, 2p^4$



Carbon $({}_6C) = 1s^2, 2s^2, 2p^2$



Nitrogen has half-filled stable configuration due to which there are more energy required for the removal of electron so that's nitrogen has more first ionization enthalpy.

377. The first ionisation potential is maximum for:

(a) Lithium (b) Uranium

(c) Iron (d) Hydrogen

AIIMS-1998

Ans. (d): The first ionization energy will be maximum for hydrogen since it has small size hydrogen has only one electron and after losing that electron it will be a nucleus with positive charge which is unstable.

378. Which one of the following configurations represents atom of the element having the highest second ionization energy?

(a) $1s^2\ 2s^2\ 2p^4$ (b) $1s^2\ 2s^2\ 2p^6$

(c) $1s^2\ 2s^2\ 2p^6\ 3s^1$ (d) $1s^2\ 2s^2\ 2p^6\ 3s^2$

J & K CET-(1998)

Ans. (c) : The element with the electronic configuration $1s^2\ 2s^2\ 2p^6\ 3s^1$ will have the highest second ionization enthalpy because the $1s^2\ 2s^2\ 2p^6\ 3s^1$ loses one electron to form $1s^2\ 2s^2\ 2p^6$. It is a stable electronic configuration of noble gas. The removal of second electron will required to high amount of energy.

379. Identify the correct statement in respect of an element in a particular group of the periodic table?

(a) A decrease is nuclear charge causes an increase in ionization energy.

(b) An increase in nuclear charge causes an increase in ionization energy.

(c) A decrease in atomic size decreases the ionization energy.

(d) An increase in the number of valence electrons decreases the ionization energy.

J & K CET-(1997)

Ans. (b) : On moving left to right in a period ionisation energy increase due to nuclear charge increase.

Ionisation energy $\propto$ Zeff

380. Which one of the following elements has the highest first ionization potential ?

(a) Boron (b) Carbon

(c) Nitrogen (d) Oxygen

A.P.EAMCET 1997

Ans. (c) : Nitrogen element has the highest first ionisation potential because of it has half-filled orbital and stable configuration so energy has high to remove the electron of nitrogen.

381. Assertion: Electrons are ejected from a certain metal when either blue or violet light strikes the metal surface. However, only violet light causes electron ejection from a second metal.

Reason: The electrons in the first metal require less energy for ejection.

(a) If both Assertion and Reason are true and the Reason is a correct explanation of the Assertion

(b) If both Assertion and Reason are true but Reason is not a correct explanation of the Assertion

(c) If Assertion is true but the Reason is false

(d) If both Assertion and Reason are false

AIIMS-1996

Ans. (a): The energy required to remove one electron in the gaseous state is lesser i.e. ionization energy first than as compared to the second ionization energy.

382. The order of decreases in atomic radii for Be, Na, and Mg is

(a) Na > Mg > Be (b) Mg > Na > Be

(c) Be > Na > Mg (d) Be > Mg > Na

A.P.EAMCET 1995

@apna_pdf

Ans. (a) : $_4Be = 1s^2\ 2s^2$

$_{11}Na = 1s^2\ 2s^2\ 2p^6\ 3s^1$

$_{12}Mg = 1s^2\ 2s^2\ 2p^6\ 3s^2$

The size of group IIA is less than group IA due to electron enter in the same shell and attraction towards the nucleus and electron increases.

Thus, correct order is

Na > Mg > Be

383. The halogen with the highest ionization potential is

(a) F (b) Cl
(c) Br (d) I

A.P.EAMCET 1993

Ans. (a) : Ionization potential decrease on moving down the group hence fluorine has highest ionisation potential.

384. EN of an atom is given by the average of EA and …..

(a) EN
(b) Ionization energy
(c) Electron affinity
(d) Electropositive character

A.P.EAMCET 1992

Ans. (b) : According to Mulliken, Electronegativity of an elements is the average of Ionization Potential and Electron affinity.

$$\text{Electronegativity (EN)} = \frac{\text{Ionization potential} + \text{Electron affinity}}{2}$$

385. Ionisation potential of 1s electron is ….. than that of 2s electron in the same atom.

(a) Same (b) Lesser
(c) Greater (d) None of these

A.P.EAMCET 1992

Ans. (c) : Ionisation potential of 1s electron is greater than that of 2s electron in the same atom because former is more closer to the nucleus.

386. Al^{3+} ion has a lower ionic radius than Mg^{2+} ion because

(a) Mg atom has less number of neutrons than Al
(b) Al^{3+} has a higher nuclear charge than Mg^{2+}
(c) their electronegativities are different
(d) Al has a lower ionization potential than Mg atom

A.P.EAMCET 1992

Ans. (b) : Al^{3+} ion has a lower ionic radius than Mg^{2+} ion because of Al^{3+} has a higher nuclear charge than Mg^{2+}. Nuclear charge increase then ionic radius decrease.

387. Among the alkali metals, the metal with the highest ionisation potential is

(a) Na (b) K
(c) Li (d) Cs

A.P.EAMCET 1991

Ans. (c) : Ionisation potential is decrease from down the group hence Li metal has highest ionisation potential.

388. First three ionisation energies (in kJ/mol) of three representative elements are given below:

Element	**IE_1**	**IE_2**	**IE_3**
P	**495.8**	**4562**	**6910**
Q	**737.7**	**1451**	**7733**
R	**577.5**	**1817**	**2745**

Then incorrect option is:

(a) Q: Alkaline earth metal
(b) P: Alkali metals
(c) R: s-block element
(d) They belong to same period

Ans. (c): The difference between Ionisation energy second and ionisation energy third is not very high as compared to between ionisation energy second hence stable oxidation state of R will be higher than +2.

Hence, first three ionization energies of three representative elements are R: s-block element.

389. Calculate the energy needed to convert three moles of sodium atoms in the gaseous state to sodium ions. The ionization energy of sodium is 495 kJ mol^{-1}_

(a) 1485 kJ (b) 495 kJ
(c) 148.5 kJ (d) none

VITEEE-2019

Ans. (a) : Given, the ionization energy of sodium is 495 kJ mol^{-1}

∴ Energy needed to convert 3 moles of Na (g) to Na^+ ions = 495 × 3 = 1485 kJ.

390. Ionisation energy of He^+ is 19.6×10^{-18} J $atom^{-1}$. The energy of the first stationary state (n = 1) of Li^{2+} is

(a) 4.41×10^{-16} J $atom^{-1}$
(b) -4.41×10^{-17} J $atom^{-1}$
(c) -2.2×10^{-15} J $atom^{-1}$
(d) 8.82×10^{-17} J $atom^{-1}$

JEE Main, 2018

Ans. (b) : Using the following equation-

$$E_n = -2.18 \times 10^{-18}\left(\frac{Z^2}{n^2}\right)J$$

Where, E_n = Energy of n^{th} orbit
Z = Atomic number
n = No. of orbit

Given– $E_1 = -19.6 \times 10^{-18}$ J $atom^{-1}$, $Z_1 = 2$, $n_1 = 1$

And $E_2 = ?$, $Z_2 = 3$, $n_2 = 1$

$$\therefore \quad E_1 = -2.18 \times 10^{-18}\left(\frac{Z_1^2}{n_1^2}\right)J \quad \text{.....(i)}$$

$$E_2 = -2.18 \times 10^{-18}\left(\frac{Z_2^2}{n_2^2}\right)J \quad \text{....(ii)}$$

From (i) and (ii) – we get

$$\frac{E_1}{E_2} = \frac{Z_1^2}{Z_2^2} \times \frac{n_2^2}{n_1^2}$$

Or $$E_2 = \frac{E_1 Z_2^2 n_1^2}{Z_1^2 n_2^2}$$

$$E_2 = \frac{-19.6 \times 10^{-18}(\text{J atom}) \times 9 \times 1}{4 \times 1}$$

$$E_2 = -4.41 \times 10^{-17}\ \text{J atom}^{-1}$$

@apna_pdf

391. Consider the following changes

$M(s) \rightarrow M(g)$ ….(1)

$M(g) \rightarrow M^{2+}(g) + 2e^-$ ….(2)

$M(g) \rightarrow M^{+}(g) + e^-$ ….(3)

$M^{+}(g) \rightarrow M^{2+}(g) + e^-$ ….(4)

$M(g) \rightarrow M^{2+}(g) + 2e^-$ ….(5)

The second ionization energy of M could be determined from the energy values associated with

(a) 1 + 2 + 4 (b) 1 + 5 – 3

(c) 2 + 3 – 4 (d) 5 – 3

VITEEE, 2015

Ans. (d) : The second ionization energy is amount of energy required to take out an electron from the monopositive cation.

Hence,

$M(g) \rightarrow M^{2+} + 2e^-$ …..(v)

$M(g) \rightarrow M^{+} + e^-$ …..(iii)

On subtracting equation (iii) from equation (v), we get–

$M^{+} \rightarrow M^{2+} + e^-$

Hence, the correct is 5-3.

392. The incorrect statement among the following is

(a) the first ionisation potential of Al is less than the first ionisation potential of Mg

(b) the second ionisation potential of Mg is greater than the second ionisation potential of Na

(c) The first ionisation potential of Na is less than the first ionisation potential of Mg

(d) the third ionisation potential of Mg is greater than the third ionisation potential of Al

IIT JEE, 1997

Ans. (b) : The second ionisation potential of Mg is less than the second ionisation potential of Na.

$Na = IE_2 = 4560$ kJ/mol

$Mg = I.E_2 = 1450$ kJ/mol

Hence the option (b) is correct.

6. Electron Affinity

393. Which halogen has the maximum electron affinity?

(a) Fluorine (b) Chlorine

(c) Bromine (d) Iodine

UP CPMT-2010
BCECE-2007, UP CPMT-2007
JIPMER-2006, UPTU/UPSEE-2015, 2006
NEET-1999

Ans. (b): On moving down a group, generally, electron affinity decreases. But in fluorine, due to its smaller size, the incoming electron experiences greater force of repulsion and hence, its electron affinity is lesser as compared to the electron affinity of chlorine. Thus, among the given, electron affinity is maximum for chlorine.

394. The correct order of electron affinity of F, Cl, Br and I is

(a) F > Cl > Br > I (b) Cl > F > Br > I

(c) I > Br > Cl > F (d) Br > I > Cl > F

UPTU/UPSEE-2016 / J&K CET-2012, 2008
CG PET -2009 / AMU–2003 / JCECE – 2003

Ans. (b) : Electron affinity of elements decreases on going from top to bottom in a group. But, electron affinity of fluorine is unexpectedly lower than that of chlorine. This can be explained as follows:-

Fluorine atom is small. So, electron charge density of F-atom is very high. The added electron will experience strong electron-electron repulsion. As a result, when an electron is added to F atom a certain amount of energy is absorbed, and the net energy released during the formation of anion is lesser. However, if an electron is added to a relatively large p-orbital (3p in the case of Cl), electron-electron repulsion is minimised, and higher electron affinity is observed.

395. Maximum electron affinity is shown by the following:

(a) Cl (b) Br

(c) N (d) Na

MHT CET-2017
MPPET - 2012, J&K CET-2001
AIIMS-1998, 1994

Ans. (a) : Electron affinity:- The amount of energy liberated when an electron is added to a neutral atom to form a negatively charged ion.

Electron affinity : Cl > F > Br > I.

$\text{Electron affinity} \propto \frac{1}{\text{Atomic size}}$.

396. Which one of the following arrangements represent the correct order of electron gain enthalpy (with negative sign) of the given atomic species?

(a) F < Cl < O < S (b) S < O < Cl < F

(c) Cl < F < S < O (d) O < S < F < Cl

UPTU/UPSEE-2014, 2007
UP CPMT-2013, BITSAT-2014

Ans. (d) : In general, on moving down in a group, EA values decreases due to increase in size, because greater is the size of valence shell, lesser is the attraction and in turn lesser is the EA.

But in period II and III, this order is reversed due to the small size of period II elements.

Thus,

O < S and F < Cl

Because O and F atoms have high electron density $\left(\frac{\text{charge}}{\text{volume}}\right)$ and so repel the test electrons.

Further, EA values increases as moving left to right along a period. It is because effective nuclear charge increases on moving left to right and more is the effective nuclear charge, more is the attraction of nucleus towards test electrons and thus more will be electron affinity. Thus, the overall increasing order of EA would be

O < S < F < Cl

397. The correct order of electron affinity is

(a) B < C < O > N (b) B > C > N > O

(c) O > C > B > N (d) O < C < B < N

J & K CET-(2005)
Assam CEE-2014

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Ans. (c) : When on going from left to right in the periodic table, electron affinity increases, because the distance between the nucleus and outermost shell decreases. So the attraction of the nucleus and electrons of the outermost shell increases hence the added electron get stabilization. Nitrogen has a half-filled electronic configuration, so, it tendency to accept electron is very less than carbon and boron.
Hence, the electron affinity order is-
$O > C > B > N$

398. Born-Haber cycle can be used to estimate
(a) electronegativity (b) electron affintiy
(c) ionic radii (d) All of these
UPTU/UPSEE-2010, 2008

Ans. (b) : The Born Haber– Cycle can be used to estimate the electron gain enthalpy, electron affinity, lattice energy of ionic solid, dissociation energy, heat of formation etc.
Born Haber cycle cannot be estimate by the electronegativity and hydration energy, ionic radii etc.

399. Which one of the following ionic species has the greatest proton affinity to form stable compound?
(a) NH^{-}_{2} (b) F^{-}
(c) I^{-} (d) HS^{-}
BCECE-2012
NEET-2007

Ans. (a) : Proton affinity decreases across a period from left to right and down a group from top to bottom. Hence, the nitrogen family has highest proton followed by oxygen family, followed by halogen. Also the ionic pieces with greatest proton affinity form the strongest base. Therefore, NH_2^- has the greatest proton affinity to form a stable compound.

400. The electron affinity of Be is similar to
(a) He (b) B
(c) Li (d) Na
UP CPMT-2002
Manipal-2018

Ans. (a) : The electronic configuration of these element are–
$_4Be = 1s^2, 2s^2$
$_2He = 1s^2$
$_5B = 1s^2, 2s^2\ 2p^1$
$_3Li = 1s^2\ 2s^1$
$_{11}Na = 1s^2\ 2s^2\ 2p^6\ 3s^1$
Thus, we can say that electron affinity of Be is similar to He.

401. The correct order of electron affinity of oxygen, sulphur, chlorine, fluorine is
(a) $S < O < Cl < F$ (b) $S < O < F < Cl$
(c) $O < S < F < Cl$ (d) $O < S < Cl < F$
WB JEE-30.04.2022
UPTU/UPSEE-2010

Ans. (c) : On moving from top to bottom in a group the electron affinity became less negative and on moving from left to right across a period, the electron affinity became more negative. Chlorine has more negative electron affinity than fluorine because on adding on electron to fluorine 2p orbital causes greater repulsion than adding on electron to chlorine 3p orbital which is larger size. Therefore, the order is-
$O < S < F < Cl$

402. The correct order of electron gain enthalpy is:
(a) $O > S > Se > Te$ (b) $Te > Se > S > O$
(c) $S > O > Se > Te$ (d) $S > Se > Te > O$
JEE Main 26.02.2021,Shift-II
CGPET-2019

Ans. (d) : Electron gain enthalpy of oxygen is very low due to small size and compact nature of oxygen atom. Sulphur has highest electron gain enthalpy because sulphur has vacant d-orbital. So the order of electron gain enthalpy is –
$\boxed{S > Se > Te > O}$

403. Electron affinity is positive when
(a) O^- is formed from O
(b) $O^{2-}$is formed from O^-
(c) O^+ is formed from O
(d) electron affinity is always a negative value
CG PET- 2013
BCECE-2006

Ans. (b) : When O^{2-} formed from O^-, change is endothermic because O^- repels the incoming electron due to similar charge. Therefore, it needs energy to accept the electron. The second electron affinity of oxygen is particularly high because the electron is being forced into a small, very dense electron. Hence, the electron affinity is positive.

404. Which of the following elements has the highest value of electron affinity?
(a) O (b) S
(c) Se (d) Te
J & K CET-2016, 2012
BCECE-2010

Ans. (b) : Oxygen has exceptionally smaller value of electron affinity (–141 kJ) due to smaller atomic size then sulphur. Hence S is highest value of electron affinity.

405. What is the value of electron gain enthalpy of Na^+ if IE_1 of Na = 5.1 eV?
(a) –5.1 eV (b) –10.2 eV
(c) +2.55 eV (d) +10.2 eV
VITEEE- 2012
NEET-2011

Ans. (a) : Given that,
Ionisation enthalpy of Na = 5.1 eV
Thus, the electron gain enthalpy of sodium cation is equal in magnitude and opposite in sign to the first ionization energy of sodium atom. It is equal to –5.1 eV.

406. The correct order of electron gain enthalpy with negative sign of F, Cl, Br and I, having atomic number 9, 17, 35 and 53 respectively, is
(a) $I > Br > Cl > F$ (b) $F > Cl > Br > I$
(c) $Cl > F > Br > I$ (d) $Br > Cl > I > F$
JEE Main-07.01.2020, Shift-I
(AIEEE 2011)

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Ans. (c) : Electron gain enthalpy has maximum in corresponding period of halogen and it becomes less negative down the group. However, the negative electron gain enthalpy of fluorine is less than that of chlorine due to the small size of fluorine atom.

Therefore, there are strong inter electronic repulsion in the relatively small 2p-orbital of fluorine thus, The incoming electron does not experience much attraction. The correct order of electron gain enthalpy are-

$Cl > F > Br > I$

407. Among the options, the element with highest electron gain enthalpy is

(a) He (b) Ne
(c) Kr (d) Xe

TS-EAMCET (Engg.), 07.08.2021 Shift-II

Ans. (b) :

Noble gas		**Electron gain enthalpy**
He	–	+ 48
Ne	–	+ 116
Ar	–	+ 96
Kr	–	+ 96
Xe	–	+ 77

Hence, from the above data, electron gain enthalpy of Ne has the highest value of electron gain enthalpy.

408. Which of the given atoms has the greatest electron affinity?

(a) F (b) Cl
(c) P (d) Al

TS-EAMCET (Engg.), 05.08.2021 Shift-II

Ans. (b) : The electron affinity is a measure of the attraction between the incoming electron to the nucleus. Generally electron affinity decreases down a group, but electron affinity of Cl is greater than electron affinity of F due to small size of F atom which can not easily accomodate the electron rather than the chlorine. Hence, Cl has highest electron affinity.

409. Arrange the elements with the following electronic configurations in increasing order of electron affinity

(i) $1s^2\, 2s^2\, 2p^5$
(ii) $1s^2\, 2s^2\, 2p^4$
(iii) $1s^2\, 2s^2\, 2p^6\, 3s^2\, 3p^4$
(iv) $1s^2\, 2s^2\, 2p^6\, 3s^2\, 3p^5$

(a) (ii)<(iii)<(i)<(iv) (b) (iii)<(ii)<(iv)<(i)
(c) (iii)<(ii)<(i)<(iv) (d) (ii)<(iii)<(iv)<(i)

COMEDK 2019

Ans. (a) : Electron affinity increases as we move left to right in a period and decreases as we move down in a group.

But electron affinity of Cl is greater than F and that of S is greater than O due to very small size of F and O. As a result, there is a strong inter-electronic repulsion when extra electron is added to these atoms.

(i) $1s^2\, 2s^2\, 2p^5$: F
(ii) $1s^2\, 2s^2\, 2p^4$: O
(iii) $1s^2\, 2s^2\, 2p^6\, 3s^2\, 3p^4$: S
(iv) $1s^2\, 2s^2\, 2p^6\, 3s^2\, 3p^5$: Cl

Thus correct order is
$Cl > F > S > O$
(iv)>(i)> (iii)>(ii)

410. The first electron affinity of C, N and O will be of the order

(a) $C < N < O$ (b) $N < C < O$
(c) $C < O < N$ (d) $O < N < C$

WB-JEE-2019

Ans. (b) : The electron affinity of an atom or molecules can be defined as the amount of energy released when an electron is attached or gained by an electrically neutral atom.

Nitrogen has a stable half-filled p-orbital.

Thus, the correct order of first electron affinity of C, N and O will be

$N < C < O$

411. Which of the following atoms should have the highest Ist electron affinity?

(a) F (b) O
(c) N (d) C

WB-JEE-2017

Ans. (a) : Fluorine has highest first electron affinity because on moving left to right in a period the electron affinity increases.

412. Why is F_2 the strongest oxidizing agent (among halogens) although electron affinity of Cl_2 is higher than F_2?

(a) Low enthalpy of dissociation and high free energy of hydration
(b) Low enthalpy of dissociation
(c) High free energy of hydration
(d) High electronegativity and low free energy of hydration

J & K CET-(2017)

Ans. (a) : F_2 is the strongest oxidizing agent among the halogen due to greater heat of hydration of F^- than Cl^- which compensates for the lower electron affinity of F than of Cl. F_2 has low enthalpy of dissociation as F–F bond is weak and high enthalpy of hydration of small F^- ion.

413. Which of the following has the highest electron affinity?

(a) K (b) O^-
(c) F^- (d) O

Manipal-2016

Ans. (d) : Electron affinity is defined as the minimum energy released electron add to the valence shell of isolated atom.

$$\text{Electron affinity} \propto \frac{1}{\text{size}}$$

Therefore, O^- has less electron affinity due to complete the shell to form stable configuration but in case of oxygen has high electron affinity.

414. Among P, S, Cl, F, the elements with most negative and least negative electron gain enthalpy respectively are

(a) Cl, S (b) F, S
(c) Cl, P (d) F, P

J & K CET-(2015)

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Ans. (c) : On moving from left to right in a period generally electron gain enthalpy increases and decrease down the group. But the electron affinity of third period is greater than the electron affinity of second period element due to small atomic size of second period element.

Hence, the order is P < S < F < Cl

Therefore, Cl and P has more negative and less negative electron gain enthalpy respectively.

415. Electron gain enthalpy with negative sign of fluorine is less than that of chlorine due to

(a) high ionisation enthalpy of fluorine
(b) smaller size of chlorine atom
(c) smaller size of fluorine atom
(d) bigger size of 2p orbital of fluorine

JCECE - 2015

Ans. (c) : Due to smaller size and high repulsive force within the outermost orbit of fluorine. Its electron gain enthalpy is less negative.

416. Copper is extracted from copper pyrites by heating in a Bessemer converter. The method is based on the principle that

(a) copper has more affinity for oxygen than sulphur at high temperature
(b) iron has less affinity for oxygen than sulphur at high temperature
(c) copper has less affinity for oxygen than sulphur at high temperature
(d) sulphur has less affinity for oxygen at high temperature

Karnataka-CET-2015

Ans. (a) : Copper is extracted from the copper pyrites by heating in a Bessemer Convertor. The method is based on the principle of copper has more affinity for oxygen than sulphur at high temperature.

417. How does electron affinity change when we move from left to right in a period in the periodic table?

(a) It increases.
(b) It decreases.
(c) It remains unchanged.
(d) It first increases and then decreases.

J & K CET-(2013)

Ans. (a) : The electron affinity generally increases in a period from left to right due to the size of the atom decrease along the period.

418. Which one of the following arrangement represents the correct order of least negative to most negative electron gain enthalpy for C, Ca, Al, F and O?

(a) Al < Ca < O < C < F
(b) Al < O < C < Ca < F
(c) C < F < O < Al < Ca
(d) Ca < Al < C < O < F

Karnataka NEET-2013

Ans. (d) : The nuclear charge increases, the force of attraction between the nucleus and the incoming electron increase and thus, the electron gain enthalpy becomes more negative.

On moving from left to right in a period, the effective nuclear charge increases. Therefore, the order are–

Ca < Al < C < O < F

419. The amount of energy released when 10^6 atoms of iodine in vapour state are converted to I^- ions is 4.9×10^{-13} J. What will be electron affinity of iodine in eV per atom?

(a) 2.0
(b) 2.5
(c) 2.75
(d) 3.06

MPPET-2013

Ans. (d) :

Electron gain enthalpy = energy release when an atom in gaseous state

$= 4.8 \times 10^{-13}$ J

Atoms of $I_2 = 10^6$

$\therefore$ 4.8×10^{-13} J for 10^6 atoms.

$$\text{Joule per atom } = \frac{4.8\times10^{-13}\text{J}}{10^6\text{ atom}}$$

Electron affinity = Electron gain enthalpy,

$$\text{E.A} = \frac{4.8\times10^{-13}}{10^6}\text{J / atom}$$

$$1\text{J} = \frac{1}{1.6021\times10^{-19}}\text{ eV}$$

$$\text{EA} = \frac{4.8\times10^{-13}}{1.6021\times10^6\times10^{-19}}\text{ eV / atom}$$

$$= 2.99\text{ eV / atom}$$

$$\text{EA} \approx 3.00\text{ eV / atom}$$

420. Which one of the following arrangements represents the correct order of least negative to most negative electron gain enthalpy for C, Ca, Al, F and O?

(a) Al<Ca<O<C<F
(b) Al<O<C<Ca<F
(c) C<F<O<Al<Ca
(d) Ca<Al<C<O<F

KARNATAKA NEET 2013

Ans. (d) : Electron gain enthalpy becomes less negative from top to bottom in a group while is becomes more negative from left to right within a period.

421. Assertion: Electron affinity refers to an isolated atom's attraction for an additional electron while electronegativity is the ability of an atom of an element to attract electrons towards itself in a shared pair of electrons.

Reason: Electron affinity is a relative number and electronegativity is experimentally measurable.

(a) If both Assertion and Reason are correct and the Reason is the correct explanation of Assertion.
(b) If both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.
(c) If Assertion is correct but Reason is incorrect.
(d) If both the Assertion and Reason are incorrect.

AIIMS-2010

Ans. (c): Electron affinity refers to an isolated atom's attraction for an additional electron while electronegativity is the ability of an atom of an element to attract electrons towards itself in a shared pair of electron due to electron affinity is experimentally measurable while electronegativity is relative number.

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422. The electron affinity values of elements A, B, C and D are respectively –135, –60, –200 and –348 kJ mol^{-1}. The outer electronic configuration of element B is

(a) $3s^23p^5$ (b) $3s^23p^4$
(c) $3s^23p^3$ (d) $3s^23p^2$

AP-EAMCET- (Engg.) - 2010

Ans. (c) : Given that the electron affinity of elements A = –135 kJ/mole, B= –60 kJ/mole, C = –200 kJ/mole and D = –348 kJ/mole then the element having half-filled or completely filled orbitals are stable electronic configuration, and have low negative value of electron affinity.
Since, the electron affinity of B is lowest and electronic configuration is – $1s^2\,2s^2\,2p^6\,\underline{3s^2\,3p^3}$

423. Carbon can reduce ferric oxide to iron at a temperature above 983 K because

(a) carbon monoxide formed is thermodynamically less stable than ferric oxide
(b) carbon has a higher affinity towards oxidation than iron
(c) free energy change for the formation of carbon dioxide is less negative than that for ferric oxide
(d) iron has a higher affinity towards oxygen than carbon

KARNATAKA-CET, 2010

Ans. (b) : Above 983 K, free energy change for the formation of CO_2 is more negative than that for ferric oxide. Thus, above this temperature, carbon has a higher affinity towards oxidation than iron.

424. The atomic numbers of elements A, B, C and D are Z–1, Z, Z+1 and Z+2, respectively. If 'B' is a noble gas, choose the correct answers from the following statements

(1) 'A' has higher electron affinity
(2) 'C' exists in +2 oxidation state
(3) 'D' is an alkaline earth metal

(a) (1) and (2) (b) (2) and (3)
(c) (1) and (3) (d) (1), (2) and (3)

A.P.EAMCET 2008

Ans. (c) : Given that,
Atomic no. of element A = Z – 1, i.e, halogen
Atomic no. of element B = Z, i.e, noble gas
Atomic no. of element C = Z + 1, i.e, group IA
Atomic no. of element D = Z + 2, i.e, group IIA
∴ • Element A must be halogen i.e, have the highest electron affinity.
• Element B is Noble gas.
• Element C must be an alkali metal exist as +1 oxidation state.
• Element D must be alkaline earth metal.

425. Which one of the following statements is false

(a) The electron affinity of chlorine is less than that of fluorine
(b) The electronegativity of fluorine is more than that of chlorine
(c) The electron affinity of bromine is less than that of chlorine
(d) The electronegativity of chlorine is more than that of bromine

MPPET-2008

Ans. (a) : (i) The electron affinity of chlorine is greater than the fluorine.
(ii) The EN of fluorine is greater than chlorine.
(iii) The electron affinity of bromine is less than of chlorine.
(iv) The electronegative of Chlorine is more than that of bromine.

426. The electronic configuration of the element with maximum electron affinity is

(a) $1s^2, 2s^2, 2p^3$
(b) $1s^2, 2s^2, 2p^5$
(c) $1s^2, 2s^2, 2p^6, 3s^2, 3p^5$
(d) $1s^2, 2s^2, 2p^6, 3s^2, 3p^3$
(e) $1s^2, 2s^2, 2p^6, 3s^1$

Kerala-CEE-2008

Ans. (c): The electronic configuration of $1s^2, 2s^2, 2p^6, 3s^2, 3p^5$ is chlorine. The electron affinity is a measure the attraction between the incoming electrons to the nucleus. Electron affinity of Cl is greater than electron affinity of F due to small size of F atom. Hence, electron affinity is highest for chlorine.

427. Which of the following is a favourable factor for cation formation?

(a) Low ionisation potential
(b) High electron affinity
(c) High electronegativity
(d) Small atomic size

AP-EAMCET (Engg.)-2005

Ans. (a) : As the ionization potential decreases the removal of electron get place easily and the cation formed. Hence, low ionization potential is a favourable factor for cation formation.

428. Which of the following has lowest electron affinity?

(a) Cl (b) I
(c) F (d) Br

J & K CET-(2005)

Ans. (b) : When we moving on a group, electron affinity decrease due to the size of atom increase.

Halogen	F	Cl	Br	I
EA(eV)	–3.6	–3.8	–3.5	–3

Hence, the electron affinity is highest in Cl and lowest in Iodine(I).

429. The electron affinity values (in kJ mol^{-1}) of three halogens X, Y and Z are respectively –349, –333 and –325. Then X, Y and Z respectively are:

(a) F_2, Cl_2 and Br_2 (b) Cl_2, F_2 and Br_2
(c) Cl_2, Br_2 and F_2 (d) Br_2, Cl_2 and F_2

AP-EAMCET (Medical), 2003

Ans. (b) : As we know, group 17 elements shows the highest negative value of electron affinity.
Chlorine has highest value of electron affinity than fluorine due to small size of fluorine and more electrostatic repulsion occur between nucleus and F outer shell. Thus, the electron affinity values (in $kJmol^{-1}$) of three halogens Cl_2, F_2 and Br_2 are respectively –349, –333 and –325.

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430. Which one of the following reagents is used for detection of unsaturation in alkenes?

(a) NaOH + CaO
(b) Cold dilute alkaline $KMnO_4$
(c) $Cl_2/h\nu$
(d) KOH / C_2H_5OH

AP-EAMCET (Medical), 2003

Ans. (b) : Both bromine water or alkaline $KMnO_4$ (Baeyer's reagent) are decolourised after the reaction with unsaturated compound. Unsaturation in alkyne or alkene in any organic compound is defected by reagents the organic compound with alkaline $KMnO_4$ or bromine water.

431. Which of the following is as per the definition of electron-affinity?

(a) $X_{2\,(g)} \xrightarrow{+2e} 2X^-_{\,(g)}$

(b) $X_{\,(g)} \xrightarrow{+e} X^-_{\,(g)}$

(c) $X^+_{\,(g)} \xrightarrow{+e} X_{(g)}$

(d) $X^-_{\,(g)} \xrightarrow{+e} X^{2-}_{\,(g)}$

J & K CET-(2001)

Ans. (b) : The electron affinity is the potential energy change of the atom when an electron is added to a neutral gaseous atom to form a negative ion.

So, $X(g) \xrightarrow{+e} X^-(g)$ is more favorable.

432. The electron affinities of halogens follow the order

(a) $F_2 > Cl_2 > Br_2 > I_2$
(b) $Cl_2 > F_2 > Br_2 > I_2$
(c) $Br_2 > Cl_2 > F_2 > I_2$
(d) $I_2 > Br_2 > Cl_2 > F_2$

Ans. (b) : Generally the electron affinity decrease down the group as the atomic size increases but F_2 has lower electron affinity compared to Cl_2 because the size of F_2 is very small and thus interelectronic repulsion is high.

7. Nomenclature of Elements with Atomic Number > 100

433. The IUPAC name of an element with atomic number 119 is

(a) ununoctium
(b) ununennium
(c) unnilennium
(d) unununnium

NEET-17.07.2022

Ans. (b) : Given, atomic No (Z) = 119

Nomenclature of elements with atomic number (Z) greater than 100 :

0 = nil, 1 = un, 2 = bi, 3 = tri, 4 = quad, 5 = pent, 6 = hex, 7 = sept, 8 = oct, 9 = enn.

Hence, the IUPAC name of element with

Z = 119 is ununennium
Z = 111 is unununnium
Z = 118 is ununoctium
Z = 109 is unnilennium

434. Identify the incorrect match

Number	**IUPAC official name**
(a) Unnilunium	**(i) Mendelevium**
(b) Unniltrium	**(ii) Lawrencium**
(c) Unnilhexium	**(iii) Seaborgium**
(d) Unununnium	**(iv) Darmstadtium**

(a) (A), (i)
(b) (B), (ii)
(c) (C), (iii)
(d) (D), (iv)

NEET-2020

Ans. (d) :

Number	**Atomic Number**	**IUPAC Name**
Unnilunium	101	Mendelevium
Unniltrium	103	Lawrencium
Unnilhexium	106	Seaborgium
Unununnium	111	Roentgenium

435. The atomic number of the element unnilennium is

(a) 109
(b) 102
(c) 108
(d) 119

(JEE Main 2020, 3 Sep Shift-I)

Ans. (a) : The atomic number of the element unnilennium is 109.

The name is derived directly from the atomic number of the element using the latin numerical roots are

Number	0	1	2	3	4
Root	nil	un	bi	tri	quad
Number	5	6	7	8	9
Root	pent	hex	sept	oct	enn

The atomic no. of element 109 is meitnerium (mt).

436. The IUPAC name of an element is Unbinilium. Its atomic number is

(a) 102
(b) 110
(c) 120
(d) 106
(e) 100

Kerala-CEE-2020

Ans. (c) : The IUPAC name for 120 is unbinilium and symbol is Ubn. According to IUPAC systematic nomenclature, the numeral roots for 1, 2, 0 are un, bi and nil respectively and then add suffix ium.

437. What is the name of the element with atomic number 105?

(a) Dubnium
(b) Holmium
(c) Kurchatovium
(d) Nobelium

UPTU/UPSEE-2012

Ans. (a) : The name of the element with atomic number 105 is Dubnium. Which means that there are 105 protons and 105 electrons in the atomic structure. The chemical symbol for dubnium is Db.

438. The name of the element with atomic number 100 was adopted in honour of

(a) Alfred Nobel
(b) Enrico Fermi
(c) Dimitri Mendeleef
(d) Albert Einstein

A.P.EAMCET 1995

Ans. (b) : The atomic number 100 element in the periodic table is Fermium is named in the honour of Enrico Fermi, a nuclear physicist. The symbol of Fermi is Fm. It is an actinide located in group 3 elements of the periodic table and in the 6 and 7 period.

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04.

Chemical Bonding and Molecular Structure

1. Hybridization

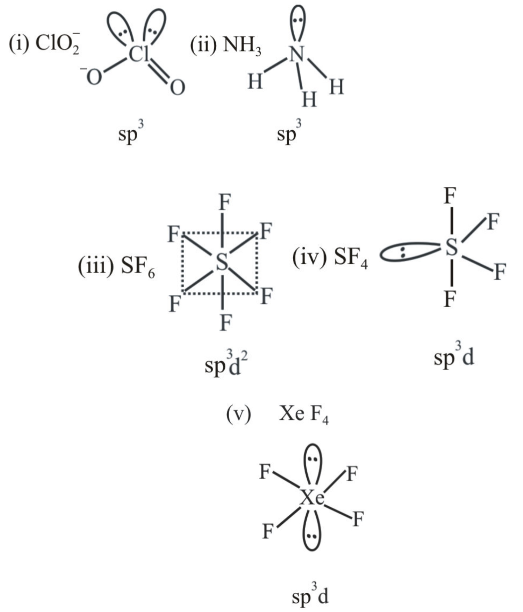
1. Among the following which are mismatched;

Molecule	**hybridization**
(A) ClO_2^-	**sp^3**
(B) NH_3	**sp^2**
(C) SF_6	**sp^3d^2**
(D) SF_4	**sp^3d**
(E) XeF_4	**sp**

(a) (A) and (C)
(b) (B) and (E)
(c) (C) and (E)
(d) (A) and (D)

CG PET-22.05.2022

Ans. (b) : The structure of given molecule are-



2. Match List-I with List-II

	List-I	**List-II**
(A)	**$[PtCl_4]^{2-}$**	**(i) sp^3d**
(B)	**BrF_5**	**(ii) d^2sp^3**
(C)	**PCl_5**	**(iii) dsp^2**
(D)	**$[Co(NH_3)_6]^{3+}$**	**(iv) sp^3d^2**

Choose the most appropriate answer from the options given below:

(a) (A)-(II), (B)-(IV), (C)-(I), (D)-(III)
(b) (A)-(III), (B)-(IV), (C)-(I), (D)-(II)
(c) (A)-(III), (B)-(I), (C)-(IV), (D)-(II)
(d) (A)-(II), (B)-(I), (C)-(IV), (D)-(III)

JEE Main-24.06.2022, Shift-I

Ans. (b)

List-I	**List-II**
$[PtCl_4]^{2-}$	dsp^2
BrF_5	sp^3d^2
PCl_5	sp^3d
$[Co(NH_3)_6]^{3+}$	d^2sp^3

3. Which one of the following reactions involves change from sp^2 to sp^3 hybridisation of the central atom?

(a) $CH_4 + 2Cl_2 \rightarrow CH_2Cl_2 + 2HCl$
(b) $NH_3 + H^+ \rightarrow NH_4^+$
(c) $AlCl_3 + Cl^- \rightarrow AlCl_4^-$
(d) $H_2O + H^+ \rightarrow H_3O^+$
(e) $PCl_3 + Cl_2 \rightarrow PCl_5$

Kerala CEE -03.07.2022

Ans. (c) :

(i) $CH_4 + 2Cl_2 \rightarrow CH_2Cl_2 + 2HCl$
sp^3 sp^3

(ii) $NH_3 + H^+ \rightarrow NH_4^+$
sp^3 sp^3

(iii) $AlCl_3 + Cl^- \rightarrow AlCl_4^-$
sp^2 sp^3

(iv) $H_2O + H^+ \rightarrow H_3O^+$
sp^3 sp^3

(v) $PCl_3 + Cl_2 \rightarrow PCl_5$
sp^3 sp^3d

4. Given below are two statements:

Statement I : $\left[Ni(CN)_4\right]^{2-}$ is square planar and diamagnetic complex, with dsp^2 hybridization for Ni but $\left[Ni(CO)_4\right]$ is tetrahedral, paramagnetic and with sp^3-hybridization for Ni.

Statement II : $\left[NiCl_4\right]^{2-}$ and $\left[Ni(CO)_4\right]$ both have same d-electron configuration, have same geometry and are paramagnetic.

In light of the above statements, chose the correct answer from the options given below:

(a) Both Statement I and Statement II are true
(b) Both Statement I and Statement II are false
(c) Statement I is correct but Statement II is false
(d) Statement I is correct but Statement II is true

JEE Main-28.06.2022, Shift-I

Ans. (b) : In $[Ni(CN)_4]^{2-}$
Ni^{+2} = [Ar] $3d^8$ $4s^0$ = dsp^2 (Square planar) and diamagnetic
For $[Ni(CO)_4)$
Ni = [Ar] $3d^8$ $4s^2 \Rightarrow sp^3$ (Tetrahedral) and diamagnetic.
For $[NiCl_4]^{2-}$
Ni^{+2}=[Ar] $3d^8$ $4s^0 \Rightarrow sp^3$ (Tetrahedral) and paramagnetic

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5. The types of hybrid orbitals of nitrogen in NO_2^+, NO_3^- and NH_4^+ respectively are

(a) sp, sp^3, sp^2 (b) sp, sp^2, sp^3
(c) sp^2, sp, sp^3 (d) sp^2, sp^3, sp

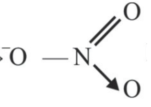
(JEE Main 2021, 20 July Shift-II)
AP EAMCET (Engg.) 17.09.2020, Shift-II
NEET-II 2016, Assam CEE-2014
AMU-2015, 2008

Ans. (b) : $NO_2^+ \Rightarrow O = \underset{sp}{\overset{\oplus}{N}} \rightarrow O$

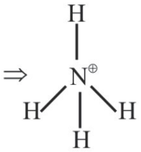
$$H = \frac{1}{2}(V + M - C + A)$$

$$H = \frac{1}{2}(5 + 0 + 1 + 0) = 2(sp)$$

Where, H = number of hybrid orbitals
V = number of valence electrons
M = number of monovalent atoms/groups
C = number of cationic or positive charge
A = number of anionic or negative charge

$NO_3^- \Rightarrow$ 

$$H = \frac{1}{2}(5 + 0 - 0 + 1) = 3(sp^2)$$

$NH_4^+ \Rightarrow$ 

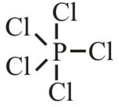
$$H = \frac{1}{2}(5 + 4 - 1 + 0) = 4(sp^3)$$

6. The hybridization involved in PCl_5 is

(a) sp^3d (b) sp^3d^2
(c) d^2sp^2 (d) sp^3

J & K CET-(2011)
UPTU/UPSEE-2011
WB-JEE-2010

Ans. (a) : The structure of PCl_5 is



sp^3d

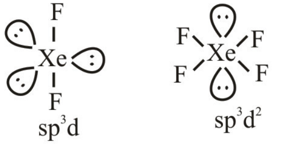
In PCl_5 molecule has phosphorous bonded with 5 chlorine in trigonal bipyramidal geometry. The hybridisation of PCl_5 is sp^3d.

7. Hybridisation in XeF_2 and XeF_4 are respectively ______.

(a) sp^2 and sp^3d^2 (b) sp^3d and sp^3d^2
(c) sp and sp^3 (d) sp^3d and sp^3

GUJCET-2022, AMU-2005

Ans. (b): The structure of XeF_2 and XeF_4 are-



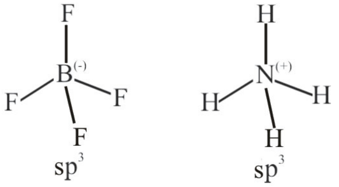
(linear) (square planar)

8. Which one of the following pairs is isostructural (i.e., having the same shape and hybridization)?

(a) [BCl_3 and $BrCl_3$] (b) [NH_3 and NO_3^-]
(c) [NF_3 and BF_3] (d) [BF_4^- and NH_4^+]

BITSAT-2014, NEET-2012

Ans. (d) : The structure of BF_4^- and NH_4^+ is-



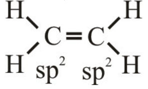
The species BF_4^- and NH_4^+ have same-same i.e tetrahedral and hybridization is Sp^3

9. Which of the following has sp^2-hybridisation?

(a) C_2H_6 (b) C_2H_4
(c) $BeCl_2$ (d) C_2H_2

JIPMER-2012
NEET-1996

Ans. (b) : in C_2H_6 both carbon has sp^3 hybridisation. In C_2H_4 both carbon has sp^2 hybridisation



In $BeCl_2$, beryllium has sp hybridisation.

$$\underset{sp}{Cl - Be - Cl}$$

In C_2H_2 each carbon has sp hybridisation.

$$H - \underset{sp}{C} \equiv \underset{sp}{C} - H$$

10. The 'd' orbital involved in the hybridisation in the PCl_5 molecule is

(a) $3d_{x^2-y^2}$ (b) $3d_{z^2}$
(c) $3d_{xy}$ (d) $4d_{x^2-y^2}$

J & K CET-(2009, 2005)

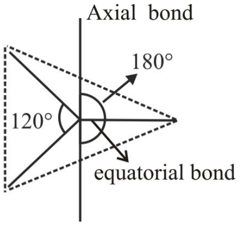
Ans. (b) : The hybridisation of PCl_5 molecule is sp^3d the hybridisation number should be 5. These five orbitals are degenerate, that is their energies are the sume but configuration are different.
In sp^3d hybridisation there are a total of s orbitals which are s, p_x, p_y, p_z. In case of d- subshell, the d_{z^2} orbital take part in hybridisation.

11. The geometrical shape of sp^3d hybridization is

(a) linear (b) trigonal bipyramid
(c) square planar (d) tetrahedral

J & K CET-(2007, 2002)

Ans. (b) : The geometrical shape of sp^3d hybridisation is trigonal bipyramid.



@apna_pdf

12. An sp^3-hybrid orbital contains

(a) $\frac{1}{4}$ s-character (b) $\frac{1}{2}$ s-character

(c) $\frac{2}{3}$ s-character (d) $\frac{3}{4}$ s-character

JIPMER-2011
NEET-1991

Ans. (a) : In sp^3 hybrid orbital, is formed by mixing of 1s and 3p-orbitals to form a equivalent sp^3 orbital's. Therefore sp^3 hybrid orbital has 25% s-character and 75% p-character. So, sp^3-hybrid orbital contains $\frac{1}{4}$ s-character.

Hybrid atomic orbital's do not exist and do not appropriately describe molecular bonding.

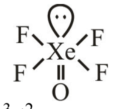
13. The type of hybridisation and number of lone pair(s) of electrons of Xe in XeOF$_4$, respectively, are

(a) sp^{3}d^2 and 1 (b) sp^{3}d and 2

(c) sp^3 and 1 (d) sp^{3}d^2 and 2

(JEE Main 2019, 10 Jan Shift-I)
UPTU/UPSEE-2015

Ans. (a) : The structure of XeOF$_4$ are –



The hybridisation is sp^{3}d^2.

Hybridisation = Bond pair + lone pair

= (4 + 1) +1

= 6 (sp^{3}d^2)

So, the hybridization of XeOF$_4$ is sp^{3}d^2 and lone pair is 1.

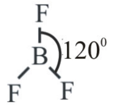
14. The planar structure of BF$_3$ can be explained by the fact that BF$_3$ is

(a) sp-hybridised (b) sp^2-hybridised

(c) sp^3-hybridised (d) sp^{3}d hybridised

J & K CET-(2017)
BCECE-2007

Ans. (b) : The structure of BF$_3$ is



sp^2 (triangular planar.)

In BF$_3$ has sp^2 hybridization due to three fluorine atom are arranged in a trigonal geometry.

15. Sulphur reacts with chlorine in 1 : 2 ratio and form X. Hydrolysis of X gives a sulphur compound Y. What is the hybridisation state of central atom in the anion of Y ?

(a) sp^3 (b) sp

(c) sp^2 (d) sp^{3}d

AP- EAPCET- 07-09-2021, Shift-I
AP-EAMCET (Engg.)-2004

Ans. (a) : When sulphur reacts with chlorine in 1 : 2 ratio then SCl$_4$ is obtained which one hydrolysis gives sulphurous acid (H$_2$SO$_3$).

$$S + 2Cl_2 \rightarrow \underset{\text{sulphur tetrachloride}}{SCl_4}$$

$$SCl_4 + 4H_2O \rightarrow \underset{\text{unstable}}{S(OH)_4} + 4HCl$$

$$S(OH)_4 \rightarrow \underset{\text{sulfurous acid}}{H_2SO_3} + H_2O$$

Hybridization of S in SO_3^{2-} is sp^3.

16. Which of the following is an octahedral molecule?

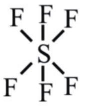
(a) SF$_6$ (b) BF$_4^-$

(c) PCl$_5$ (d) IF$_7$

J & K CET-(2017, 1998)

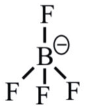
Ans. (a) : From the following molecule are –

(i) SF$_6$



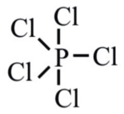
sp^{3}d^2 (Octahedral)

(ii) BF$_4^-$



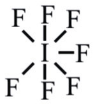
sp^3 (tetrahedral)

(iii) PCl$_5$



sp^{3}d (trigonal bipyramidal)

(iv) IF$_7$



sp^{3}d^3 (Pentagonal bi pyramidal)

SF$_6$ molecule has octahedral geometry.

17. The state of hybridization of 'B' in BCl$_3$ is:

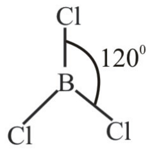
(a) sp^3 (b) sp^2

(c) sp (d) sp^{3}d^2

AP EAMCET (Medical) -1998
AP-EAMCET-1996

Ans. (b): The type of hybridization that occurs is BCl$_3$ is sp^2 hybridization. In BCl$_3$ molecule, boron will be the central atom which contains three bonded atom but no lone pair of electron.

The structure of BCl$_3$ is given below–



Hybridization = No. of bond pair + No. of lone pair

Hybridization = 3 + 0 = 3 (sp^2)

18. sp^{3}d hybridisation results in:

(a) A square planar molecule

(b) An octahedron molecule

(c) A trigonal bipyramidal molecule

(d) A tetrahedron molecule

UPTU/UPSEE-2005, 2004

Ans. (c) : The hybridisation of sp^{3}d is tirgonal bipyrmidal molecule. A sp^{3}d hybridisation includes 5 hybrid orbitals arranged in space so is to minimise the repulsion between them and the geometry which results from such an arrangement is trigonal bipyramidal.

@apna_pdf

19. Match List-I and List-II.

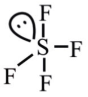
	List I (Species)		List II (Hybrid orbitals)
A	SF_4	i.	sp^3d^2
B	IF_5	ii.	d^2sp^3
C	NO_2^+	iii.	sp^3d
D	NH_4^+	iv.	sp^3
		v.	sp

	A	B	C	D
(a)	(i)	(ii)	(v)	(iii)
(b)	(ii)	(i)	(iv)	(v)
(c)	(iii)	(i)	(v)	(iv)
(d)	(iv)	(iii)	(ii)	(v)

(JEE Main 2021, 22 July Shift-II)

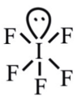
Ans. (c) :

(i) SF_4



sp^3d

(ii) IF_5



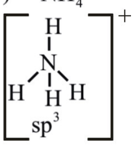
sp^3d^2

(iii) NO_2^+

$O=\overset{+}{N}=O$

sp

(iv) NH_4^+



Therefore, the SF_4 has sp^3d hybrid orbital IF_5 has sp^3d^2, NO_2^+ has sp and NH_4^+ has sp^3 hybrid orbital.

20. XeF_6 on partial hydrolysis gives a compound X, which has square pyramidal geometry 'X' is

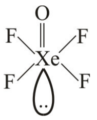
(a) XeO_3 (b) XeO_4

(c) $XeOF_4$ (d) XeO_2F_2

Kerala-CEE-29.08.2021

Ans. (c) : XeF_6 on partial hydrolysis gives a compound $XeOF_4$ which has square pyramidal geometry which is given as follows -

$$XeF_6 + H_2O \rightarrow XeOF_4 + 2HF$$



(Square pyramidal)

21. Match the following

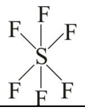
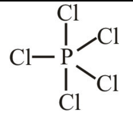
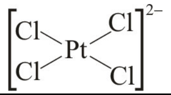
Column – I	Column – II
Compound	**Hybridization**
(A) SF_6	(I) dsp^2
(B) PCl_5	(II) d^2sp^3
(C) $[PtCl_4]^{2-}$	(III) sp^3d^2
	(IV) sp^3
	(V) sp^3d

The correct match is

	A	B	C
(a)	III	I	V
(b)	III	V	I
(c)	IV	V	I
(d)	II	V	I

TS EAMCET 10.08.2021, Shift-II

Ans. (b) :

Species	Hybridization	Geometry
SF_6	sp^3d^2	
PCl_5	sp^3d	
$[Pt(Cl_4)]^{2-}$	dsp^2	

22. Consider the reaction $BCl_3 + NH_3 \rightarrow BCl_3 . NH_3$. The geometries of BCl_3 and $BCl_3 . NH_3$ respectively are ______

(a) Trigonal planar & Tetrahedral

(b) Tetrahedral & square planar

(c) Tetrahedral & Trigonal bipyramidal

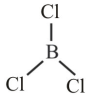
(d) Square planar & Trigonal pyramidal

AP EAPCET 23-08-2021 Shift-I

Ans. (a) : Given reaction is-

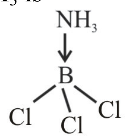
$$BCl_3 + NH_3 \rightarrow BCl_3 . NH_3$$

Structure of BCl_3 is-



The geometries of BCl_3 is trigonal planar.

Structure of $BCl_3 . NH_3$ is-



The geometries of $BCl_3.NH_3$ is tetrahedral.

23. In which of the following molecules/ ions the central atom is sp^2 hybridized?

BF_3, NO_2^-, NH_2^-, & H_2O

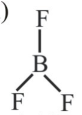
(a) NH_2^- & H_2O (b) NO_2^- & H_2O

(c) BF_3 & NO_2^- (d) NO_2^- & NH_2^-

AP EAPCET 19-08-2021 Shift-I

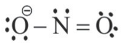
Ans. (c) : Formula = lone pair + Bond pair.

(i)



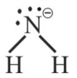
Hybridization
= 0 + 3
= 3 (sp^2)

(ii)



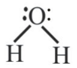
H.B = 1 + 2
= 3 (sp^2)

(iii)



H.B = 2 + 2
= 4 (sp^3)

(iv)



H.B = 2 + 2
= 4 (sp^3)

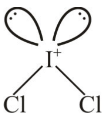
24. The hybridization of the central atom in the species ICl_2^+ is ____

(a) sp^3d^2 (b) sp

(c) sp^2 (d) sp^3

AP EAPCET-6 Sep. 2021, Shift-II

Ans. (d): The structure of the ICl_2^+ is–



Hybridisation = No. of bond pair + No. of lone pair
= 2+2
= 4
i.e, sp^3

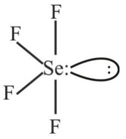
@apna_pdf

25. **The hybridization of Se in SeF_4 and its geometry respectively are________**

(a) sp^3d, see-saw shaped (b) sp^3d^2, octahedral
(c) sp^3d^3, trigonal planar (d) sp^3d^2, square planar

AP EAPCET 20.08.2021 Shift-II

Ans. (a): Structure of SeF_4 is–



Hybridization of SeF_4 is sp^3d and geometry is see-saw shaped.

26. **Match List-I (species) with List-II (hybridisation) and select the correct code given below :**

List-I	List-II
(A) XeF_4	(1) dsp^2
(B) H_2O	(2) sp^3
(C) PCl_5	(3) sp^3d^2
(D) $[Pt(NH_3)_4]^{2+}$	(4) sp^3d

Codes :

	A	B	C	D
(a)	3	2	4	1
(b)	1	4	2	3
(c)	3	4	2	1
(d)	1	2	4	3

Manipal-2020

Ans. (a) :

Species	Hybridization
XeF_4	sp^3d^2
H_2O	sp^3
PCl_5	sp^3d
$[pt(NH_3)_4]^{2+}$	dsp^2

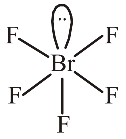
27. **Which one of the following molecules is formed by sp^3d hybridisation?**

(a) BrF_5 (b) PF_5
(c) SF_6 (d) $[Co(NH_3)_6]^{3+}$
(e) $[Pt(Cl)_4]^{2-}$

Kerala-CEE-2020

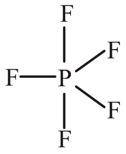
Ans. (b) :

(i) BrF_5



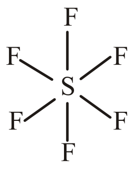
(sp^3d^2)

(ii) PF_5



(sp^3d)

(iii) SF_6



(sp^3d^2)

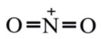
28. **The percentage of s-character in the hybrid orbitals of nitrogen in NO_2^+, NO_3^- and NH_4^+ respectively are**

(a) 33.3%, 50%, 25% (b) 33.3%, 25%, 50%
(c) 50%, 33.3%, 25% (d) 25%, 50%, 33.3%

Karnataka-CET-2020

Ans. (c) : The structure of NO_2^+ NO_3^- and NH_4^+

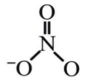
(i) NO_2^+


$O=\overset{+}{N}=O$

sp

The percentage of s-character is 50% and p- character is 50%

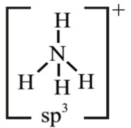
(ii) NO_3^-



sp^2

The percentage of s-character is 33.3% and p-character is 66.6%

(iii) NH_4^+



sp^3

The percentage of s-character is 25% and p-character is 75%.

Hence, the percentage of s-character in the hybrid orbital of nitrogen in NO_2^+ is 50%, NO_3^- is 33.3% and NH_4^+ and is 25% respectively.

29. **The linear shape of CO_2 is due to.......**

(a) sp^3 -hybridisation of carbon
(b) sp-hybridisation of carbon
(c) $p\pi$ - $d\pi$ bonding between carbon and oxygen
(d) sp^2 -hybridisation of carbon

AP EAMCET (Engg.) 21.09.2020, Shift-I

Ans. (b) : The geometry of CO_2 is linear. As there are no non-bonding pairs, the space is not even distorted or bent and remain a perfect 180° angle. This is due to the overlapping of s and p.

Orbitals of both atoms to form sp hybrid and $p\pi - p\pi$ bonding between carbon and oxygen.

30. **The reaction in which the hybridisation of the underlined atom is affected is**

(a) $\underline{Xe}F_4 + SbF_5 \rightarrow$
(b) $H_2\underline{S}O_4 + NaCl \xrightarrow{420k}$
(c) $H_3\underline{P}O_2 \xrightarrow{\text{Disproportionation}}$
(d) $\underline{N}H_3 \xrightarrow{H^+}$

(JEE Main 2020, 4 Sep Shift-II)

Ans. (a) : (i) $\underset{sp^3d^2}{XeF_4} + SbF_5 \longrightarrow \underset{sp^3d}{(XeF_3)}(SbF_6)^-$

(ii) $\underset{sp^3}{H_2SO_4} + NaCl \xrightarrow{420k} \underset{sp^3}{NaHSO_4} + HCl$

(iii) $\underset{sp^3}{H_3PO_2} \xrightarrow{\text{Disproportionation}} \underset{sp^3}{PH_3} + \underset{sp^3}{H_3PO_4}$

(iv) $\underset{sp^3}{NH_3} \xrightarrow{H^+} \underset{sp^3}{NH_4^+}$

@apna_pdf

31. What is the hybridisation of Be in BeF_2 molecule ?

(a) dsp^2 (b) sp^2d
(c) sp (d) sp^3

AP EAMCET (Engg.) 18.09.2020, Shift-I

Ans. (c) : Hybridisation state of Be in BeF_2 is sp.

F—Be—F

$$H = \frac{1}{2}(V + M - C + A)$$

$$= \frac{1}{2}(2 + 2 - 0 + 0) = 2(sp)$$

Where, V = number of valence electrons of Be = 2
H = number of monovalent F atom = 2
C = number of cationic charge = 0
A = number of anionic charge = 0

So, the hybridisation of Be in BeF_2 molecule is sp.

32. The types of hybridisation on the five carbon atoms from left to right in pent-1-en-4-yne are

(a) sp^2, sp^2, sp^3, sp, sp (b) sp, sp, sp^3, sp^2, sp^2
(c) sp^2, sp^3, sp, sp, sp^3 (d) sp^2, sp, sp^3, sp, sp^2

AP EAMCET (Engg.) 18.09.2020, Shift-I

Ans. (a) : $\underset{\underset{sp^2}{\uparrow}}{\overset{1}{C}H_2} = \underset{\underset{sp^2}{\uparrow}}{\overset{2}{C}H} — \underset{\underset{sp^3}{\uparrow}}{\overset{3}{C}H_2} — \underset{\underset{sp}{\uparrow}}{\overset{4}{C}} \equiv \underset{\underset{sp}{\uparrow}}{\overset{5}{C}H}$

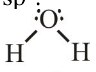
(Pent-1-ene-4-yne)

33. What is hybridization of O in H_2O?

(a) sp (b) sp^3
(c) sp^2 (d) No hybridisation

JIPMER-2019

Ans. (b) : The structure of H_2O is V-shaped or bent shaped because two lone pair present on oxygen atom to repel each other and two bonded hydrogen atom. The hybridization of H_2O is sp^3.



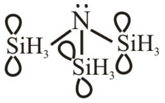
sp^3

34. The hybridization and geometry in $N(SiH_3)_3$, respectively, are

(a) sp^3, tetrahedral (b) sp^3, pyramidal
(c) sp^2, triangular planar (d) sp^3d, T-shaped.

AMU-2019

Ans. (c) : In trisilylamine, N atom is sp^2 hybridised which results in planar geometry There is $p\pi - d\pi$ bonding because Si has vacant d–orbitals.



sp^2 (triangular planar.)

35. Match the Xenon compounds in Column-I with its structure in Column-II and assign the correct code.

Column-I		Column-II	
(A)	XeF_4	(i)	Pyramidal
(B)	XeF_6	(ii)	Square planar
(C)	$XeOF_4$	(iii)	Distorted octahedral
(D)	XeO_3	(iv)	Square pyramidal

	A	B	C	D
(a)	(iii)	(iv)	(i)	(ii)
(b)	(i)	(ii)	(iii)	(iv)
(c)	(ii)	(iii)	(iv)	(i)
(d)	(ii)	(iii)	(i)	(iv)

(NEET 2019, NEET-I 2016)

Ans. (c) :

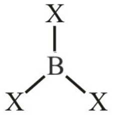
Column-I	Column-II
XeF_4	Square planar
XeF_6	Distorted octahedral
$XeOF_4$	Square pyramidal
XeO_3	Pyramidal.

36. The hybridization state of boron in its trihalides is

(a) sp^2 (b) sp3
(c) sp (d) sp^3d

J & K CET-(2019)

Ans. (a) : The hybridization state of boron in its trihalides is sp^2 because boron bonded with three halides to a trigonal planar geometry.



sp^2 hybridisation

Where, X = Halide group.

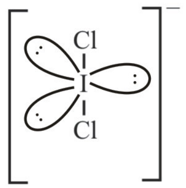
37. The ion that has sp^3d^2 hybridisation for the central atom, is

(a) $[IC\ell_2]^-$ (b) $[BrF_2]^-$
(c) $[IC\ell_4]^-$ (d) $[IF_8]^-$

(JEE Main 2019, 8 April Shift-II)

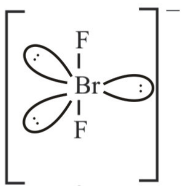
Ans. (c) : The structure of the following molecule-

(i) $[ICl_2]^-$



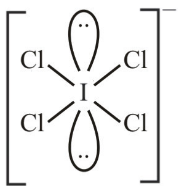
sp^3d

(ii) $[BrF_2]^-$



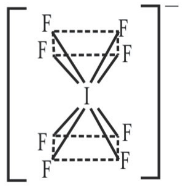
sp^3d

(iii) $[ICl_4]^-$



sp^3d^2

(iv) $[IF_8]^-$



sp^3d^4

Thus $[ICl_4]^-$ ion has sp^3d^2 hybridisation.

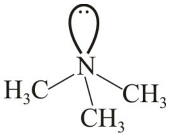
38. Type of hybridization of N and C – N – C bond angle in $(CH_3)_3N$ are ______ and respectively?

(a) $sp^3, 108^o$ (b) $sp^2, 120^o$
(c) $sp^3, 109^o28'$ (d) $sp^2, 117.5^o$

GUJCET-2019

@apna_pdf

Ans. (a) :



Nitrogen has 3 bonds pairs, 1 lone pair. Hence, by VSEPR theory, it is sp^3 hybridised and bond angle is 108°.

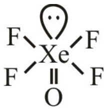
39. The number of lone pair of electron and hybridisation in $XeOF_4$ is

(a) 0,sp^3 (b) 1,sp^3d

(c) 1,sp^3d^2 (d) 2,sp^3d^2

CG PET -2019

Ans. (c) : For $XeOF_4$



The number of lone pair of electron is 1 and hybridization is sp^3d^2.

Hybridisation = Bond pair + lone pair.

= (4 + 1) + 1

= 6 (sp^3d^2).

40. A molecule is square plannar with no lone pair. What type of hybridization is associated with it?

(a) sp^3d (b) sp^3d^2

(c) dsp^3 (d) dsp^2

COMEDK-2019

Ans. (d) : dsp^2 hybridisation leads to square planar geometry and no lone pair.

41. Specify the coordination geometry and hybridization of N and B atoms in a 1:1 complex of BF_3 and NH_3.

(a) N: tetrahedral, sp^3; B: tetrahedral, sp^3

(b) N: pyramidal, sp^3; B: pyramidal , sp^3

(c) N: pyramidal, sp^3, B: planar, sp^2

(d) N: pyramidal, sp^3, B: tetrahedral, sp^3

COMEDK–2018

Ans. (a) : NH_3 and BF_3 have sp^3 (pyramidal) and sp^2 (planar) hybridization respectively, having one lone pair of electron on N atom which is responsible for pyramidal shape of NH_3 inspite of sp^3 hybridisation. However, as soon as it is coordinated to BF_3, both attain tetrahedral geometry and acquire sp^3 hybridisation.

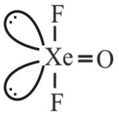
42. In $XeOF_2$ molecule, the hydridisation of Xe orbital is–

(a) sp^3d^3 (b) sp^3d^2

(c) sp^3d (d) sp^3

BCECE-2018

Ans. (c) : The structure of $XeOF_2$ is



The hybridization of $XeOF_2$ is sp^3d

Hybridisation = bond pair + lone pair

= (2 + 1) + 2

= 5 (sp^3d)

43. What is the structure of $XeOF_4$?

(a) Square pyramidal

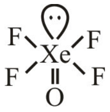
(b) Trigonal bipyramidal

(c) Pyramidal

(d) Square bipyramidal

GUJCET-2018

Ans. (a) : The structure of $XeOF_4$ is –



According to VSEPR theory, Xe bonded with four fluorine atom and one doubly bonded oxygen atom, and present one lone pair. The hybridisation of $XeOF_4$ is sp^3d^2 and structure is square pyrimdal.

44. The state of hybrid orbitals of carbon in CO_2, CH_4 and CO_3^{2-} respectively is

(a) sp^3, sp^2 and sp (b) sp^3, sp and sp^2

(c) sp, sp^3 and sp^2 (d) sp^2, sp^3 and sp

Karnataka-CET-2018

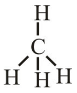
Ans. (c) : The structure of CO_2, CH_4 and CO_3^{2-} is

(i) CO_2

O=C=O

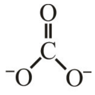
sp

(ii) CH_4



sp^3

(iii) CO_3^{2-}



sp^2

Therefore, the hybrid orbital's of carbon in CO_2, CH_4 and CO_3^{2-} is sp, sp^3 and sp^2 respectively.

45. formation of PCl_3 is explained on the basis of what hybridisation of phosphorus atom?

(a) sp^2 (b) sp^3

(c) sp^3d (d) sp^3d^2

MHT CET-2018

Ans. (b) : Hybridisation of an atom can be determined by the formula.

$$\text{Hybridisation} = \frac{1}{2}[V + Y - C + A]$$

Where, V = Valence electron

Y = Monovalent atom

C = Cationic charge

A = Anionic charge

For PCl_3 , V=5, Y= 3, C = 0, A = 0

$$\text{So,} \quad \text{hybridisation} = \frac{1}{2}\,[5 + 3 - 0 + 0]$$

$$= \frac{1}{2} \times 8$$

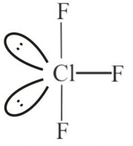
4 (sp^3)

46. In the structure of ClF_3, the number of lone pairs of electrons on central atom 'Cl' is

(a) one (b) two (c) four (d) three

NEET-2018

Ans. (b) : The structure of ClF_3 is -



sp^3d (T- shaped)

@apna_pdf

In ClF_3 molecule three fluorine atoms is bonded to chlorine and two lone pairs are present in central atom of Cl. The hybridization of ClF_3 is sp^3d and shape is T-shaped.

47. Sulphur reacts with chlorine in 1:2 ratio and forms X. Hydrolysis of X gives a sulphur compound Y. The hybridisation of central atom in the anion Y is

(a) sp^3 (b) sp^2
(c) sp^3d (d) sp

JIPMER-2017

Ans. (a) : When sulphur reacts with chlorine in 1 : 2. The ratio of the SCl_4 is obtained which on hydrolysis gives H_2SO_4. Therefore, the compound X is SCl_4 and Y is H_2SO_4

$$\underset{}{S+2Cl_2 \longrightarrow \underset{(X)}{SCl_4}}$$

$$SCl_4 + 4H_2O \longrightarrow \underset{\text{(unstable)}}{S(OH)_4} + 4HCl$$

$$S(OH)_4 \longrightarrow H_2SO_4 + H_2O$$

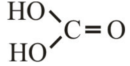
Hence, the hybridisation of sulphur in SO_4^{3-} is sp^3.

48. Among the following compounds, which compound is polar as well as well as exhibit sp^2 –hybridisation by the central atom

(a) H_2CO_3 (b) SiF_4
(c) BF_3 (d) $HClO_3$

JIPMER-2017

Ans. (a) : The structure of H_2CO_3 is –



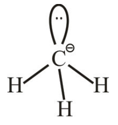
So, the geometry is trigonal planar and hybridization is sp^2.
Now, H_2CO_3 and BF_3 are central atom C and B are sp^2 hybridised. In H_2CO_3 is dipole moment is not zero.
Hence, H_2CO_3 molecule is polar as well as exhibit sp^2 hybridisation.

49. Hybridisation of carbon in CH_3^-

(a) sp^2 (b) sp^3
(c) sp^3d (d) sp^3d^2
(e) sp^2d^3

Kerala-CEE-2017

Ans. (b) : The structure of CH_3^- is



sp^3

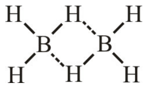
The hybridisation of CH_3^- is sp^3 due to three hydrogen atom is bonded to carbon and one lone pair is present so the hybrisation is sp^3.

50. Hybridisation of boron in diborone (B_2H_6) is–

(a) sp (b) sp^2
(c) sp^3 (d) sp^3d

BCECE-2016

Ans. (c) : The structure of diborane (B_2H_6) is-



Each boron atom in diborane is sp^3 hybridisation in the structure of diborane four H–atoms two are left and right, known as terminal hydrogen and in different environment two hydrogen atom which known as bridging atoms.

51. For the following pattern of hybridisation shown by the central atom.
sp, sp^2, sp^3, sp^3d
(1) (2) (3) (4)
which of the following will represent the correct sequence of hybridisation, i.e. according to the sequence mentioned above?

(a) H_2O, CO_2, BF_3, PCl_5
(b) CO_2, H_2O, BF_3, PCl_5
(c) CO_2, BF_3, H_2O, PCl_5
(d) H_2O, CO_2, PCl_5, BF_3

JCECE - 2016

Ans. (c) : The orbitals of the central atom that goes for hybridisation are:
(a) Orbitals used for a σ bond formation.
(b) Orbitals contain l.p. (lone pair) of electrons.
(c) If required empty orbitals.
Note: Orbitals involved in π-bond formation and having odd electron will not get hybridised.

Molecule	**Hybridisation**	**No. of σ bonds + l.p.**
CO_2	sp	$\begin{pmatrix}\text{no. of } \sigma \text{ bonds} = 0\\ \text{no. of lp of electrons} = 0\end{pmatrix}$
BF_3	sp^2	$\begin{pmatrix}\text{no. of } \sigma \text{ bonds} = 3\\ \text{no. of lp of electrons} = 0\end{pmatrix}$
H_2O	sp^3	$\begin{pmatrix}\text{no. of } \sigma \text{ bonds} = 2,\\ \text{no. of lp of electrons} = 2\end{pmatrix}$
PCl_5	sp^3d	$\begin{pmatrix}\text{no. of } \sigma \text{ bonds} = 5\\ \text{no. of lp of electrons} = 0\end{pmatrix}$

52. The hybridization of C in diamond, graphite and ethyne is in the order.

(a) sp^3, sp, sp^2 (b) sp^3, sp^2, sp
(c) sp, sp^2, sp^3 (d) sp^2, sp^3, sp

Karnataka-CET-2016

Ans. (b) : A diamond has a tetrahedral structure in which all C-atoms are bonded by 4σ - bonds with 4 neighbouring C-atoms. Thus it has sp^3 hybridisation.
Graphite forms a hexagonal in which each carbon is bonded by 3σ - bonds with 3-C atoms in the same plane. Thus, the graphite has sp^2 hybridisation.
In Ethyne $CH \equiv CH$ in which one C-atom is bonded with other C-atom through only one σ -bond (2π bonds do not take part in hybridization). So, ethyne has sp hybridization.
Thus, the correct order is sp^3, sp^2, sp,

53. The hybridised state of Al^{3+} in the complex ion formed when $AlCl_3$ is treated with aqueous acid is

(a) sp^3 (b) dsp^2
(c) sp^3d^2 (d) sp^2d
(e) sp^2

Kerala-CEE-2016

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Ans. (c) : Al^{3+} ions give a complex ion in which Al^{3+} ion form six coordinate covalent bonds with six H_2O molecules.

Al^{3+} + aqueous acid $\rightarrow [Al(H_2O)_6]^{3+}$

Hence, it shows sp^3d^2 hybridisation

54. The correct geometry and hybridization for XeF_4 are

(a) octahedral sp^3d^2

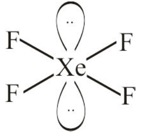
(b) trigonal bipyramidal, sp^3d

(c) planar triangle, sp^3d^3

(d) square planar, sp^3d^2

NEET-II 2016

Ans. (a) : The geometry of XeF_4 is



The geometry of XeF_4 is octahedral. It has sp^3d^2 hybridisation.

55. Amongst $NO_3^-, AsO_3^{3-}, CO_3^{2-}, ClO_3^-, SO_3^{2-}$, and BO_3^{30} the non-planar species are

(a) NO_3^-, CO_3^{2-} and BO_3^{3-}

(b) SO_3^{2-}, ClO_3^-, and BO_3^{3-}

(c) CO_3^{2-}, SO_3^{2-}, and BO_3^{3-}

(d) AsO_3^{3-}, CO_3^{2-} and SO_3^{2-}

UPTU/UPSEE-2016

Ans. (b) : (i) NO_3^- has sp^2 hybridisation and its geometry is trigonal planar with no lone pair.

(ii) AsO_3^{3-} has sp^3 hybridisation and its geometry is pyramidal with one lone pair.

(iii) CO_3^{2-} has sp^2 hybridisation and its geometry is trigonal planar with zero lone pair.

(iv) ClO_3^- has sp^3 hybridisation and its geometry is pyramidal with one lone pair.

(v) SO_3^{2-} has sp^3 hybridisation and its geometry is pyramidal with one lone pair.

(vi) BO_3^{3-} has sp^2 hybridisation and its geometry is tirgonal planar with zero lone pair.

Therefore AsO_3^{3-}, ClO_3^- and SO_3^{2-} have non-planar species as their geometry is pyramidal.

56. In which one of the following pairs the two species have identical shape, but differ in hybridsation?

(a) $I_3^-, BeCl_2$ (b) NH_3, BF_3

(c) XeF_2, I_3^- (d) NH_4^+, SF_4

AP-EAMCET (Engg.) 2015

Ans. (a) : I_3^- has sp^3d hybridisation and linear shape. $BeCl_2$ has sp hybridisation and linear shape.

The structure of I_3^- and $BeCl_2$ are –

I_3^- $BeCl_2$

$[I - \ddot{\underset{..}{I}} - I]^-$, Cl – Be – Cl

(linear) (linear)

57. Which one of the following does not have sp^3 hybridisation?

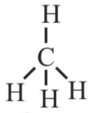
(a) CH_4 (b) XeF_4

(c) H_2O (d) NH_3

J & K CET-(2015)

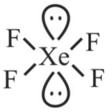
Ans. (b) : The structure of the following are-

(i) CH_4



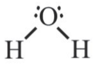
sp^3(tetrahedral)

(ii) XeF_4



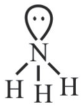
sp^3d^2 (distorted Octahedral)

(iii) H_2O



sp^3 (V-shaped/ bent shaped)

(iv) NH_3



sp^3 (tetrahedral)

In XeF_4 molecule has sp^3d^2 hybridisation but another are all sp^3 hybridisaton.

58. The hybridized state of bromine in bromine pentafluoride is

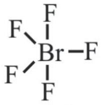
(a) sp^3d (b) dsp^3

(c) d^2sp^3 (d) sp^2d

(e) sp^3d^2

Kerala-CEE-2015

Ans. (e) : The structure of bromine pentafluoride is-



(sp^3d^2)

The hybridization state of bromine in bromine pentafluoride is sp^3d^2.

59. The angular shape of ozone molecule (O_3) consists of.

(a) 1 sigma and 2 pi bonds

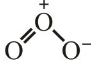
(b) 2 sigma and 2 pi bonds

(c) 1 sigma and 1 pi bonds

(d) 2 sigma and 1 pi bonds

JIPMER-2014

Ans. (d) : The structure O_3 is bent. The central atom has one double bond and one single bond with its neighbouring Oxygen molecules which keeps interchanging their positions and Ozone molecule has 2 sigma bond and one pi bond.



60. In which one of the following the central atom is sp^3 hydridised?

(a) NH_4^+ (b) BF_3

(c) SF_6 (d) PCl_5

(e) XeF_4

Kerala-CEE-2014

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Ans. (a) : Molecule/ion	**Hybridisation**
NH_4^+	sp^3
BF_3	sp^2
SF_6	sp^3d^2
PCl_5	sp^3d
XeF_4	sp^3d^2

61. What is the hybridization of carbon atom '2' in the following compound?

$$\overset{1}{C}H_2=\overset{2}{C}=\overset{3}{C}H-\overset{4}{C}H_3$$

(a) sp^3 (b) sp^2
(c) sp (d) sp^3d

S. C. R. A - 2014

Ans. (c) : In the given compound,

$$\underset{sp^2}{\overset{1}{C}H_2}=\underset{sp}{\overset{2}{C}}=\underset{sp^2}{\overset{3}{C}H}-\underset{sp^3}{\overset{4}{C}H_3}$$

Hence, the hybridization of carbon atom '2' in is sp.

62. The number of electrons is the valence shell of the central atom of a molecule is 8. The molecule is

(a) BCl_3 (b) BeH_2
(c) SCl_2 (d) SF_6

AP-EAMCET (Engg.) - 2014

Ans. (c) : The number of electrons in the valence shell of SCl_2 of the central atom of a molecule is 8.
In SCl_2 valence electron = 6+2 = 8

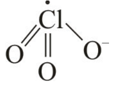
63. Which of the following is not correctly matched?

(a) $ClO_3^- - sp^2$ hybridised
(b) $SO_3 - sp^2$ hybridised
(c) $NH_3 - sp^3$ hybridised
(d) $PCl_5 - sp^3d$ hybrodised

UP CPMT-2014

Ans. (a) : $ClO_3^- \Rightarrow 3bp + 1/p \Rightarrow sp^3$hybridised

pyramidal geometry



64. The hybridisation of central atoms in case of diamond and carborundum respectively are

(a) sp^2, sp^3 (b) sp^3, sp^2
(c) sp^2, sp (d) sp^3, sp^3

UP CPMT-2014

Ans. (d) : In diamond and carborundum (SiC) both the central atoms (i.e.,C and Si) are sp^3 hybridised.

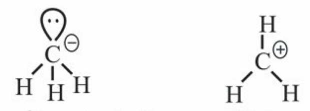
65. Which of the following species has a trigonal planar shape?

(a) $:CH_3^-$ (b) CH_3^+
(c) BF_4^- (d) SiH_4

J & K CET-(2013)

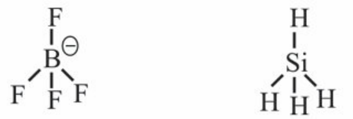
Ans. (b) : The shape of the following species are-

(i) CH_3^- (ii) CH_3^+



sp^3(tetrahedral) sp^2(trigonal planar)

(iii) BF_4^- (iv) SiH_4



sp^3 (tetrahedral) sp^3 (tetrahedral)

In the CH_3^+ molecule has trigonal planar shape.

66. In which of the following pairs of molecules/ions, the central atoms have sp^2 hybridisation?

(a) BF_3 and NH_2^- (b) NO_2^- and NH_3
(c) BF_3 and NO_2^- (d) NH_2^- and H_2O

JCECE - 2013

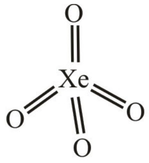
Ans. (c) : BF_3 and NO_2^- are sp^2 hybridised while NH_2^-, NH_3 and H_2O are sp^3 hybridised.

67. Identify the incorrect statement, regarding the molecule XeO_4

(a) XeO_4 molecule is square planar
(b) There are four pπ-d, π-bonds
(c) There are four sp^3-p, σ-bonds
(d) XeO_4 molecule is tetrahedral

(Karanakata, NEET 2013)

Ans. (a) : The XeO_4 molecule is tetrahedral. The geometry of molecule is-



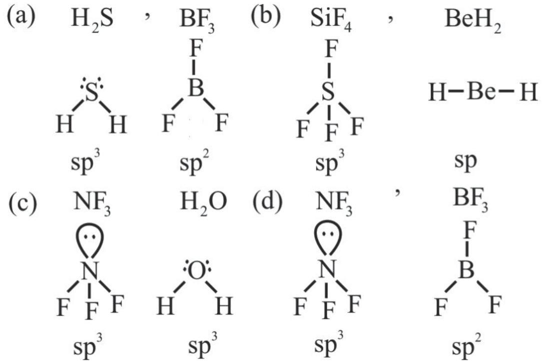
sp^3 (Tetrahedral)

68. In which of the following a pair both the species have sp^3 hybridization?

(a) H_2S, BF_3 (b) SiF_4, BeH_2
(c) NF_3, H_2O (d) NF_3, BF_3

AIIMS 25 May 2019 (Evening)
Karnataka NEET-2013

Ans. (c):



69. In which of the following pair both the species have sp^3 hybridisation?

(a) SiF_4, BeH_2 (b) NF_3, H_2O
(c) NF_3, BF_3 (d) H_2S, BF_3

KARNATAKA NEET 2013

Ans. (b) : NF_3 and H_2O have sp^3- hybridization.

@apna_pdf

70. The outer orbitals of C in ethene molecule can be considered to be hybridized to give three equivalent sp^2 orbitals. The total number of sigma (σ) and pi (π) bonds in ethene molecule is

(a) 3 sigma (σ) and 2 pi (π) bonds

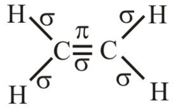
(b) 4 sigma (σ) and 1 pi (π) bonds

(c) 5 sigma (σ) and 1 pi (π) bonds

(d) 1 sigma (σ) and 2 pi (π) bonds

KARNATAKA NEET 2013

Ans. (c) : The structure of ethene is–



5 σ-bond and 1 π-bond

71. In which of the following pairs (of molecules/ions) the central atom has the same hybridisation?

(a) XeF_4 and ClO_4^- (b) $BeCl_2$ and SO_2

(c) BH_3 and ClF_3 (d) NH_3 and NH_4^+

SRMJEEE – 2012

Ans. (d) :

Hybridisation of Xe = lone pair + bond pair

(a) In XeF_4, Hybridisation of Xe = 2 + 4 = 6(sp^3d^2)

In ClO_4^-, Hybridisation of Cl = 0 + 4 = 4 (sp^3)

(b) In $BeCl_2$, Hybridisation of Be = 0 + 2 = 2 (sp)

In SO_2, Hybridisation of S = 1 + 2 = 3 (sp^2)

(c) In BH_3, Hybridisation of B = 0 + 3 = 3(sp^2)

In ClF_3, Hybridisation of Cl = 2 + 3 = 5 (sp^3d)

(d) In NH_3, Hybridisation of N = 1 + 3 = 4 (sp^3)

In NH_4^+, Hybridisation of N = 0 + 4 = 4 (sp^3)

Hence, NH_3 and NH_4^+ have the same hybridisation.

72. The hybridization of carbon in molecular CO_2 is

(a) sp (b) sp^2

(c) sp^3 (d) sp^3d

J & K CET-(2012)

Ans. (a) : In the CO_2 molecule the structure is

$$\underset{sp}{O=C=O}$$

In CO_2 molecule carbon bonded with two oxygen by double bond. It is linear geometry and hybridisation is sp.

73. The percentage of p-character of the hybrid orbitals in graphite and diamond are respectively

(a) 50 and 75 (b) 67 and 75

(c) 33 and 75 (d) 33 and 25

Karnataka-CET-2012

Ans. (b) : Graphite forms a hexagonal sheet like structure in which each carbon is bonded by 3 σ bonds. So, the hybridization of graphite is sp^2. The percentage of p- character is 66.67 ≈ 67%.

Diamond is a tetrahedral structure in which all C-atoms are bonded by 4 σ - bond with neighbouring C-atoms. So, the hybridisation of diamond is sp^3. The percentage of p-character is 75%.

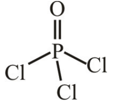
74. The state of hybridization of the central atom and the number of lone pairs over the central atom in $POCl_3$ are

(a) sp,0 (b) sp^2,0

(c) sp^3,0 (d) dsp^2,1

WB-JEE-2012

Ans. (c) : The structure of $POCl_3$ is



The state of hybridisation of the central atom is sp^3 and the number of lone pairs is zero.

75. The hybrid state of C in charcoal is–

(a) sp^3 (b) sp^2

(c) sp (d) No specific state

BCECE-2011

Ans. (d) : Charcoal is an amorphous form of carbon. Thus, the hybrid state of C in charcoal is not specific.

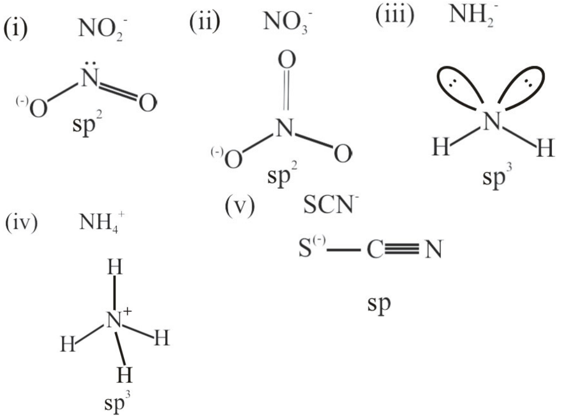
76. Which of the two ions from the list given below that have the geometry that is explained by the same hybridization of orbitals, NO_2^-, NO_3^-, NH_2^-, NH_4^+, SCN^-?

(a) NO_2^- and NO_3^- (b) NH_4^+ and NO_3^-

(c) SCN^- and NH_2^- (d) NO_2^- and NH_2^-

NEET-2011

Ans. (a) : The following in have the structure



Since, both ions NO_2^- and NO_3^- have the same Hybridisation. When compared to all ions. The Hybridisation is sp^2 in NO_2^- and NO_3^-.

77. Which of the following statements is/are true about the P–Cl bonds in PCl_5?

(a) Three bonds are of one type and two of another type

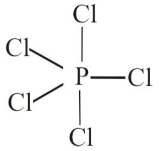
(b) Two bonds are of one type and three of another type

(c) All the bonds are of the same type

(d) Each P–Cl bonds is unique

UPTU/UPSEE-2011

Ans. (a) : In PCl_5 Structure is



@apna_pdf

In PCl_5 , three bonds are one type is equitorial bond and two of another type is Axial bond.
Hence, option (a,b) both are correct.

78. The sp^3d^2 hybridization of central atom of a molecule would lead to.
(a) Square planar geometry
(b) Tetrahedral geometry
(c) Trigonal bipyramidal geometry
(d) Octahedral geometry

WB-JEE-2011

Ans. (d) : The sp^3d^2 hybridisation of central atom of a molecule would lead to octahedral geometry. In sp^3d^2 orbital one s-orbital, three p-orbital and two d-orbital i.e. d_{z^2} and $d_{x^2-y^2}$ are intermixed to form a new 6 new sp^3d^2 hybrid orbital.

79. In CO_2, CH_4 and CH_3^+ the hybridisation of carbon atoms are
(a) sp^2, sp^3 and sp^2 respectively
(b) sp, sp^3 and sp^2 respectively
(c) sp, sp^3 and sp respectively
(d) sp^2, sp^3 and sp respectively

J & K CET-(2010)

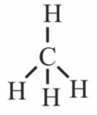
Ans. (b) :

(i) CO_2

$O=C=O$

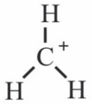
sp(linear)

(ii) CH_4



sp^3 (tetrahedral)

(iii) CH_3^+



sp^2(trigonal planar)

In CO_2 , CH_4 and CH_3^+, the hybridisation of carbon atom are sp, sp^3 and sp^2 respectively.

80. The AsF_5 molecule is trigonal bipyramidal. The hybrid orbitals used by the As atoms for bonding are
(a) $d_{x^2-y^2}, d_{z^2}, s, p_x, p_y$
(b) d_{xy}, s, p_x, p_y, p_z
(c) $s, p_x, p_y, p_z, d_{z^2}$
(d) $d_{x^2-y^2}, s, p_x, p_y$

JCECE - 2010

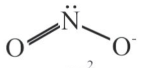
Ans. (c) : The geometry of AsF_5 molecule is trigonal bipyramidal, it is sp^3d hybridised. Thus, s, p_x, p_y, p_z and d_{z^2} orbitals are utilised by As atom for bonding.

81. In which of the following pairs of molecules/ ions, the central atoms have sp^2 hybridisation?
(a) NO_2^- and NH_3
(b) BF_3 and NO_2^-
(c) NH_2^- and H_2O
(d) BF_3 and NH_2^-

NEET-2010

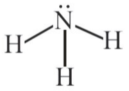
Ans. (b) :

(i) NO_2^-



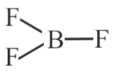
sp^2

(ii) NO_3



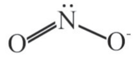
sp^2

(iii) BF_3



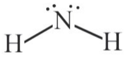
sp^2

(iv) NO_2^-



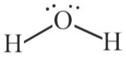
sp^2

(v) NH_2^-



sp^3

(vi) H_2O



sp^3

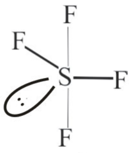
Since, BF_3 and NO_2^- molecules have sp^2 hybridized central atoms.

82. In which one of the following species the central atom has the type of hybridization which is not the same as that present in the other three?
(a) SF_4
(b) I_3^-
(c) $SbCl_5^{2-}$
(d) PCl_5

NEET-2010

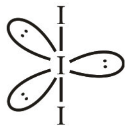
Ans. (c) : The structure of the molecule is-

(i) SF_4



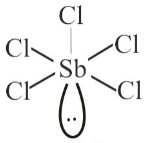
sp^3d

(ii) I_3^-



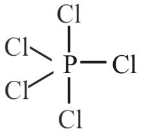
sp^3d

(iii) $SbCl_5^{2-}$



sp^3d^2

(iv) PCl_5



sp^3d

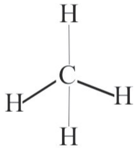
Hence, $SbCl_5^{2-}$ has sp^3d^2 hybridisation which is not same as the other three species.

83. In which of the following molecules the central atom does not have sp^3 hybridization?
(a) CH_4
(b) SF_4
(c) BF_4^-
(d) NH_4^+

NEET-2010

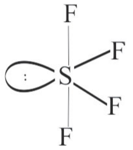
Ans. (b) : The structure of the following compound-

(i) CH_4



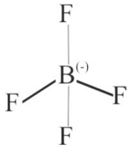
sp^3

(ii) SF_4



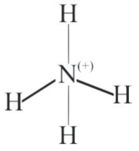
sp^3d

(iii) BF_4^-



sp^3

(iv) NH_4^+



sp^3

In SF_4 has sp^3d hybridisation other has sp^3 hybridisation.

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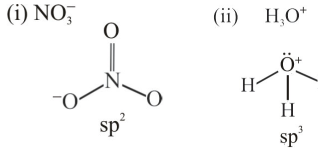
84. Some of the properties of the two species, NO_3^- and H_3O^+ are described below. Which one of them is correct?

(a) Dissimilar in hybridization for the central atom with different structures
(b) Isostructural with same hybridization for the central atom.
(c) isostructural with different hybridization for the central atom.
(d) Similar in hybridization for the central atom with different structures.

NEET-2010

Ans. (a) :


(i) NO3−
O
N
−O
O
sp2
(ii) H3O+
O+
H
H
H
sp3

In NO_3^- and H_3O^+ has dissimilar in hybridization.

sp^2 hybridasition in NO_3^- and sp^3 hybridisation in H_3O^+ with the different structures.

85. The compound which is non-linear :

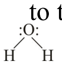
(a) CO_2
(b) CS_2
(c) $HgCl_2$
(d) H_2O

MPPET- 2009

Ans. (d) : The shape of a molecules depends on the number of lone pairs and bond pairs present around the central atom.

CO_2, CS_2 and $HgCl_2$ is a linear and sp hybridisation but H_2O is V- shaped structure.

- In H_2O the central atom oxygen is sp^3 hybridized. Oxygen has 2 bond pairs and 2 lone pairs, so the geometry is tetrahedral. The shape of H_2O is bent due to the presence of 2 lone pairs.

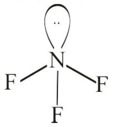
 therefore, H_2O is not linear molecule.

86. Hybridisation of central atom in NF_3 is

(a) sp^3
(b) sp
(c) sp^2
(d) dsp^2

WB-JEE-2009

Ans. (a) : The structure of NF_3 is



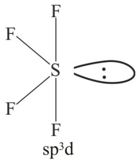
The structure of NF_3 is pyramidal and hybridization is sp^3.

87. The state of hybridization of S in SF_4 is

(a) sp^3 and has a lone pair of electron
(b) sp^2 and has tetrahedral structure
(c) sp^3d and has a trigonal bipyramidal structure
(d) sp^3d^2 and has an octahedral structure.

AMU – 2009

Ans. (c) : The structure of SF_4 is–



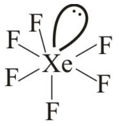
The state of hybridization of SF_4 is sp^3d and has a trigonal bipyamidal structure.

88. In XeF_6 oxidation state and state of hybridisation of Xe, and shape of the molecule are, respectively

(a) +6, sp^3d^3, distroted octahedral
(b) +4, sp^3d^2, square planar
(c) +6, sp^3, pyramidal
(d) +6, sp^3d^2, square pyramidal.

AMU – 2009

Ans. (a) : The structure of XeF_6 is–



Distorted Octahedral

Oxidation state of XeF_6 has

$$x + 6(-1) = 0$$
$$x = +6$$

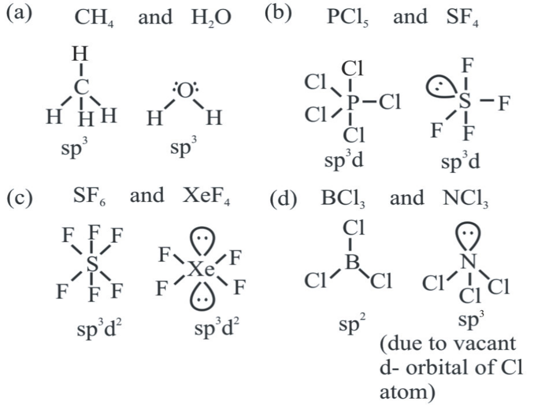
and hybridization XeF_6 is sp^3d^3

89. In which of the following pairs both molecules do not possess same type of hybridisation?

(a) CH_4 and H_2O
(b) PCl_5 and SF_4
(c) SF_6 and XeF_4
(d) BCl_3 and NCl_3

CG PET -2009

Ans. (d) : The structure of following molecule–

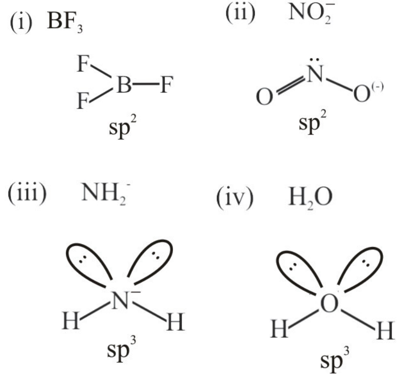

(a) CH4 and H2O
(b) PCl5 and SF4
H
C
H H H
sp3
O
H H
sp3
Cl
Cl
P
Cl
Cl
Cl
sp3d
F
S
F
F
F
sp3d
(c) SF6 and XeF4
(d) BCl3 and NCl3
F F F
S
F F F
sp3d2
F
Xe
F
F
F
sp3d2
Cl
B
Cl
Cl
sp2
N
Cl
Cl
Cl
sp3
(due to vacant d- orbital of Cl atom)

90. In which of the following molecules/ions BF_3, NO_2^-, NH_2^- and H_2O, the central atom is sp^2 hybridised?

(a) NH_2^- and H_2O
(b) NO_2^- and H_2O
(c) BF_3 and NO_2^-
(d) NO_2^- and NH_2^-

NEET-2009

Ans. (c) : The structure of the following molecules are-


(i) BF3
(ii) NO2−
F
B
F
F
sp2
N
O
O(-)
sp2
(iii) NH2−
(iv) H2O
N−
H
H
sp3
O
H
H
sp3

Hence, BF_3 and NO_2^- has sp^2 hybridisation.

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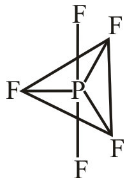
91. Hybridization of the central atom in PF_5 involves the mixing of atomic orbitals

(a) d_{xy}, s, p_x, p_y, p_z (b) s, p_x, p_y, p_z, d_{z^2}

(c) $d_{x^2-y^2}$, s, p_x, p_y, p_z (d) s, p_x, p_y, p_z, $d_{x^2-y^2}$

AMU – 2008

Ans. (b) :



Trigonal bipyramidal structure (sp^3d)

PF_5 molecule has tringonal bipyramidal geometry and all the bond angles in triagonal bipyramidal geometry are not equvalent. The hybridised orbitals involved are

s + 3p + d
s (p_x, p_y, p_z) (d_{z^2})

92. An octahedral complex is formed when hybrid orbitals of the following type are involved

(a) sp^3 (b) dsp^2

(c) d^2sp^3 (d) sp^2d^2

KARNATAKA-CET, 2008

Ans. (c) :

Hybridisation	**Geometry of Complex**
sp^3	tetrahedral
dsp^2	square planar
d^2sp^3	octahedral
sp^2d^2	not possible

93. Which of the following is not tetrahedral?

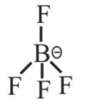
(a) BF_4^- (b) NH_4^+

(c) CO_3^{2-} (d) SO_4^{2-}

AP EAMCET (Engg.) -2007

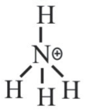
Ans. (c) : The structure of the following molecules are–

(i) For BF_4^-



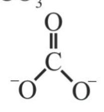
Tetrahedral

(ii) NH_4^+



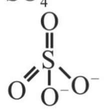
Tetrahedral

(iii) CO_3^{2-}



Trigonal planar

(iv) SO_4^{2-}



Tetrahedral

Hence, the CO_3^{2-} is not tetrahedral.

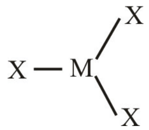
94. If a molecule MX_3 has the dipole moment zero, then the sigma (σ) bonding orbitals used by M(Z < 21) is

(a) sp^2-hybridised (b) pure p-orbitals

(c) sp^3-hybridised (d) sp-hybridised.

SRMJEEE – 2007

Ans. (a) : The molecule MX_3 has zero dipole moment, the σ-bonding orbitals used by M (Z < 21) are sp^2 hybridized. In this case, planar triangular geometry results in the cancellation of the dipole moments of individual M–X bonds.



95. Assertion (A) : CO_2 is linear

Reason (R) : It is not in sp-hybridized state

The correct answer is

(a) Both (A) and (R) are true and (R) is the correct explanation of (A)

(b) Both (A) and (R) are true but (R) is not the correct explanation of (A)

(c) (A) is true and (R) is not true

(d) (A) is not true and (R) is true

AP - EAMCET (Medical) - 2007

Ans. (c) : CO_2 is linear because it has sp hybridisation. The structure of CO_2 is–

$$\ddot{O}=C=\ddot{O}$$

Hybridization = Bond pair + Lone pair

Hybridization = 2 + 0 = 2(sp) (linear)

It is sp hybridized which is illustrated above.

96. The hybridisation state of carbon in fullerene is

(a) sp (b) sp^2

(c) sp^3 (d) sp^3d

JCECE - 2007

Ans. (b) : In fullerene, all the carbon atoms are equal. Fullerene consists of 20 hexagonal and 12 pentagonal rings as the basis of an icosahedral symmetry closed cage structure. Each carbon atom is bonded to three others and the hybridization is sp^2. Fullerenes are the third allotropic form of carbon after graphite and diamond.

97. Which of the following set of properties belongs to PCl_5?

(a) sp^3, tetrahedral, 4 valence shell pairs of electrons

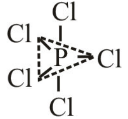
(b) sp^3d, trigonal bipyramidal, 5 valence shell pairs of electrons

(c) sp^3d^2, octahedral, 6 valence shell pairs of electrons

(d) sp^3d, square planar, 4 valence shell pairs of electrons

J & K CET-(2006)

Ans. (b) : The geometry of PCl_5 is trigonal bipyramidal



In PCl_5 molecule has sp^3d hybridisation. Its geometry is trigonal bipyramidal and it has 5 valence shell pairs of electrons.

98. In SO_2 hybridisation is :

(a) sp (b) sp^3

(c) dsp^2 (d) sp^2

JCECE - 2006

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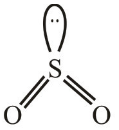
Ans. (d) : In SO_2 hybridisation is sp^2



sp^2 (V-shaped)

Hybridisation of SO_2 = Bond pair + lone pair
= 2 + 1
= 3 (sp^2)

99. Consider the following molecules or ions:

(i) H_2O **(ii) NH_4^+**
(iii) SO_4^{2-} **(iv) ClO_4^-**
(v) NH_3

sp^3 hybridization is involved in the formation of:

(a) (i), (ii), (v) only
(b) (i), (ii) only
(c) (ii) only
(d) (i), (ii), (iii), (iv) Only
(e) (i), (ii), (iii), (iv) and (v)

Kerala-CEE-2006

Ans. (e) :

Molecule/ion	**Hybridisation**
H_2O	sp^3
NH_4^+	sp^3
SO_4^{2-}	sp^3
ClO_4^-	sp^3
NH_3	sp^3

100. The correct order regarding the electronegativity of hybrid orbitals of carbon is

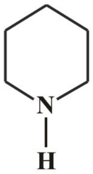
(a) $sp < sp^2 < sp^3$ (b) $sp > sp^3 > sp^2$
(c) $sp > sp^2 > sp^3$ (d) $sp < sp^2 > sp^3$

NEET-2006

Ans. (c) : The electronegativity of hybrid orbitals of carbon is depend on the s-character percentage s-character is increase then the electronegativity is increase percentage s-character in sp, sp^2 and sp^3 are 50%, 33.3%, and 25% respectively.

Hence, the electronegativity of hybrid carbon is
$sp > sp^2 > sp^3$

101. In piperidine



, the hybrid state assumed by N is

(a) sp (b) sp^2
(c) sp^3 (d) dsp^2

BITSAT 2005

Ans. (c) : Hybridisation of N = $\frac{1}{2}[5 + 3 + 0 - 0]$
= 4 (sp^3)

Or Hybridisation = Bond pair + Lone pair
= 3 + 1
= 4 (sp^3)

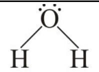
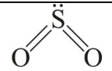
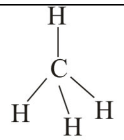
So, the hybridisation of piperidine is sp^3.

102. Which of the following is a linear molecule ?

(a) $BeCl_2$ (b) H_2O
(c) SO_2 (d) CH_4

AP-EAMCET/2005

Ans. (a):

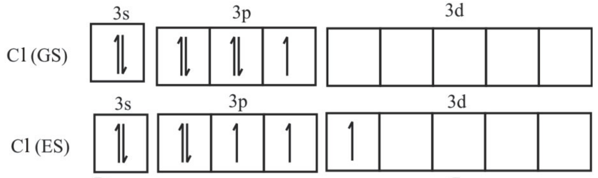
Molecule	**Structure**	**Hybridization /Shape**
$BeCl_2$	Cl–Be–Cl	sp(Linear)
H_2O		sp^3(V-shaped)
SO_2		sp^2(Angular)
CH_4		sp^3(Tetrahedral)

103. Hybridization present in ClF_3 is

(a) sp^2 (b) sp^3
(c) dsp^2 (d) sp^3d

UP CPMT-2005

Ans. (d) : The configuration of chlorine to find hybridisation.



sp^3d hybridisation

∴ ClF_3 has sp^3d hybridisation and T-shaped geometry (due to presence of two lone pairs electrons).

104. Hybridisation involves

(a) Addition of an electron pair
(b) Mixing up of atomic orbitals
(c) Removal of an electron pair
(d) Separation of orbitals

CG PET -2004

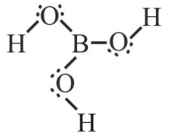
Ans. (b) : Hybridisation is defined as the mixing of atomic orbitals to form new hybrid orbitals with same energies, same shape etc. there is minimum repulsion between these hybridized orbital's.

105. The states of hybridisation of boron and oxygen atoms in boric acid (H_3BO_3) are respectively

(a) sp^2 and sp^2 (b) sp^2 and sp^3
(c) sp^3 and sp^2 (d) sp^3 and sp^3

(AIEEE-2004)

Ans. (b) : The structure of boric acid (H_3BO_3) is –



The hybridisation of boron is sp^2 and hybridization of oxygen is sp^3. Boric acid (H_3BO_3) is triangular planar structure.

106. The maximum number of 90° angles between bond pair-bond pair of electrons is observed in

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(a) dsp^3 hybridisation (b) sp^3d hybridisation
(c) dsp^2 hybridisation (d) sp^3d^2 hybridisation

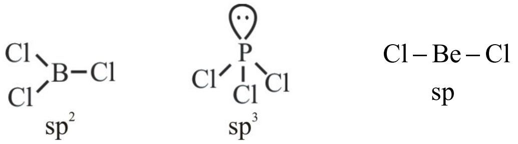
(AIEEE-2004)

Ans. (d) : sp^3d^2 hybridisation has octahedral geometry 90° angles between bond pair-bond pair of electrons. This molecule is made up of 6 equally spaced sp^3d^2 hybrid orbital's arranged at 90° angles.
In square pyramidal geometry contains five bond pair and one lone pair of electrons. Thus square pyramidal geometry contains four bond has 90°.

107. Which of the following has sp^3–hybridization?
(a) BCl_3 (b) PCl_3
(c) $BeCl_2$ (d) None of these

JIPMER-2004

Ans. (b) : The structure the following-
(i) BCl_3 (ii) PCl_3 (iii) $BeCl_2$



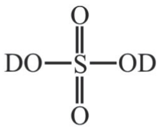
Hence, PCl_3 molecule has sp^3 hybridsation.

108. Sulphur trioxide is dissolved in heavy water to form a compound X. The hybridization state of sulphur in X is
(a) sp^2 (b) sp^3
(c) sp (d) dsp^2

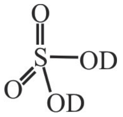
AP EAMCET- 2003

Ans. (b) : When sulphur trioxide is dissolved in heavy water then form the D_2SO_4.

$$SO_3 + D_2O \longrightarrow \underset{'X'}{D_2SO_4} \equiv$$



Hybridization = Bond Pair + Lone pair
= 4 + 0 = 4 (sp^3)



109. What is the number of free electrons present on each carbon atom in graphite?
(a) Zero (b) 3
(c) 2 (d) 1

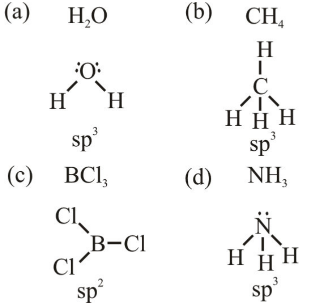
AP-EAMCET (Medical), 2003

Ans. (d) : Graphite has a two dimensional structure. In this case, only three of the four valence electron of each carbon atom are involved in bonding. Thus, each carbon atom make use of sp^2-hybrid orbitals.
Hence, the fourth valence of each carbon atom remains unsatisfied i.e. the fourth valence electrons remains unpaired or free. This free electron can easily move from one carbon to another under the influence of applied potential. So, in structure of graphite only one electron is free on each carbon atom.

110. sp^3-hybridisation is not found in :
(a) H_2O (b) CH_4
(c) BCl_3 (d) NH_3

BCECE-2003

Ans. (c) : The structure of the compound is-

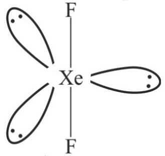


Hence, the option (c) has not sp^3 hybridisation.

111. Which one of the following is a correct pair with respect to molecular formula of Xenon compound and hybridization state of xenon in it?
(a) XeF_4, sp^3 (b) XeF_2, sp
(c) XeF_2, sp^3d (d) XeF_4, sp^2

AP EAMCET- 2002

Ans. (c) : Xenon difluoride has the two bond pair and three lone pair due to which they have sp^3d hybridization with linear shape.



sp^3d(linear)

113. The hybridisation present IF_3 is
(a) sp^3d (b) sp^3
(c) sp^3d^2 (d) sp^3d

UP CPMT-2002

Ans. (a) :

Species	Bond pair + Loan pair	Hybridisation
CO_2	2	sp
BCl_3	3	sp^2
CH_4	4	sp^3
IF_3	3 + 2	sp^3d

114. Hybridisation of the underline atom changes in
(a) $\underline{Al}H_3$ changes to AlH_4^-
(b) $H_2\underline{O}$ changes to H_3O^+
(c) NH_3 changes to NH_4^+
(d) In all cases

(AIEEE-2002)

Ans. (a) :

(a) $AlH_3 \xrightarrow{H^+} AlH_4^-$
sp^2 sp^3

(b) $H_2O \xrightarrow{O} H_3O^+$
sp^3 sp^3

(c) $NH_3 \xrightarrow{H^+} NH_4^+$
sp^3 sp^3

Thus, the hybridization of the underline atom AlH_3 changes to AlH_4^-.

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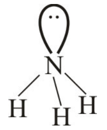
115. What is the hybridization state of the central atom in the conjugate base of NH_4^+ ion?

(a) sp (b) sp^3

(c) sp^2 (d) d sp^2

AP-EAMCET/2002

Ans. (b): The conjugate base of NH_4^+ is NH_3 because it donates an H^+ ion to the water. It then becomes ammonia (NH_3) which would be the conjugate base of NH_4^+.



The central atom of NH_3 is N and its hybridization state is sp^3.

116. Which compound has planar structure?

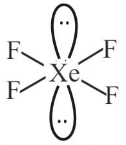
(a) XeF_4 (b) $XeOF_2$

(c) XeO_2F_2 (d) XeO_4

(NEET-2000)

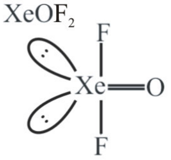
Ans. (a) : The structure of the compound is-

(i) XeF_4



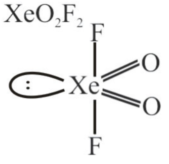
Square planar (sp^3d^2)

(ii) $XeOF_2$

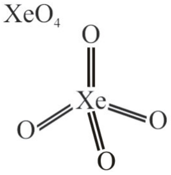


T- shaped (sp^3d)

(iii) XeO_2F_2



(iv) XeO_4



Sew-saw (sp^3d) Tetrahedral (sp^3)

117. When the hybridisation state of carbon atom changes from sp^3 to sp^2 and finally to sp, the angle between the hybridised orbitals

(a) decreases gradually

(b) decreases considerably

(c) is not affected

(d) increases progressively.

NEET-1993

Ans. (d) : When the hybridisation state of carbon atom changes from sp^3 to sp^2 and finally to sp, the angle between the hybridised orbitals increase progressively. The bond angles in sp^3 hybridisation is 109°, sp^2 is 120° and sp hybridisation is 180° respectively.

118. Linear combination of two hybridised orbitals belonging to two atoms and each having one electron leads to the formation is

(a) Sigma bond

(b) Double bond

(c) Co-ordinate covalent bond

(d) Pi bond

NEET-1990

Ans. (a) : Linear combinations of two hybridized orbitals belonging to two atoms and each having one electron leads to the formation is sigma bond.

119. In which one of the following molecules the central atom can be said to adopt sp^2 hybridization?

(a) BeF_2 (b) BF_3

(c) C_2H_2 (d) NH_3

NEET-1989

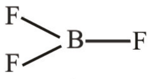
Ans. (b) : The structure of the following compound-

[i] BeF_2

F—Be—F

sp

[ii] BF_3



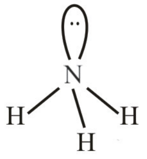
sp^2

[iii] C_2H_2

H—C≡C—H

sp sp

[iv] NH_3



sp^3

So, the molecules BF_3 has sp^2 hybridisation.

120. Equilateral shape has

(a) sp hybridization (b) sp^2 hybridization

(c) sp^3 hybridization (d) dsp^3 hybridization

NEET-1988

Ans. (b) : Atomic orbital are mixed with formed a new hybridised orbital, in sp^2 hybridisation, one s- orbital and two p- orbital overlap each other to form hybridised sp^2 orbital. In sp^2, p- character is 67% and s- character is 33% in triangular planar structure minimize the maximum repulsion and have energetically stable geometrical structure. Thus the equilateral shape has sp^2 hybridization.

2. Vsepr Theory

121. Given below are two statements: one is labeled as Assertion (A) and the other is labelled as Reason (R).

Assertion (A): ICI is more reactive than I_2.

Reason (R): I-Cl bond is weaker than I-I bond

In the light of the above statements choose the most appropriate answer from the options given below:

(a) Both (A) and (R) are correct but (R) is not the correct explanation of (A).

(b) (A) is correct but (R) is not correct

(c) (A) is not correct but (R) is correct

(d) Both (A) and (R) are correct but (R) is the correct explanation of (A)

NEET-17.07.2022

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Ans. (d) : Inter halogen compound are more reactive than halogen compound and they break easily due to weak bond. Therefore, I-Cl is more reactive than I_2 because of weaker I-Cl bond then I-I bond.
Both A and R are true and R is correct explanation of A

122. Based upon VSEPR theory, match the shape (geometry) of the molecules in List-I with the molecules in List – II and select the most appropriate option.

	List – I (Shape)		**List – II (Molecules)**
(A)	**T-shaped**	**(I)**	**XeF_4**
(B)	**Trigonal planar**	**(II)**	**SF_4**
(C)	**Square planar**	**(III)**	**ClF_3**
(D)	**See-saw**	**(IV)**	**BF_3**

(a) (A)-(I), (B)-(II), (C)-(III), (D)-(IV)
(b) (A)-(III), (B)-(IV), (C)-(I), (D)-(II)
(c) (A)-(III), (B)-(IV), (C)-(II), (D)-(I)
(d) (A)-(IV), (B)-(III), (C)-(I), (D)-(II)

JEE Main-27.06.2022, Shift-I

Ans. (b) :

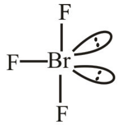
List-I (Molecules)	**List-II (Shape)**
XeF_4	Square planar
SF_4	See - Saw.
ClF_3	T - shaped
BF_3	Trigonal planar

123. Number of lone pair(s) of electrons on central atom and the shape of BrF_3 molecule respectively, are

(a) 0, triangular planar
(b) 1, pyramidal
(c) 2,bent T-shape
(d) 1, bent T-shape

JEE Main-29.06.2022, Shift-II

Ans. (c) : The structure of the BrF_3 is -



Bent T-shape

In BrF_3, two lone pair of electron on central atom and the shape of molecule is bent T-shape.

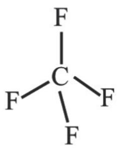
124. Pair of species having identical shape for molecule is:

(a) CF_4, SF_4
(b) BF_3, PCl_3
(c) XeF_2, CO_2
(d) PF_5, IF_5

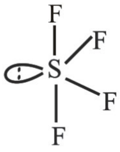
CG PET-22.05.2022

Ans. (c) : The structure of the following molecule are-

(i) CF_4 , SF_4

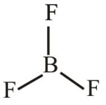


Tetrahedral

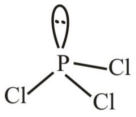


Sec-saw

(ii) BF_3 , PCl_3

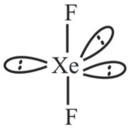


Trigonal planar



Pyramidal

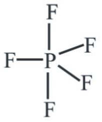
(iii) XeF_2, CO_2



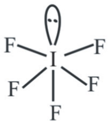
linear

linear

(iv) PF_5 , IF_5



Trigonal bipyramidal



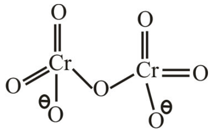
Square Pyramidal

125. In the dichromate dianion $(Cr_2O_7)^{2-}$

(a) 4 Cr – O bonds are equivalent
(b) 6 Cr – O bonds are equivalent
(c) All Cr – O bonds are equivalent
(d) All Cr – O bonds are not equivalent

CG PET-22.05.2022

Ans. (b) : The structure of the dichromate dianion $(Cr_2O_7)^{2-}$ is -



In dichromate dianion $(Cr_2O_7)^{2-}$ has 6 Cr – O bonds are equivalent due to resonance.

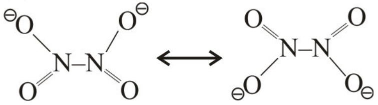
126. Among the given oxides of nitrogen; N_2O, N_2O_3, N_2O_4 and N_2O_5 the number of compound/(s) having N – N bond is :

(a) 1 (b) 2 (c) 3 (d) 4

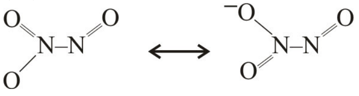
JEE Main-28.06.2022, Shift-II

Ans. (c) : (i) $N_2O \Rightarrow \bar{N} = \overset{+}{N} = O \leftrightarrow N \equiv \overset{+}{N} - \bar{O}$

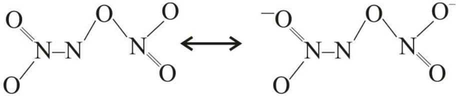
(ii) $N_2O_4 \Rightarrow$



(iii) $N_2O_3 \Rightarrow$



(iv) $N_2O_5 \Rightarrow$



Hence, the number of compound having N – N bond is 4.

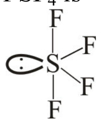
@apna_pdf

127. In the structure of SF_4 the lone pair of electrons on S is in.

(a) Equatorial position and there are two lone pair-bond pair repulsion at 90°
(b) Equatorial position and there are three lone pair bond pair repulsion at 90°
(c) Axial position and there are three lone pair-bond pair repulsion at 90°
(d) Axial position and there are two lone pair bond pair repulsion at 90°

JEE Main-28.06.2022, Shift-II

Ans. (a) : In structure of SF_4 is



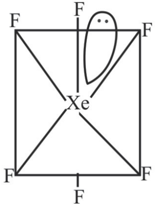
Lone pair at equatorial position with two lone pair – bond pair repulsion at 90.

128. The shape of XeF_6 is

(a) Pentagonal bipyramidal
(b) Square planar
(c) Octahedral
(d) Distorted octahedral

WB JEE-2014
JIPMER-2011
Karnataka CET-2016
AP- EAMCET(Medical) -2010
AMU-2007, 2004, 2003

Ans. (d): For XeF_6, the hybridization will be-
hybridization = lone pair +bond pair
hybridization = 1+6 =7 (sp^3d^3)



Due to one lone pair, the geometry of XeF_6 will be distorted octahedral.

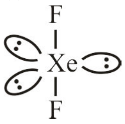
129. In XeF_2, XeF_4, XeF_6 the number of lone paris on Xe are respectively

(a) 2, 3, 1
(b) 1, 2, 3
(c) 4, 1, 2
(d) 3, 2, 1

BITSAT-2021, AMU-2015
Assam CEE-2014, AIEEE-2011, 2002

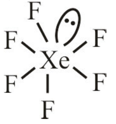
Ans. (d) : The structure of the following is –

(i) XeF_2



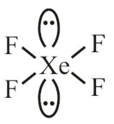
2 bond pair + 3 lone pair

(iii) XeF_6



6 bond pair + 1 lone pair

(ii) XeF_4



4 bond pair + 2 lone pair

In XeF_2, XeF_4 and XeF_6, the number of lone pairs on Xe are 3, 2, 1 respectively.

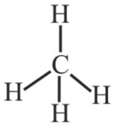
130. In which molecule are all atoms coplanar?

(a) CH_4 (b) BF_3 (c) PF_3 (d) NH_3

WB JEE-2016, JIPMER-2007
CG PET -2005, J&K CET-2001, 1999

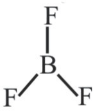
Ans. (b) : The molecule which have in same plane is called coplanar.

(i) CH_4



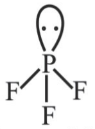
(Td)

(ii) BF_3



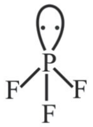
(Planar)

(iii) PF_3



(Pyramidal)

(iv) NH_3



(linear)

In BF_3 has trigonal planar structure it is coplanar all atom. Other are non planar.

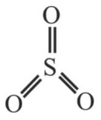
131. The species having pyramidal shape among the following is

(a) SO_3 (b) NO_3^- (c) $PC\ell_3$ (d) CO_3^{2-}

(JEE Main 2021, 27 Aug. Shift-II)
JIPMER-2007
JCECE-2006
J&K CET-1998

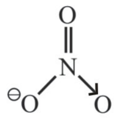
Ans. (c) : The structure of the following molecule are

(i) SO_3



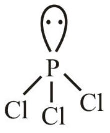
Trigonal planar

(ii) NO_3^-



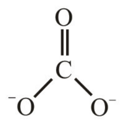
Trigonal planar

(iii) ACl_3



Pyramidal

(iv) CO_3^{2-}



Trigonal planar

So, the PCl_3 molecule has pyramidal shape.

132. Molecular shapes of SF_4, CF_4 and XeF_4 and the number of lone pairs on the central atom are respectively

(a) the same, with 1,2 and 1
(b) the same, with 1, 0 and 1
(c) different, with 0, 1 and 2
(d) different, with 1, 0 and 2
(e) the same, with 0, 0 and 1

Kerala-CEE-2013, 2004
JCECE - 2008
UPTU/UPSEE-2007
(AIEEE-2005)

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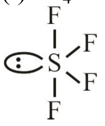
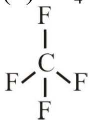
Ans. (d) : The structure of the following are –

(i) SF_4



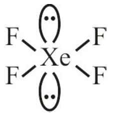
1 lone pair +
4 bond pair
(See-saw)

(ii) CF_4



0 lone pair +
4 bond pair
(Tetrahedral)

(iii) XeF_4



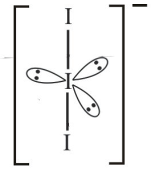
2 lone pair +
4 bond pair
(Square planar)

133. The number of lone pairs of electrons possessed by the central atom in the anionic species I_3^- is

(a) one (b) two
(c) three (d) all are bond pairs.

AMU – 2008
(JEE Main 2021, 20 July Shift-I)
MHT CET-2012, JCECE - 2011

Ans. (c) : There are two bond pairs and three lone pairs in the outer shell of central atom.

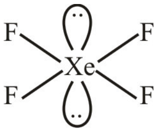


134. Shape of XeF_4 molecule is :

(a) Pyramidal (b) Square Planar
(c) Triangular Planar (d) Linear

HP CET-2018, AMU-2015
J&K CET-2005
AIIMS-1998

Ans. (b): The shape of XeF_4 is square planer. In Xe, four fluorine atom is bonded by σ bond and two lone pairs is present. The hybridisation of XeF_4 is sp^3d^2.
Shape of XeF_4 molecule.



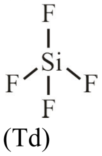
135. Among the following, the pair in which the two species are not isostructure, is

(a) SiF_4 and SF_4 (b) IO_3^- and XeO_3
(c) BH_4^- and NH_4^+ (d) PF_6^- and SF_6

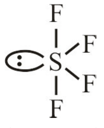
AMU-2016
UPTU/UPSEE-2007
NEET-2004

Ans. (a) : The structure of the following species –

(a) SiF_4 and SF_4

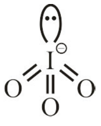


(Td)

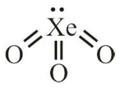


(see-saw)

(b) IO_3^- and XeO_3

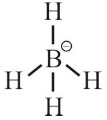


(Pyramidal)

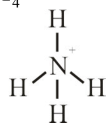


(Pyramidal)

(c) BH_4^- and NH_4^+

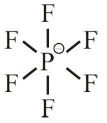


(Td)

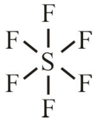


(Td)

(d) PF_6^- and SF_6



(Oh)



(Oh)

Hence, the SiF_4 and SF_4 are not iso-structural.

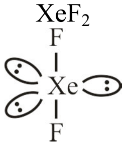
136. Which of the following pairs is iso-structural?

(a) XeF_2, IF_2^- (b) NH_3,BF_3
(c) CO_3^{2-} , SO_3^{2-} (d) PCl_5,ICl_5

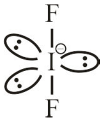
Tripura JEE-2019
AIEEE-2003
NEET-2001

Ans. (a) : The following pairs are iso-structural.

XeF_2



Linear



Linear

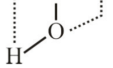
In XeF_2 and IF_2^- both pair have iso-structural shape i.e linear and geometry is trigonal bipyramidal. The hybridisation of pair of species is sp^3d.

137. The structure of H_2O_2 is

(a) planar (b) non-planar
(c) spherical (d) linear

AMU-2013, JCECE - 2005, NEET-2003

Ans. (b) : The structure of H_2O_2 is non-planar. One O – O bond lying in a plane and two O – H bonds lying in different plane. H_2O_2 has open book type structure.

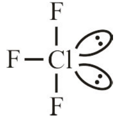


138. The shape of ClF_3 molecule is

(a) triangular planar (b) pyramidal
(c) T-shape (d) trigonal bipyramidal

Kerala CEE-2016, BCECE-2011
J&K CET-2010

Ans. (c) : The shape of ClF_3 is T-shaped.



In ClF_3 has 3 bond pair and two lone pair. The hybridisation is sp^3d. The shape is trigonal bipyramidal but two lone pairs repel to each other the shape became T-shape.

139. Which of the following statements is/are true?

1. **PH_5 and $BiCl_5$ do not exist.**
2. **pπ – dπ bond is present in SO_2.**
3. **I_3^+ has bent geometry.**
4. **SeF_4 and CH_4 have same shape.**

@apna_pdf

(a) 1, 2, 3 (b) 1, 3
(c) 1, 3, 4 (d) 1, 2, 4

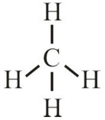
NEET-II-2016
BITSAT 2010

Ans. (a) : (i) PH_5 and $BiCl_5$ do not exist due to 'H' is less electronegative, so it can't exrt charge contraction in 'p'. Hence, it does not extend its valency to 5.

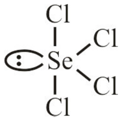
(ii) pπ – dπ bond is present in SO_2 due to sulphur is belong to 3rd period element.

(iii) I_3^+ has bent geometry.

(iv) CH_4 has tetrahedral and $SeCl_4$ has see-saw shape.



sp^3 (Td)

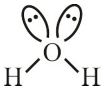


see-saw

140. The shape of water molecule according to VSEPR theory, is
(a) octahedral
(b) distorted tetrahedral
(c) trigonal planar
(d) trigonal bipyramidal

MHT CET-2018
CG PET -2008

Ans. (b) : The shape of water molecule according to the VSEPR theory is distorted tetrahedral due to in water molecule two lone pair are present and repeal to each other.



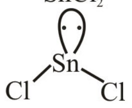
Distorted tetrahedral

141. CO_2 in isostructural with
(a) $SnC1_2$ (b) SO_2
(c) $HgC1_2$ (d) All of these

CG PET -2005
NEET-1992

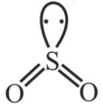
Ans. (c) : CO_2 is a linear molecule which has sp hybridisation. The given compound are –

(i) $SnCl_2$



V–Shaped

(ii) SO_2



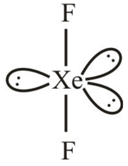
V–Shaped

(iii) H_gCl_2
Cl—Hg—Cl
liner

142. XeF_2 is isostructural with :
(a) ICl_2^- (b) $SbCl_3$
(c) $BeCl_2$ (d) TeF_2

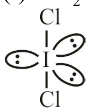
Manipal-2019
NEET-2013

Ans. (a) : The structure of XeF_2 is



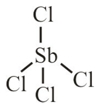
Trigonal bipyramidal (sp^3d)

(i) ICl_2^-



Trigonal bipyramidal (sp^3d)

(ii) $SbCl_3$



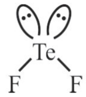
Trigonal planar (sp^2)

(iii) $BeCl_2$

Cl – Be – Cl

Linear (sp)

(iv) TeF_2



V-shaped (sp^3)

143. Shape and hybridisation of SO_2 are
(a) V shape, sp^3 (b) triangular planar, sp^2
(c) V shape, sp^2 (d) tetrahedral, sp^3

UP CPMT-2012, 2010

Ans. (c): In SO_2, the number of hybrid orbitals

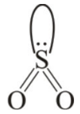
$$H = \frac{1}{2}[V + Y - C + A]$$

Where, V = number of valence electrons
Y = monovalent species
C and A = positive and negative charge over species

$$\therefore \quad H = \frac{1}{2}[6 + 0 - 0 + 0] = 3$$

Thus, hybridization is sp^2.

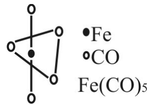
Since, SO_2 contains one lone pair of electrons its geometry becomes V shape.



144. The shape of $Fe(CO)_5$ molecule is
(a) octaheral (b) trigonal bipyramidal
(c) trigonal (d)tetrahedral.

AMU-2004, BCECE-2012

Ans. (b) : The shape of $Fe(CO)_5$ molecule is trigonal bipyramidal.



Hybridised orbitals: dsp^3

145. Which one of the following conversion involve change in both by hybridisation and shape?
(a) $CH_4 \longrightarrow C_2H_6$ (b) $NH_3 \longrightarrow NH_4^+$
(c) $BF_3 \longrightarrow BF_4^-$ (d) $H_2O \longrightarrow H_3O^+$

Karnataka CET-2015
BCECE-2014

Ans. (c) : $\underset{sp^3}{CH_4} \rightarrow \underset{sp^3}{C_2H_6}$

CH_4 and C_2H_6 both have sp^3 hybridisation and tetrahedral shape.

(ii) $\underset{sp^3}{NH_3} \rightarrow \underset{sp^3}{NH_4^+}$

NH_3 and NH_4^+ have sp^3 hybridisation. But the shape of NH_3 is pyramidal and shape of NH_4^+ is tetrahedral.

@apna_pdf

(iii) $\underset{sp^2}{BF_3} \rightarrow \underset{sp^3}{BF_4^-}$

BF_3 is sp^2 hybridisation and BF_4^- has sp^3 hybridisation

BF_3 is trigonal planar and BF_4^- has tetrahedral.

(iv) $\underset{sp^3}{H_2O} \rightarrow \underset{sp^3}{H_3O^+}$

H_2O and H_3O^+ both have sp^3 hybridisation. H_2O is bent shaped and H_3O^+ is pyramidal.

146. Among the following species, correct set of iso structural pairs are : $NF_3, NO_3^-, BF_3, H_3O^+$

(a) (NF_3, NO_3^-) and (BF_3, H_3O^+)

(b) (NF_3, H_3O^+) and (NH_3, BF_3)

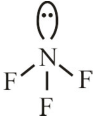
(c) (NF_3, H_3O^+) and (NO_3^-, BF_3)

(d) (NF_3, NH_3) and (NH_3^-, H_3O^+)

BCECE-2017, J&K CET-2000

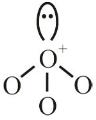
Ans. (c) : The structure of the following is–

(i) NF_3



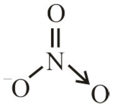
Pyramidal

(ii) H_3O^+



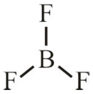
Pyramidal

(iii) NO_3^-



Trigonal planar

(iv) BF_3



Trigonal planar

The correct set of iso-structural pairs are (NF_3, H_3O^+) and (NO_3^-, BF_3).

147. Which of the following exhibits square pyramidal geometry?

(a) XeF_6 (b) XeO_3

(c) BrF_5 (d) XeF_4

MHT CET-03.05.2019, SHIFT-I

AMU – 2010

Ans. (c) : XeF_6 – Distorted octahedral

XeO_3 – Pyramidal

BrF_5 – Octahedral (Square pyramidal)

XeF_4 – Square planar

148. According to VSEPR theory, the geometry of ammonia and water molecules will, respectively, be

(a) pyramidal and bent

(b) tetrahedral and pyramidal

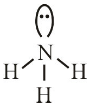
(c) bent and pyramidal

(d) pyramidal and tetrahedral.

AMU-2019, J&K CET-2012

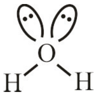
Ans. (a) : The geometry of ammonia (NH_3) and water (H_2O) molecule are pyramidal and bent. Both have sp^3 hybridisation.

(i) NH_3



Pyramidal

(ii) H_2O



Bent

149. Molecular structures of XeO_3 and $XeOF_4$ respectively are

(a) trigonal planar and octahedral

(b) pyramidal and square pyramidal

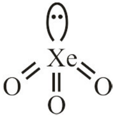
(c) pyramidal and trigonal bipyramidal

(d) both have imperfect tetrahedral shape.

BCECE-2017, AMU-2015

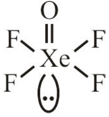
Ans. (b) : The structure of the following are –

(i) XeO_3



Pyramidal

(ii) $XeOF_4$



Square pyramidal

The central atom Xe both have one lone pair. In XeO_3, has pyramidal and $XeOF_4$ has square pyramidal.

150. In which of the following pairs of molecules/ions both the species are not likely to exists?

(a) H_2^+, He_2^{2-} (b) H_2^-, He_2^{2-}

(c) H_2^{2+}, He_2 (d) H_2^-, He_2^{2+}

Odisha NEET-2019, JEE Main-2013

Ans. (c) : For $H_2^+ = \sigma 1s^1$, $\text{B.O.} = \frac{1-0}{2} = 0.5$

For $H_2^{2+} = \sigma 1s^0$, $\text{B.O.} = \frac{0-0}{2} = 0$

For $H_2^- = \sigma 1s^2, \sigma^* 1s^1$, $\text{B.O.} = \frac{2-1}{2} = 0.5$

For $He_2^{2+} = \sigma 1s^2$, $\text{B.O.} = \frac{2-0}{2} = 1$

For $He_2 = \sigma 1s^2, \sigma^* 1s^2$, $\text{B.O.} = \frac{2-2}{2} = 0$

For $He_2^{2-} = \sigma 1s^2, \sigma^* 1s^2, \sigma 2s^2$, $\text{B.O.} = \frac{4-2}{2} = 1$

Thus, the bond order of H_2^{2+} and He_2 are zero. Both pairs of molecules/ions are not likely to exist.

151. The number of species below that have two lone pairs of electrons in their central atom is ... (Round off to the nearest integer)

$SF_4, BF_3^-, ClF_3, AsF_3, PCl_5, BrF_5, XeF_4, SF_6$

(a) 4 (b) 3

(c) 2 (d) 5

(JEE Main 2021, 18 March Shift-II)

J&K CET-2011

Ans. (c) :

Species	Bond pair	Lone pair
SF_4	4	1
BF_3^-	3	1
ClF_3	3	2
AsF_3	3	1
PCl_5	5	0
BrF_5	5	1
XeF_4	4	2
SF_6	6	0

The two lone pair of electrons in their central atom is two.

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152. Which of the following statements is correct?

(a) All carbon to carbon bonds contain a sigma bond and one of more pi bonds
(b) All carbon to hydrogen bonds are pi bonds
(c) All oxygen to hydrogen bonds are hydrogen bonds
(d) All carbon to hydrogen bonds are sigma bonds

UPTU/UPSEE-2015, JCECE - 2005

Ans. (d) : Carbon and hydrogen form only σ-bond between them, hence, the all carbon to hydrogen bonds are sigma bonds.

153. The shape of gaseous $SnCl_2$ is

(a) tetrahedral (b) linear
(c) angular (d) T-shape

JIPMER-2017
MHT CET-2011

Ans. (c) : The central atom Sn has 4 valence electron two are bonded with chlorine and one lone pair is present. The three atomic orbitals of tin undergo hybridisation to form three degenerate hybrid orbital. The geometry of molecule is bent or angular.

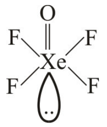
154. XeF_6 on partial hydrolysis gives a compound X, which has square pyramidal geometry 'X' is

(a) XeO_3 (b) XeO_4
(c) $XeOF_4$ (d) XeO_2F_2

Kerala-CEE-29.08.2021
Karnataka-CET-2021

Ans. (c) : XeF_6 on partial hydrolysis gives a compound $XeOF_4$ which has square pyramidal geometry which is given as follows -

$$XeF_6 + H_2O \rightarrow XeOF_4 + 2HF$$



(Square pyramidal)

155. The incorrectly matched pair, among the following is

	Molecule	**Shape**
(a)	BrF_5	Trigonal bipyramidal
(b)	SF_4	See saw
(c)	ClF_3	T-shape
(d)	NH_4^+	Tetrahedral
(e)	NH_3	Trigonal pyramidal

Kerala-CEE-2014, 2012

Ans. (a) :

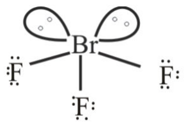
Molecule	**Shape**
BrF_5	Square pyramidal
SF_4	See-saw
ClF_3	T-shaped
NH_4^+	Tetrahedral
NH_3	Trigonal pyramidal

156. According to VSEPR theory, the molecular shape of BrF_3 is

(a) Trigonal bipyramid (b) Triangular
(c) Bent T-shape (d) Pyramidal

TS EAMCET 10.08.2021, Shift-I
AMU-2017

Ans. (c) :



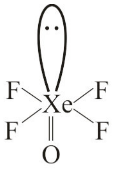
Fluorine atoms will be bent towards away from lone pair to minimize the lone pair lone pair repulsions. Thus Shape would be that of a slightly bent T-Shape.

157. The structure of $XeOF_4$is

(a) Trigonal bipyramidal
(b) Square planar
(c) Square pyramidal
(d) Pyramidal

J&K CET-2018
AP EAMCET (Engg.) -2014

Ans. (c) : The structure of $XeOF_4$ is square pyramidal



(Square Pyramidal)

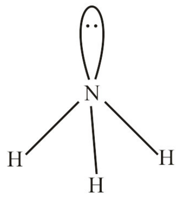
The hybridisation of $XeOF_4$ is sp^3d^2

158. Which one of the following is a planar molecule?

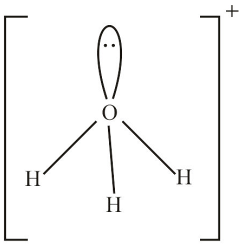
(a) NH_3 (b) H_3O^+
(c) BCl_3 (d) PCl_3

NEET-2005
AP-EAMCET (Medical), 2003

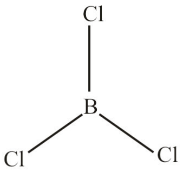
Ans. (c) : The molecule's are NH_3, H_3O^+,BCl_3 and PCl_3.



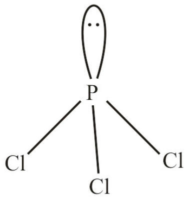
Hybridisation→ sp^3
Geometry→ pyramidal



sp^3
pyramidal



sp^2
Trigonal planar



sp^3
pyramidal

159. Number of non-bonding electron pair on Xe in XeF_6, XeF_4 and XeF_2 respectively will be ....

(a) 6, 4, 2 (b) 1, 2, 3
(c) 3, 2, 1 (d) 0, 3, 2

AMU-2013
GUJCET-2011

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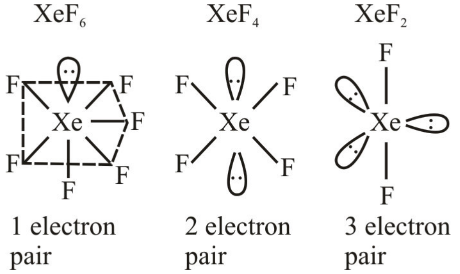
Ans. (b): The structure is given as-



160. For N_3^- which statement is wrong:

(a) Isoelectronic with CO_2
(b) NH_2OH and N_3^- have same O.N. on nitrogen atom.
(c) N-N bond length are same.
(d) HN_3 have linear shape.

JEE Main-17.03.2021, Shift-II
AIIMS-27 May,2018 (M)

Ans. (d): The structure of N_3^- is–

$$\overset{-}{N} = \overset{+}{N} = \overset{-}{N}$$

(i) N_3^- is isoelectronic with CO_2.
(ii) NH_2OH and N_3^- have same O.N on nitrogen atom.
(iii) N–N bond length are same.
(iv) HN_3 have bent structure.

161. Match List I and List II and pick out correct matching codes from the given choices:

List -I Compound	**List- II Structure**
A. ClF_3	**1. Square planar**
B. PCl_5	**2. Tetrahedral**
C. IF_5	**3. Trigonal bipyramidal**
D. CCl_4	**4. Square pyramidal**
E. XeF_4	**5. T- shaped**

Codes

(a) A-5, B-4,C-3,D-2,E-1
(b) A-5,B-3,C-4,D-2,E-1
(c) A-5,B-3,C-4,D-1,E-2
(d) A-4,B-3,C-5,D-2,E-1

AIIMS-2015
Kerala-CEE-2006

Ans. (b):

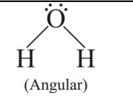
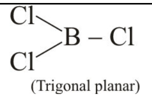
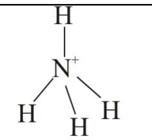
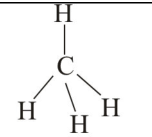
Compound	**Structure**
A. ClF_3	T- shaped
B. PCl_5	Trigonal bipyramidal
C. IF_5	Square pyramidal
D. CCl_4	Tetrahedral
E. XeF_4	Square planar

162. Which one of the following is a correct set?

(a) H_2O, sp^3, angular
(b) BCl_3, sp^3, angular
(c) NH_4^+, dsp^2, square planar
(d) CH_4, dsp^2, tetrahedral

AP-EAMCET/2008, 2003

Ans. (a):

Molecule	**Hybridization**	**Shape**
H_2O	sp^3	 (Angular)
BCl_3	sp^2	 (Trigonal planar)
NH_4^+	sp^3	 (Tetrahedral)
CH_4	sp^3	 (Tetrahedral)

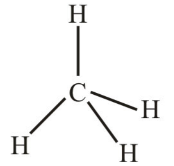
163. A pair of molecules with see-saw shape and linear shape, respectively, is

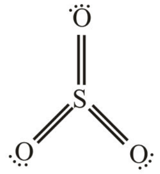
(a) CH_4 and SO_3
(b) XeF_4 and CS_2
(c) SF_4 and C_2H_2
(d) CCl_4 and CO_2

TS-EAMCET (Engg.), 07.08.2021 Shift-II
J&K CET-2015

Ans. (c) :

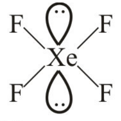
(a) CH_4 and SO_3





sp^2(Planer)

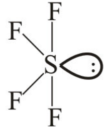
(b) XeF_4 and CS_2



sp^3d^2 (square planer)

$:\!\ddot{S}=C=\ddot{S}\!:$
sp (linear)

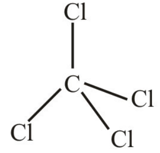
(c) SF_4 and C_2H_2



sp^3d (see-saw)

H–C≡C–H
sp (linear)

(d) CCl_4 and CO_2



sp^3(Tetrahedral)

$:\!\ddot{O}=C=\ddot{O}\!:$
sp (linear)

Hence, correct option is (c).

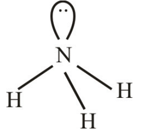
164. The shape of NH_3 molecule is:

(a) Tetrahedral
(b) Trigonal planar
(c) Trigonal pyramidal
(d) Linear

MHT-CET-2007
AIIMS-2001

@apna_pdf

Ans. (c): The shape of NH_3 (ammonia) is trigonal pyramidal. In ammonia hydrogen atom is bonded with nitrogen by 3σ bond and one lone pair present on nitrogen. The hybridisation of NH_3 is sp^3.



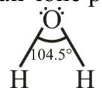
The shape of NH_3 molecule.

165. H–O–H bond angle in H_2O is 104.5° and not 109° 28' because of:

(a) Lone pair-lone pair repulsion
(b) Lone pair-bond pair repulsion
(c) Bond pair-bond pair repulsion
(d) High electronegative of oxygen

AP-EAMCET (Medical), 2006
UP CPMT-2008

Ans.(a): According to the VSEPR theory-The interactions of lone pair-lone pair> lone pair-bond pair > bond pair-bond pair. In H_2O molecule, the bond angle decreases due to lone pair-lone pair repulsion.



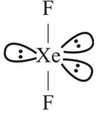
166. XeF_2, NO_2, HCN, ClO_2, CO_2
Identify the non-linear molecule-pair from the above mentioned molecules.

(a) XeF_2, ClO_2
(b) CO_2, NO_2
(c) HCN, NO_2
(d) ClO_2, NO_2

WB-JEE-30.04.2022

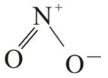
Ans. (d) : The structure of the following are-

(i) XeF_2



Linear

(ii) NO_2



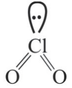
Bent

(iii) HCN

H–C≡N

Linear

(iv) ClO_2



Bent

(v) CO_2

O = C= O

Linear

Therefore NO_2 and ClO_2 have non-linear molecule-pair.

167. Molecular bromine on reaction with three moles of molecular fluorine produces an inter halogen compound. The total number of lone pairs at the central halogen atom is ———

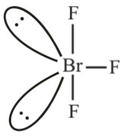
(a) 3
(b) 2
(c) 1
(d) 0

AP EAPCET 25.08.2021, Shift-II

Ans. (b) : Given, Molecular bromine is Br_2 and three moles molecular fluorine is $3F_2$ so the reaction is–

$$Br_2(g) + 3F_2(g) \rightarrow 2BrF_3$$

Structure of BrF_3 is



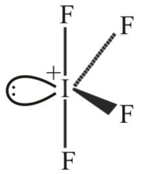
So the total number of lone pairs at the central halogen atom is 2.

168. That is the electronic geometry of IF_4^+?

(a) Tetrahedral
(b) Octahedral
(c) Trigonal bipyramidal
(d) Trigonal planar

TS EAMCET 10.08.2021, Shift-I

Ans. (c) : The geometry of IF_4^+



Note

lone Pair	Bond Pair	Geometry
0	5	Trigonal bipyramidal
1	4	See – saw

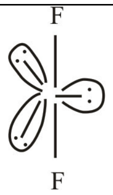
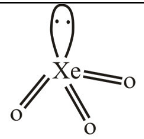
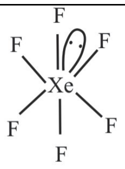
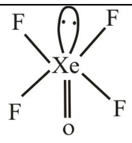
169. Match the following :-

Molecule	Geometry
(A) XeF_2	(i) Trigonal Pyramidal
(B) XeO_3	(ii) Distorted octahedral
(C) XeF_6	(iii) Linear
(D) $XeOF_4$	(iv) Square pyramidal

(a) (A – iii), (B – i), (C – ii), (D – iv)
(b) (A – iv), (B – iii), (C – ii), (D – i)
(c) (A – iii), (B – i), (C – iv), (D – ii)
(d) (A – iv), (B – iii), (C – ii), (D – i)

AP EAPCET 24.08.2021, Shift-I

Ans. (a) :

	Molecule	Hybridization	Structure
(a)	XeF_2	sp^3d	 (Linear)
(b)	XeO_3	sp^3	 (Trigonal pyramidal)
(c)	XeF_6	sp^3d^2	 (Distorted octahedral)
(d)	$XeOF_4$	sp^3d^2	 (Square pyramidal)

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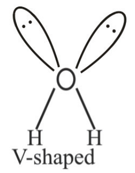
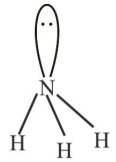
170. Incorrect matching amongst the following is____(according to geometry of molecules)

(a) H_2O, NH_3 (b) $BeCl_2$, CO_2
(c) SF_4, $TeCl_4$ (d) ClF_3, ICl_3

AP EAPCET 20.08.2021 Shift-II

Ans. (a): H_2O is V-shaped geometry and NH_3 is pyramidal geometry.


V-shaped


pyramidal

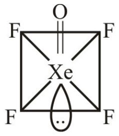
$BeCl_2$ and CO_2 are linear geometry, SF_4 are trigonal bipyramidal geometry and ClF_3, ICl_3 are trigonal pyramid geometry.

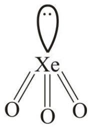
171. The structure of $XeOF_4$ and XeO_3, respectively, are

(a) Square pyramidal and pyramidal
(b) Pentagonal planar and pyramidal
(c) Pentagonal pyramidal and planar
(d) Pentagonal bipyramidal and planar

TS-EAMCET 09.08.2021, Shift-I

Ans. (a) : The molecular structure of $XeOF_4$ and XeO_3 are–


Square pyramidal

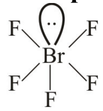
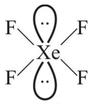

Pyramidal

172. The shapes of BrF_5 and XeF_4, respectively are

(a) square pyramid, square pyramid
(b) square planar, square planar
(c) square planar, square pyramid
(d) square pyramid, square planar

TS-EAMCET (Engg.), 06.08.2021

Ans. (d):

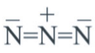
Molecule	**Hybridization**	**Shape**
BrF_5	sp^3d^2	 Square pyramidal
XeF_4	sp^3d^2	 Square planar

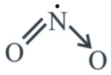
173. Amongst the following, the linear species is:

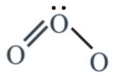
(a) N_3^- (b) NO_2
(c) O_3 (d) Cl_2O

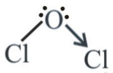
JEE Main 17.03.2021, Shift-II

Ans. (a) : The given species are N_3^-, NO_2, O_3, and Cl_2O.


Linear
sp


V-shaped
sp^2


V-shaped
sp^2


V-shaped
sp^3

174. Identify the incorrect statements among the following?

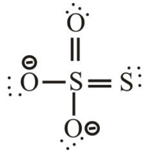
(i) SF_6 does not react with water
(ii) SF_6 is sp^3d hybridized
(iii) $S_2O_3^{2-}$ is a linear ion
(iv) There is no π - bonding in S_4^{2-} ion

(a) (ii), (iii) & (iv) only (b) (i), (ii) & (iii) only
(c) (i) & (ii) only (d) (iii) & (iv) only

AP EAPCET 19-08-2021, Shift-II

Ans. (a) : SF_6 is unreactive towards water because the sulfur atom is shielded by six fluorine atom.

SF_6 molecule has sp^3d^2 hybridisation.



Hence, the $S_2O_3^{2-}$ has a tetra hedral structure not a linear molecule.

There is $1-\pi$ bond in S_4^{2-}.

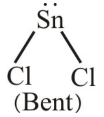
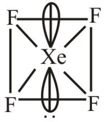
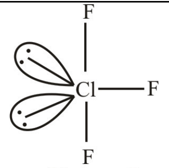
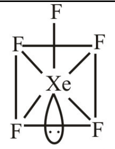
175. Match the following?

Molecule	**Geometry**
(a) $SnCl_2$	**(i) Angular (or) Bent**
(b) XeF_4	**(ii) See-saw**
(c) ClF_3	**(iii) Square pyramidal**
(d) IF_5	**(iv) T - shape**
	(v) Square - planar

(a) (a - i), (b - iii), (c - iv), (d - v)
(b) (a - iv), (b - v), (c - i), (d - iii)
(c) (a - i), (b - v), (c - iv), (d - iii)
(d) (a - iv), (b - iii), (c - ii), (d - ii)

AP EAPCET 19-08-2021, Shift-II

Ans. (c) :

Molecule	**Hybridization**	**Shape**
1. $SnCl_2$	sp^2	 (Bent)
2. XeF_4	sp^3d^2	 (Square Planer)
3. ClF_3	sP^3d	 (T-shaped)
4. IF_5	sp^3d^2	 (Square pyramidal)

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176. Which of the following is not a correct statement?

(a) Every AB_5 molecule has square pyramidal structure

(b) Multiple bonds are always shorter than corresponding single bonds

(c) The electron deficient molecules act as Lewis Acids

(d) The canonical structure have no real existence

AP- EAPCET- 07-09-2021, Shift-I

Ans. (a) : The option (1) is not correct because AB_5 molecules have square pyramidal and triagonal bipyramidal structure and other option is correct.

177. In which of the following species, the central atom has the maximum number of lone pair of electrons?

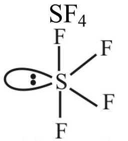
(a) SF_4 (b) XeF_4

(c) ClO_3^- (d) I_3^-

AP- EAPCET- 07-09-2021, Shift-I

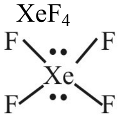
Ans. (d) : Structure of given compound is -

SF_4



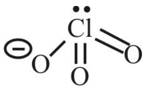
1 lone pair

XeF_4



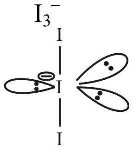
2 lone pair

ClO_3



1 lone pair

I_3^-



3 lone piar

So the option (d) is correct.

178. Which of the following are isostructural pairs?

A. SO_4^{2-} and CrO_4^{2-} **B. $SiC\ell_4$ and $TiC\ell_4$**

C. NH_3 and NO_3^- **D. $BC\ell_3$ and $BrC\ell_3$**

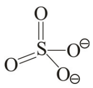
(a) A and B only (b) A and C only

(c) B and C only (d) C and D only

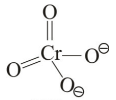
(JEE Main 2021, 24 Feb Shift-I)

Ans. (a) : The structure of the following are –

(a)



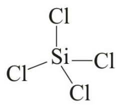
(Td)



(Td)

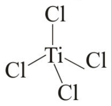
(b)

$SiCl_4$



(Td)

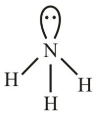
$TiCl_4$



(Td)

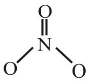
(c)

NH_3



Pyramidal

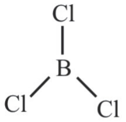
NO_3^-



Trigonal planar

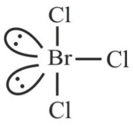
(d)

BCl_3



Trigonal planar

$BrCl_3$



T-shape

Hence, the option (a) is correct.

179. A central atom in a molecule has two lone pairs of electrons and forms three single bonds. The shape of this molecule is

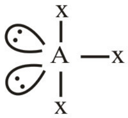
(a) see-saw (b) Planar triangular

(c) T-shaped (d) Trigonal pyramidal

(JEE Main 2021, 17 March Shift-I)

Ans. (c) : A central atom in a molecule has two lone pairs of electrons and forms three single bonds. The shape of this molecule is T-shaped.

For example –



sp^3d (T-shape)

180. Match List-I with List-II

	List- I		List-II
(A)	**PCl_5**	**(i)**	**Square pyramidal**
(B)	**SF_6**	**(ii)**	**Trigonal planar**
(C)	**BrF_5**	**(iii)**	**Octahedral**
(D)	**BF_3**	**(iv)**	**Trigonal bipyramidal**

Choose the correct answer from the options given below -

(a) (A) - (iv), (B) - (iii), (C) -(ii), (D) - (i)

(b) (A) - (iv), (B) - (iii), (C) -(i), (D) - (ii)

(c) (A) - (ii), (B) - (iii), (C) -(iv), (D) - (i)

(d) (A) - (iii), (B) - (i), (C) -(iv), (D) - (ii)

NEET-2021

Ans. (b) :

List-I	**List-II**
PCl_5	Trigonal bipyramidal
SF_6	Octahedral
BrF_5	Square pyramidal
BF_3	Trigonal planar

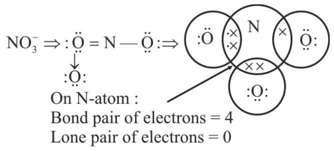
181. In NO_3^- ion, the number of bond pairs and lone pairs of electrons on nitrogen atom are

(a) 2, 2 (b) 3, 1

(c) 1, 3 (d) 4, 0

AP EAMCET (Engg.) 17.09.2020, Shift-II

Ans. (d) :


$NO_3^- \Rightarrow :\ddot{O} = N — \ddot{O}: \Rightarrow$
:Ö:
On N-atom :
Bond pair of electrons = 4
Lone pair of electrons = 0

182. In which of the following molecule/ion, all the bonds are not equal ?

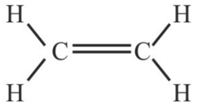
(a) XeF_4 (b) BF_4^-

(c) C_2H_4 (d) SF_4

AP EAMCET (Engg.) 17.09.2020, Shift-II

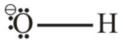
@apna_pdf

Ans. (c) : In XeF_4, BF_4^- and SF_4 only one type of covalent bonds are present, which are Xe—F, B—F and Si—F respectively.
In C_2H_4, two types of covalent bonds are present, which are C = C and C—H, which are not equal for any property.



183. How many lone pairs of electrons are present in a hydroxyl ion ?
(a) Two pairs (b) Three pairs
(c) One pair (d) Four pairs
AP EAMCET (Engg.) 17.09.2020 Shift-I

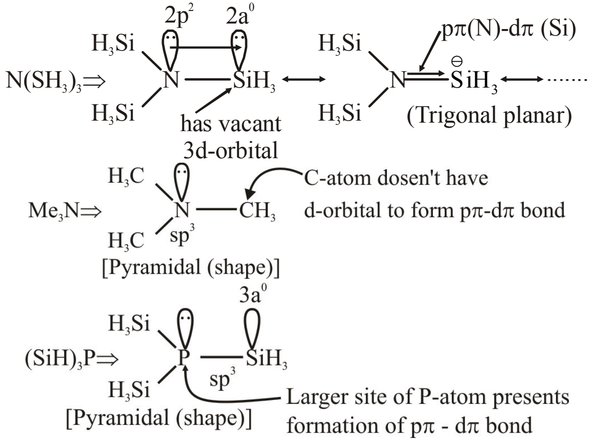
Ans. (b) : In hydroxyl ion, $OH^{\ominus}$



Number of lone pair of electrons = 3

184. The geometry with respect to the central atom of the molecules $N(SiH_3)_3$ - Me_3N, $(SiH_3)_3$ P respectively are
(a) Planar, pyramidal, planar
(b) planer, pyramidal, pyramidal
(c) pyramidal, pyramidal, pyramidal
(d) pyramidal, planar, pyramidal
AP EAMCET (Engg.) 17.09.2020 Shift-I

Ans. (b) :



185. When SbF_5 reacts with XeF_4 to for an adduct, the shapes of cation and anion in the adduct respectively are
(a) square planar, trigonal bipyramidal
(b) T-shaped, octahedral
(c) square pyramidal, octahedral
(d) plane triangular, trigonal bipyramidal
AP EAMCET (Engg.) 18.09.2020, Shift-I

Ans. (b) : In the reaction between XeF_4 and SbF_5, XeF_4 acts as flouride (F^-) donor.

$$XeF_4 + SbF_5 \rightarrow \underset{\text{Cation}}{\left[:\ddot{X}eF_3\right]^{\oplus}} \underset{\text{Anion}}{\left[SbF_6\right]^{\ominus}}$$

Hybridisation	sp^3d(Xe)	sp^3d^2 (Sb)
Geometry	Trigonal bipyramidal	octahedral
Shape	T-shaped	octahedral

186. Which of the following molecules can be represented as AB_2E_2, where A-central atom, B-bond pairs of electrons, E-lone pairs of electrons?
(a) SO_2 (b) H_2O_2
(c) H_2O (d) XeF_2
AP EAMCET (Engg.) 18.09.2020, Shift-I

Ans. (c) :

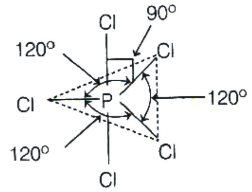
			Number of	
Molecule	**Type**	**A**	**B**	**E**
$:SO_2 \Rightarrow$	AB_2E	S	4	1
$H—\ddot{\underset{..}{O}}—OH \Rightarrow$	$A_2B_3E_4$	O (2 atom)	3	4
$\boxed{H_2\ddot{O}:} \Rightarrow$	$\boxed{AB_2E_2}$	O	2	2
$:\overset{..}{\underset{..}{Xe}}:F_2 \Rightarrow$	AB_2E_3	Xe	2	3

187. What is the shape of I_3^- ion ?
(a) Trigonal (b) Linear
(c) Bent (d) Trigonal planar
AP EAMCET (Engg.) 21.09.2020, Shift-II

Ans. (b) : I_3^- molecular geometry is linear. While there are three iodine atoms, one of the atoms has a negative charge which further gives 3 lone pairs of electrons and 2 bond pairs.
Hence, the correct option is (b).

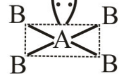
188. The number of 120º, Cl—P—Cl angles in phosphorus pentachloride are
(a) 3 (b) 6
(c) 9 (d) 1
AP EAMCET (Engg.) 18.9.2020 Shift-I

Ans. (a) : Geometry and structure of phosphorus pentachloride (PCl_5) molecule is trigonal bipyramidal where P-atom is sp^3 d-hybridised.
The 3Cl-atoms are present at equatorial positions with Cl — P — Cl = 120º and two Cl - atoms are present at axial positions with Cl— P — Cl = 90º.



189. If AB_4, molecule is a polar molecule, a possible geometry of AB_4 is
(a) Square pyramidal (b) Square planar
(c) Rectangular planar (d) Tetrahedral
(JEE Main 2020, 2 Sep. Shift-I)

Ans. (a) : AB_4 has three type of structure.
(i) If AB_4 molecule is square pyramidal then it has one lone pair. It should be polar because dipole moment of lone pair.



(Square pyramidal)
(ii) If AB_4 molecule has tetrahedral then it has no lone pair.

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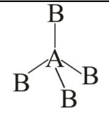
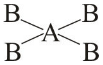


It is non polar due to symmetrical.

(iii) If AB_4 molecule is a square planar then it should be non polar because of vector sum of dipole moment is zero.



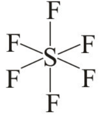
190. The molecular geometry of SF_6 is octahedral. What is the geometry of SF_4 (including lone pair(s) of electrons, if any)?

(a) Tetrahedral (b) Trigonal bipyramidal

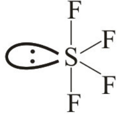
(c) Pyramidal (d) Square planar

(JEE Main 2020, 2 Sep. Shift-II)

Ans. (b) : The molecular geometry of SF_6 is octahedral. The geometry of SF_4 (including lone pair of electron) is trigonal bipyramidal.



(Octahedral)



(Trigonal bipyramidal)

191. The structure of PCl_5 in the solid state is

(a) Tetrahedral $[PC\ell_4]^+$ and octahedral $[PC\ell_6]^-$

(b) Trigonal bipyramidal

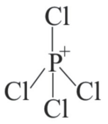
(c) Square planar $[PC\ell_4]^+$ and octahedral $[PC\ell_6]^-$

(d) Square pyramidal

(JEE Main 2020, 5 Sep. Shift-I)

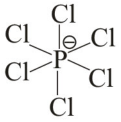
Ans. (a) : In solid PCl_5 exists as PCl_4^+ and PCl_6^- as the ionic bonding enhances the crystalline nature. PCl_4^+ is tetrahedral while PCl_6^- is octahedral which gives more stability to solid structure.

$[PCl_4]^+$



(Tetrahedral)

$[PCl_6]^-$



(Octahedral)

192. Incorrectly matched pair is

(a) XeO_3 pyramidal

(b) XeF_4 tetrahedral

(c) XeF_6 disorted octahedral

(d) $XeOF_4$ square pyramidal

Karnataka-CET-2020

Ans. (b) :

Molecule	**Geometry**
XeO_3	Pyramidal
XeF_4	Square planar
XeF_6	Disorted octahedral
$XeOF_4$	Square pyramidal

193. Assertion: BO_3^{3-} and SO_3^{2-} are not isostructural.

Reason: In SO_3^{2-} sulphur has one lone pair of electron.

(a) If both Assertion and Reason are correct and Reason is the correct explanation of Assertion.

(b) If both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.

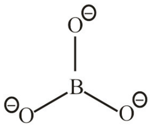
(c) If Assertion is correct but Reason is incorrect.

(d) If both the Assertion and Reason are incorrect.

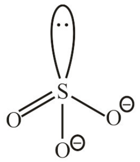
AIIMS 26 May 2019 (Evening)

Ans. (a): The structure of BO_3^{3-} and SO_3^{2-} is

(i) BO_3^{3-} (ii) SO_3^{2-}



sp² (Trigonal planar)



sp³ (Pyramidal)

BO_3^{3-} and SO_3^{2-} are not isostructural because SO_3^{2-} sulphur has one lone pair of electron.

194. Select the correct statement regarding shapes of PCl_5, BrF_5 & IF_7:

(a) All are square pyramidal.

(b) All are trigonal bipyramidal.

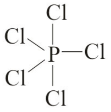
(c) One of the following is square pyramidal.

(d) One of the following is tetrahedral.

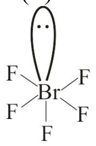
AIIMS 26 May 2019 (Evening)

Ans. (c): The structure of these molecules are –

(i) PCl_5 (ii) BrF_5

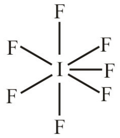


Trigonal bipyramidal



Square Pyramidal

(iii) IF_7



Pentagonal bipyramidal

Hence, BrF_5 molecule has square pyramidal shape.

195. When Ag^+ reacts with excess of sodium-thio sulphate then the obtained species having charge & geometry respectively will be?

(a) –3, Linear (b) –2, tetrahedral

(c) –1, square planer (d) –3, square planar

AIIMS 25 May 2019 (Morning)

Ans. (a): $AgBr + 2Na_2S_2O_3 \rightarrow Na_3[Ag(S_2O_3)_2] + NaBr$ the coordination number of Ag^+ is 2 it is sp hybridisation and shape is linear.

196. The number of species having zero lone pair at central atom is?

XeO_3, XeO_2F_2, XeO_4, XeO_3F_2

(a) 2 (b) 3

(c) 4 (d) Zero

AIIMS 25 May 2019 (Morning)

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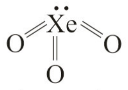
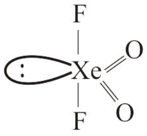
Ans. (a): The structure of the following species –

(i) XeO_3



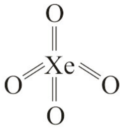
1 lone pair

(ii) $X_eO_2F_2$



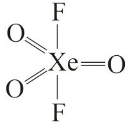
1 lone pair

(iii) XeO_4



zero lone pair

(iv) XeO_3F_2



zero lone pair

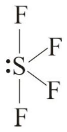
The molecule XeO_4 and XeO_3F_2 having zero lone pair at central atom and number of species are two.

197. **Assertion:** SF_4 molecule has see-saw geometry.
Reason: In SF_4 molecule sulphur has four bond pairs and one lone pair.

(a) If both Assertion and Reason are correct and Reason is the correct explanation of Assertion.
(b) If both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.
(c) If Assertion is correct but Reason is incorrect.
(d) If both the Assertion and Reason are incorrect.

AIIMS 26 May 2019 (Morning)

Ans. (a): The structure of SF_4 molecule is –



SF_4 molecule has see-saw geometry and in SF_4 molecule sulphur has four bond pairs and one lone pair.

198. **Which of the following is incorrect about cyanogens gas?**

(a) It has bent structure
(b) It is psuedohalogen
(c) It's behaviour is similar to halides
(d) Both carbon are sp hybridized

AIIMS 26 May 2019 (Morning)

Ans. (a): The molecular formula of cyanogens gas is $(CN)_2$. The structure of $(CN)_2$ is

$$N \equiv \underset{sp}{C} - \underset{sp}{C} \equiv N$$

The hybridisation of cyanogen gas is sp . It has a bent structure.

199. **Which of the following is correct?**

(a) $SO_3^2 \Rightarrow$ Tetrahedral
(b) $NO_2^- \Rightarrow$ Trigonal planar
(c) $ClO_4^- \Rightarrow$ Tetrahedral
(d) $NH_3 \Rightarrow$ Trigonal planar

JIPMER-2019

Ans. (c) :

Molecule	Geometry
SO_3^{2-}	Pyramidal
NO_2^-	V-shaped
ClO_4^-	Tetrahedral
NH_3	Pyramidal

200. **Which of the following pair contains 2 lone pair of electrons on the central atom?**

(a) I_3^+, H_2O
(b) H_2O, NF_3
(c) XeF_4, NH_3
(d) SO_4^{2-}, H_2S

Karnataka-CET-2019

Ans. (a) :

Molecule	Bond pair	Lone pair
I_3^+	2	2
H_2O	2	2
NF_3	3	1
XeF_4	4	2
NH_3	3	1
SO_4^{2-}	4	0
H_2S	2	2

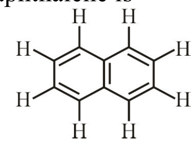
Therefore, I_3^+, H_2O pair contains 2 lone pair of electrons on the central atom.

201. **The number of π-bonds and σ-bonds present in naphthalene are respectively**

(a) 6, 19
(b) 5, 19
(c) 5, 11
(d) 5, 20

Karnataka-CET-2019

Ans. (b) :
The structure of naphthalene is



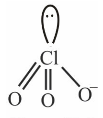
The number of π-bonds and σ-bond present in naphthalene are 5 π-bond and 19 σ-bond respectively.

202. **According to the VSEPR theory, the shape of ClO_3^- would be**

(a) Linear
(b) Triangular planar
(c) Pyramidal
(d) Square planar
(e) Angular

Kerala-CEE-2019

Ans. (c) : The shape of $Cl\,O_3^-$ would be pyramidal



Pyramidal

203. **What is the shape and magnetic nature of permanganate ion?**

(a) Pyramidal diamagnetic
(b) Tetrahedral, diamagnetic
(c) Tetrahedral, paramagnetic
(d) Planar, paramagnetic

MHT CET-03.05.2019, SHIFT-I

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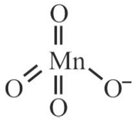
Ans. (b) : The shape of permanganate ion (MnO_4^-)



Tetrahedral (sp^3)

In permagnate ion there is no unpaired electron, it is diamagnetic.

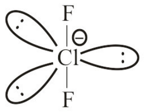
204. In ClF_2^- and ClF_4^- find out the number of lone pair and shape.

(a) 3-Linear, 2-Square planar
(b) 3-Squared planar, 2- Linear
(c) 0-Linear, 3-Square planar
(d) 2-Linear, 2-Square planar

AIIMS-27 May,2018 (M)

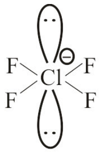
Ans. (a): The structure of the molecule is –

(i) ClF_2^-



3 lone pair and two bond pair (linear)

(ii) ClF_4^-



2 lone pair and four bond pair (Squar planar)

Hence, in ClF_2^- and ClF_4^- number of lone pair and shape are 3-linear, 2- square planar respectively.

205. Which contains alteast one e^- in $\sigma 2p$ bonding MO?

(a) O_2 (b) B_2
(c) C_2 (d) Li_2

AIIMS-26 May,2018 (E)

Ans. (a): (i) Molecular orbital of O_2 is

$=\sigma 1s^2, \sigma^* 1s^2, \sigma 2s^2, \sigma^* 2s^2, \sigma 2p_z^2, \pi 2p_x^2 = \pi 2p_y^2,$

$\pi^* 2p_x^1 = \pi^* 2p_y^1$

(ii) MO of $B_2 = = \sigma 1s^2, \sigma^* 1s^2, \sigma 2s^2, \sigma^* 2s^2, \pi 2p_x^1 = \pi 2p_y^1$

(iii) MO of $C_2 = \sigma 1s^2, \sigma^* 1s^2, \sigma 2s^2, \sigma^* 2s^2, \pi 2p_x^2 = \pi 2p_y^2,$

(iv) MO of $Li_2 = = \sigma 1s^2, \sigma^* 1s^2, \sigma 2s^2$

Therefore, O2 contains at least one e^- in σ_{2p} bonding MO.

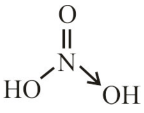
206. Structure anions of acids, HNO_3, H_3PO_4 and H_2SO_4 are respectively

(a) tetrahedral, tetrahedral and trigonal bipyramidal
(b) angular, tetrahedral and trigonal bipyramidal
(c) tetrahedral, tetrahedral and angular
(d) planar, tetrahedral and tetrahedral

AMU-2018

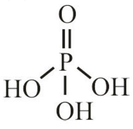
Ans. (d) : The structure of the following are –

(i) HNO_3



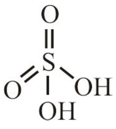
Trigonal planar

(ii) H_3PO_4



Tetrahedral

(iii) H_2SO_4



Tetrahedral

207. Which of the following is the correct according increasing order of lone pair of electrons on the central atom?

(a) $IF_7 < IF_5 < ClF_3 < XeF_2$
(b) $IF_7 < XeF_2 < ClF_2 < IF_5$
(c) $IF_7 < ClF_3 < XeF_2 < IF_5$
(d) $IF_7 < XeF_2 < IF_5 < ClF_3$

BITSAT 2018

Ans. (a) : The number of lone pairs of electrons on central atom in various given species are

Species	Number of lone pairs on central atom
IF_7	nil
IF_5	1
ClF_3	2
XeF_2	3

Thus the correct increasing order is

$$\underset{0}{IF_7} < \underset{1}{IF_5} < \underset{2}{ClF_3} < \underset{3}{XeF_2}$$

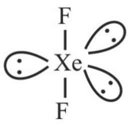
208. What is the hybridization and geometry off given species? The species are XeF_2 and ICl_2^-

(a) sp^3d and trigonal bipyramidal
(b) sp^3d^2 and square planar
(c) sp^3d and linear
(d) sp^3 and irregular tetrahcdron

J & K CET-(2018)

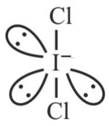
Ans. (a) : The given species are –

(i) XeF_2



(sp^3d)

(ii) ICl_2^-



(sp^3d)

The hybridisation = Bond pair + lone pair

For XeF_2, Hybridisation = 2 + 3 = 5 (sp^3d)

For ICl_2^-, Hybridisation = 2 + 3 = 5 (sp^3d)

The geometry of the given species is trigonal bipyramidal and the shape is linear.

209. What will be the geometry of the compound MB_4L_2? Here B is bond pair and L is lone pair.

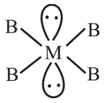
(a) Square planar (b) Octahedral
(c) Square pyramid (d) Tetrahedral

J & K CET-(2018)

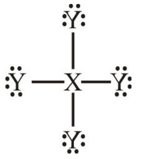
Ans. (a) : The given compound MB_4L_2.

Where, B = Bond pair
L = Lone pair

Geometry of the compound will be octahedral with two lone pairs. Hence, the structure is square planar.



210. For the dot structure shown, the most likely elements X = … and Y = … are



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(a) carbon, flourine (b) carbon, hydrogen
(c) carbon, oxygen (d) oxygen, carbon

JIPMER-2018

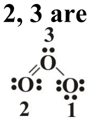
Ans. (a) : X is a tetravalent without lone pair, Y has three lone pairs and one bond pair. X is carbon can make maximum 4 bonds as its valency is 4 and Y has fluorine has total 7 electron in valence shell. Out of that 1 electron has gone for bonding.

211. Which of the following does not depend on the attraction of the bonding pair towards the nucleus ?
(a) The number of protons in the nucleus
(b) The repulsion by the electrons in the same valence shell
(c) The amount of sheieding by inner shell electron
(d) The distance from the nucleus

UPTU/UPSEE-2018

Ans. (b) : The repulsion by the electrons in the same valence shell does not depend on the attraction of the bonding pair towards the nucleus because of electrons are identical in charge. The repulsion is minimised if the two electron are far apart as possible.

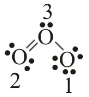
212. The Lewis structure for O_3 molecule is given below. The correct formal charges on oxygen atoms labeled 1, 2, 3 are respectively.



(a) – 1, 0, + 1 (b) + 1, 0, – 1
(c) + 1, – 1, 0 (d) 0, + 1, – 1

AP EAMCET-2017

Ans. (a):



Formal charge (F.C) = Number of valence electron-

$$[\text{no. of lone pair} + \frac{1}{2}\text{no. of bond pair}]$$

For $O_{(1)} = 6 - (6 + 1) = -1$
$O_{(2)} = 6 - (4 + 2) = 0$
$O_{(3)} = 6 - (2 + 3) = +1$

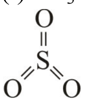
Hence option (a) is correct.

213. The species having pyramidal shape according to VSEPR theory is
(a) SO_3 (b) BrF_3
(c) SiO_3^{2-} (d) OSF_2

TS EAMCET-2017

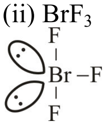
Ans. (d) : The structure of the species is –

(i) SO_3



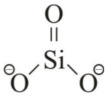
Trigonal planar

(ii) BrF_3



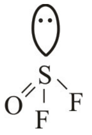
Trigonal bipyramidal

(iii) SiO_3^{2-}



Trigonal planar

(iv) OSF_2



Pyramidal

214. IF_7 is known to exist while BrF_7 does not exist the reason is.
(a) stability of higher oxidation state increases with the size
(b) Br is more electronegative than I
(c) Br cannot gain 7 electrons
(d) I can easily react with F.

J & K CET-(2017)

Ans. (a) : The size of halogen on moving down the group is increases. The interhalogen compound that is formed when there is large electronegativity difference between two halogens and also there is large difference between sizes of the halogens atoms. Seven small fluorine atoms are able to accommodate around a large iodine atom but seven fluorine atoms are not accommodate around a bromine atom due to electronic repulsion between the fluorine atoms and stability of higher oxidation state increases with the size.

215. Which of the following is correct electron dot structure of N_2O molecule?
(a) $:N = N = \ddot{O}:$ (b) $:N \equiv \overset{+}{N} - \underset{\cdot\cdot}{\ddot{O}}:$
(c) $:\ddot{N} = N = \underset{\cdot\cdot}{\ddot{O}}$ (d) $:\ddot{N} = N - \underset{\cdot\cdot}{\ddot{O}}$

Karnataka-CET-2017

Ans. (b) : N_2O is known as nitrous oxide. It commonly name is laughing gas. At room temperature it is a colourless non flammable gas and has a slightly sweet scent and taste. Nitrous oxide is a powerful oxidiser. The dot structure of N_2O molecule –

$$:N \equiv \overset{+}{N} - \underset{\cdot\cdot}{\ddot{O}}:$$

216. Which of the following structure of a molecule is expected to have three bond pairs and one lone pair of electrons?
(a) Octahedral (b) Trigonal planar
(c) Pyramidal (d) Tetrahedral

Karnataka-CET-2017

Ans. (c) : Pyramidal structure of a molecule is expected to have three bond pairs and one lone pair of electrons.
e.g.– NH_3 (ammonia) molecule one electron pair geometry is tetrahedral and molecular shape is pyramidal.

217. Which of the following pairs of compounds is isoelectronic and iso-structural?
(a) TeI_2, XeF_2 (b) IBr_2^-, XeF_2
(c) IF_3, XeF_2 (d) $BeCl_2$, XeF_2

NEET-2017

Ans. (b) : The compound IBr_2^- and XeF_2 are isostructural both have the same number of valence electrons. According to VSEPR geometry is trigonal bipyramidal but the shape are XeF_2 and IBr_2^- is linear.
Isoelectronic species have same number of electron.

218. Which one of the following has (have) octahedral geometry?
(i) $SbCl_6^-$ (ii) $SnCl_6^{2-}$
(iii) XeF_6 (iv) IO_6^{5-}
(a) (i) (ii) and (iv) (b) (ii) (iii) and (iv)
(c) (i) (ii) and (iii) (d) All of these

UPTU/UPSEE-2017

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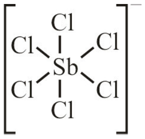
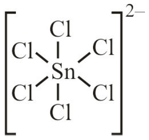
Ans. (a) The geometry of the following molecule –

(i) $SbCl_6^-$



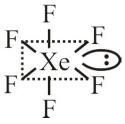
Octahedral

(ii) $SnCl_6^{2-}$



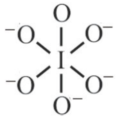
Octahedral

(iii) XeF_6



Distorted octahedral

(iv) IO_6^{5-}



Octahedral

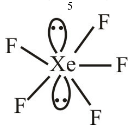
Hence, the $SbCl_6^-$, $SnCl_6^{2-}$ and IO_6^{5-} have the octahedral geometry.

219. The shape of XeF_5^- will be

(a) square pyramid
(b) trigonal bipyramidal
(c) planar
(d) pentagonal bipyramid

WB-JEE-2017

Ans. (c) : The shape of XeF_5^- is–



The XeF_5^- show Sp^3d^3 hybridisation and geometry is pentagonal bipyramidal .

Number of electron pair = $\frac{8+5+1}{2} = 7$

Number of bond pair is five and two lone pair. As lone pairs are present axially to minimize the repulsion Therefore, the shape is planar.

220. XeO_4 molecule is tetrahedral having:

(a) Two pπ–dπ bonds
(b) One pπ–dπ bonds
(c) Four pπ–dπ bonds
(d) Three pπ–dπ bonds

AIIMS-2016

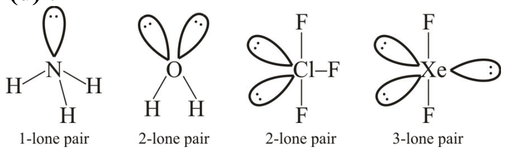
Ans. (c): XeO_4 molecule have tetrahedral structure and hybridization is sp^3. In the fourth excited state of xenon atom has 8 unpaired electrons. One s and three p–orbital undergoes sp^3 hybridisation. Four sp^3 hybrid orbitals form four σ bonds with oxygen atom. Four pπ– dπ bonds are also formed with oxygen atoms by the unpaired electron.

221. In which of the following molecules, maximum number of lone pairs is present on the central atom?

(a) NH_3
(b) H_2O
(c) ClF_3
(d) XeF_2

AP-EAMCET – 2016

Ans. (d) :



Thus, XeF_2 has maximum lone pair present on central atom.

222. Which of the following statements is false?

1. Non- bonding pairs occupy more space than bonding pairs.
2. The bonding orbitals in trigonal bipyramidal molecule are described
3. $SnCl_2$ has linear shape.
4. PCl_4^+ and $AlCl_4^-$ are isoelectronic.

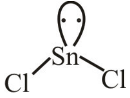
(a) 1
(b) 2
(c) 3
(d) 4

CG PET- 2016

Ans. (c) : (i) Non-bonding pairs occupy more space than bonding pairs.

(ii) The bonding orbitals in trigonal bipyramidal molecule.

(iii) $SnCl_2$ is V-shaped.



(iv) PCl_4^+ and $AlCl_4^-$ are isoelectronic.

223. The central atom of which one of the following molecules, has 3 bond pairs and 2 lone pairs of electrons in its valence shell?

(a) Boron trifluoride
(b) Phosphorous trichloride
(c) Chlorine trifluoride
(d) Xenon trioxide

J & K CET-(2016)

Ans. (c) :

Molecule	Bond pair	Lone pair
Boron trifluoride (BF_3)	3	0
Phosphorous trichloride (PCl_3)	3	1
Chlorine trifluride (ClF_3)	3	2
Xenon trioxide (XeO_3)	3	1

224. Which of the following pairs of ions is isoelectronic and is isostructural?

(a) CO_3^{2-}, NO_3^-
(b) ClO_3^-, CO_3^{2-}
(c) SO_3^{2-}, NO_3^-
(d) ClO_3^-, SO_3^{2-}

NEET-II 2016

Ans. (a) :

Ion	No. of electron	Structure
CO_3^{2-}	32	Trigonal planar
NO_3^-	32	Trigonal planar
ClO_3^-	42	Pyramidal
SO_3^{2-}	58	Pyramidal

Note : ClO_3^- and SO_3^{2-} is isostructural but not isoelectronic.

225. The molecule C_3O_2 has a linear structure, This compound has

(a) 2σ and 3π bonds
(b) 3σ and 4π bonds
(c) 4σ and 4π bonds
(d) 3σ and 2π bonds

UPTU/UPSEE-2016

Ans. (c) : The molecule C_3O_2 has a linear. The structure of the compound are –

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$O=\underset{sp}{C}=\underset{sp}{C}=\underset{sp}{C}=O$

In C_3O_2 have 4σ and 4π bond, and hybridisation of each carbon has sp and angle is 180^0.

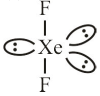
226. The structure of XeF_2 and NH_3 respectively are

(a) linear, see-saw (b) bent, see-saw
(c) bent, tetrahedral (d) linear, pyramidal

UPTU/UPSEE-2016

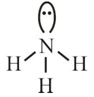
Ans. (d) : The structure of XeF_2 and NH_3 are –

(i) XeF_2



Linear (sp^3d)

(ii) NH_3



Pyramidal (sp^3)

227. The number of lone pair (s) of electrons on the central atom in $[BrF_4]^-$, XeF_6 and $[SbCl_6]^{3-}$ are, respectively

(a) 2, 1 and 1 (b) 2, 1 and 0
(c) 2, 0 and 1 (d) 1, 0 and 0

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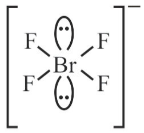
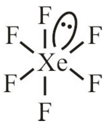
Ans. (a) : The structure of the compound are –

(i) $[BrF_4]^-$



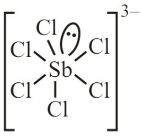
2 lone pair +
4 bond pair
(Square planar)

(ii) XeF_6



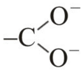
1 lone pair +
6 bond pair
(Distorted octohedral)

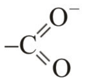
(iii) $[SbCl_6]^{3-}$

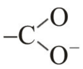


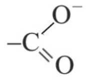
1 lone pair +
6 bond pair
(Distorted octahedral)

228. The structure of carboxylate ion is best represented as

(a) 

(b) 

(c) 

(d) 

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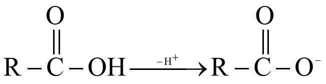
Ans. (d): The name carboxyl comes from the fact that a carbonyl and hydroxyl group are attached to the same carbon. In carboxylic acid hydrogen is removed then form carboxylate ion.



$$R-\overset{\overset{O}{\|}}{C}-OH \xrightarrow{-H^+} R-\overset{\overset{O}{\|}}{C}-O^-$$

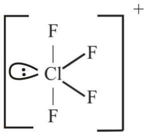
The hybridization of carbon in carboxylate ion is sp^2

229. The geometry around the central atom in ClF_4^+ is

(a) Octahedral (b) Trigonal bipyramidal
(c) Square planar (d) Square pyramidal

UPTU/UPSEE-2016

Ans. (b): The geometry around the central atom in ClF_4^+ is trigonal bipyramidal.



230. Match the following.

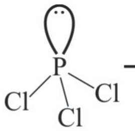
	List I		List II
(A)	PCl_3	(I)	Square planar
(B)	BF_3	(II)	T-shape
(C)	ClF_3	(III)	Trigonal pyramidal
(D)	XeF_4	(IV)	See-saw
		(V)	Trigonal planar

	(A)	(B)	(C)	(D)
(a)	(IV)	(II)	(I)	(III)
(b)	(III)	(V)	(II)	(IV)
(c)	(III)	(V)	(II)	(I)
(d)	(II)	(IV)	(III)	(V)

TS-EAMCET-2016

Ans. (c) :

PCl_3=

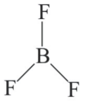


⟶ Trigonal pyramidal

Hybridisation = Bond pair + Lone pair
= 3 + 1 = 4(sp^3)

Similarly,

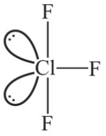
BF_3 =



⟶ Trigonal planer

Hybridisation = 3 + 0 = 3(sp^2)

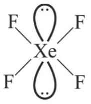
ClF_3=



⟶ T-shaped

Hybridisation = 3 + 2 = 5(sp^3d)

XeF_4=



⟶ Square planer

Hybridisation = 4 + 2 = 6(sp^3d^2)

231. Assertion: Lone pair- lone pair repulsive interaction are greater than lone pair- bond pair and bond pair- bond pair interactions.

Reason: The space occupied by lone pair electrons is more as compared to bond pair electrons.

(a) If both Assertion and Reason are correct and the Reason is the correct explanation of Assertion
(b) If both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.
(c) If Assertion is correct but Reason is incorrect
(d) If both the Assertion and Reason are incorrect

AIIMS-12016

Ans. (a): Lone pair are localised on the central atom, each bonded pair is shared between two atoms. As a result, the lone pair electrons in a molecule occupy more space as compare to the bonding pairs of electrons.

Hence, the greater repulsion between lone pairs-lone pair of electron as compared to lone pair-bond pair and bond pair-bond pair repulsions.

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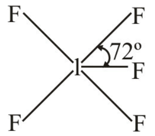
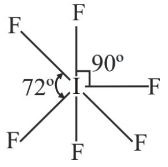
232. The structure of IF_5 can be described as

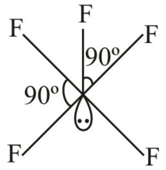
(a)



(b)



(c)

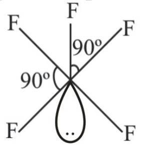


(d) None of these

JCECE - 2015

Ans. (c) : Number of hybrid orbitals
= number of bp + number of lp
= 5 + 1 = 6

Thus, hybridisation is sp^3d^2 but geometry due to the presence of one lone pair is square pyramidal.



233. Number of oxygen atoms shared per SiO_4^{4-} tetrahedron is

I. two dimensional sheet structured silicates
II. cyclic silicates and
III. single strand chain silicates respectively are

(a) 3, 3, 2
(b) 3, 2, 2
(c) 4, 3, 1
(d) 4, 3, 2

JIPMER-2015

Ans. (b) : In two dimensional sheet silicate three oxygens of each SiO_4^{4-} units are shared. Therefore, it contains $(Si_2O_5)_n^{2-}$ type anion. Cyclic silicates are obtained by sharing of two oxygen atoms of each SiO_4^{4-} tetrahedron. Chain silicates are also formed by the sharing of two oxygen atom of each SiO_4^{4-} unit.

234. Which of the following will be able to show geometrical isomerism?

(a) MA_3B – square planar
(b) MA_2B_2–tetrahedral
(c) MABCD–square planar
(d) MABCD– tetrahedral

Karnataka-CET-2015

Ans. (c) : In tetrahedral and square planar arrangements, only the square planar arrangement will be able to show geometrical isomerism. In MA_3B all the arrangement will be same. Therefore, it will show no geometrical isomerism. Square planar complex MABCD type form three isomers i.e. two cis and one trans.

Note : Tetrahedral complexes do not show geometrical isomerism because ligand are attached to central metal atom are same with respect to each other.

235. In which of the following pairs, both the species are not isostructral?

(a) Diamond, silicon carbide
(b) NH_3, PH_3
(c) XeF_4, XeO_4
(d) $SiCl_4$, PCl^+_4

NEET-2015

Ans. (c) :

- Diamond and silicon carbide both are iso structural because their central atom is sp^3 hybridised and tetrahedral geometry.
- NH_3 and PH_3 both the isostructural because central atom is sp^3 hybridised and pyramidal shape.
- XeF_4 has sp^3d^2 hybridisation while XeO_4 has sp^3 hybridisation. So, XeF_4 and XeO_4 are not isostructural.
- $SiCl_4$ and PCl_4^+ both have isostructural and central atom is sp^3 hybridised and shape is tetrahedral.

236. The number of lone pairs of electrons on the central atoms of H_2O, $SnCl_2$, PCl_3 and XeF_2 respectively, are

(a) 2, 1, 1, 3
(b) 2, 2, 1, 3
(c) 3, 1, 1, 2
(d) 2, 1, 2, 3

WB-JEE-2015

Ans. (a) :

Species	Bond pair	Lone Pair
H_2O	2	2
$SnCl_2$	2	1
PCl_3	3	1
XeF_2	2	3

237. What are the shapes of ethyne and methane?

(a) Square planar and linear
(b) Tetrahedral and trigonal planar
(c) Linear and tetrahedral
(d) Trigonal planar and linear

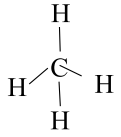
AP EAMCET (Engg.) -2014

Ans. (c) : The shape of ethyne and methane are linear and tetrahedral respectively.

(i) Ethyne (C_2H_2) (ii) Methane (CH_4)

$H-C\equiv C-H$

(linear)



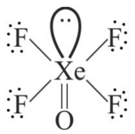
(Tetrahedral)

238. The structure of $XeOF_4$ is

(a) trigonal bipyramidal
(b) square planar
(c) square pyramidal
(d) pyramidal

AP-EAMCET (Engg.) - 2014

Ans. (c) : Hybridisation of $XeOF_4$ is sp^3d^2. Structure of $XeOF_4$ is given below–



The central Xe atom has 1 lone pair of electrons and 5 bonding domains. It undergoes sp^3d^2 hybridization the electron pair geometry is octahedral and the molecular shape is square pyramid.

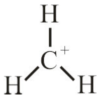
239. The structure of CH_3^+ is

(a) tetrahedral
(b) linear
(c) planar
(d) pyramidal

Assam CEE-2014

@apna_pdf

Ans. (c) : The structure of CH_3^+ is –



Trigonal planar

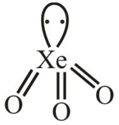
In CH_3^+ the structure is trigonal planar and hybridisation is sp^2 and the bond angle is 120°.

240. What is the geometrical shape of XeO_3 ?

(a) Planar triangular (b) Trigonal pyramidal
(c) Square planar (d) Tetrahydral

GUJCET-2014

Ans. (b) : The structure XeO_3 is –



The geometrical shape of XeO_3 is trigonal pyramidal. The hybridisation of XeO_3 is sp^3.

241. The pair of compounds having identical shapes for their molecules is

(a) CH_4, SF_4 (b) BCl_3, ClF_3
(c) XeF_2, $ZnCl_2$ (d) SO_2, CO_2

Karnataka-CET-2014

Ans. (c) :

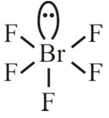
Molecule	**Shape**
CH_4	Tetrahedral
SF_4	See-saw
BCl_3	Trigonal planar
ClF_3	T-shaped
XeF_2	Linear
$ZnCl_2$	Linear
SO_2	V-shaped
CO_2	Linear

242. What is the geometry of molecule of bromine penta fluoride?

(a) Square planar (b) Trigonal bipyramidal
(c) Squre pyramidal (d) Octahedral

MHT CET-2014

Ans. (d) : The geometry of bromine pentafluoride (BrF_5) is octahedral–



The bromine pentafluride 5 are bond pair and one lone pair present so, the shape is square pyramidal.

243. Which one of the following species has planar triangular shape?

(a) N_3^- (b) NO_3^-
(c) NO_2^- (d) CO_2

NEET-2014

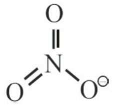
Ans. (b) : The structure of the following are –

(i) N_3^-

$\overset{-}{N}-\overset{+}{N}\equiv N$

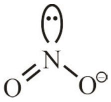
Linear

(ii) NO_3^-



Triangular shape

(iii) NO_2^-



Bent

(iv) CO_2

$O=C=O$

Linear

It the sp^2 hybridisation are triangular planar shape. In NO_3^- has sp^2 hybridised with no lone pair of electron on the central atom.

244. Which of the following molecules possesses linear geometry?

(a) XeF_2 (b) XeF_4
(c) $XeOF_4$ (d) XeF_6

UP CPMT-2014

Ans. (a) : $XeF_2 \Rightarrow$2bp+4*l*p Thus, geometry linear.

$XeF_4 \Rightarrow$ 4bp+2*l*p square planar

$XeOF_4 \Rightarrow$ 5bp+1*l*p square pyramid

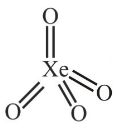
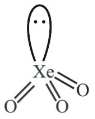
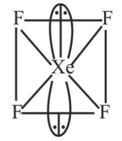
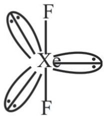
$XeF_6 \Rightarrow$ 6bp + 1*l*p distorted octahedral

245. Identify the correct set.

	Molecule	Hybridi-sation	Shape	Number of lone pairs of electrons
(a)	XeO_4	sp^3d^2	pyramidal	1
(b)	XeO_3	sp^3	pyramidal	1
(c)	XeF_4	sp^3d^2	planar	3
(d)	XeF_2	sp^3d	linear	2

AP EAMCET (Medical) - 2013

Ans. (b) : The chemical compounds are XeO_4, XeO_3, XeF_4 and XeF_2.

				
Hybridisation	sp^3	sp^3	sp^3d^2	sp^3d
Shape	Tetrahedral	Pyramidal	Square planer	Linear
Lone pair	0	1	2	3

246. Among the following groups which represents the collection of isoelectronic species?

(a) $NO^+, C_2^{2-}, O_2^-, CO$ (b) N_2, C_2^{2-}, CO, NO
(c) CO, NO^+, CN^-, C_2^{2-} (d) NO, CN^-, N_2, O_2^-

AIIMS-2013

Ans. (c): Isoelectronic speices haring the same number of electrons.

$NO^+ = 7+7=14$

$C_2^{2-} = 2\times6+2=14$

$O_2^- = 2\times8+1=17$

$CO = 6+8 = 14$

$N_2 = 2\times7= 14$

$NO = 7 + 8 = 15$

$CN^- = 6 + 7 + 1 = 14$

$O_2= 2\times8=16$

Hence, the option (c) has isoelectronic species.

@apna_pdf

247.

	Molecule	Hybridisation of central atom	Shape
(a)	PCl_5	dsp^3	square pyramidal
(b)	$[Ni(CN)_4]^{2-}$	sp^3	tetrahedral
(c)	SF_6	sp^3d^2	octahedral
(d)	IF_3	dsp^3	pyramidal

Identify the correct set.

AP-EAMCET (Engg.) 2013

Ans. (c) :

Molecule	hybridisation of central atom	Shape
PCl_5	sp^3d	Trigonal bipyramidal
$[Ni(CN)_4]^{2-}$	dsp^2	Square planar
SF_6	sp^3d^2	Octahedral
IF_3	sp^3d	T-shaped

248. Which of the following will have the shape of a trigonal bipyramid?

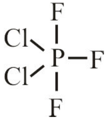
(a) PF_3Cl_2 (b) IF_5

(c) BrF_5 (d) SbF_5^{2-}

CG PET- 2013

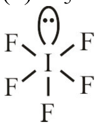
Ans. (a) : The shape of the following species is –

(a) PF_3Cl_2



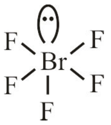
Trigonal bipyramidal

(b) IF_5



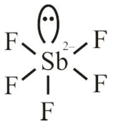
Square pyramidal

(c) BrF_5



Square pyramidal

(d) SbF_5^{2-}



Square pyramidal

So, PF_3Cl_2 has trigonal bipyramidal and other are square pyramidal.

249. d^2sp^3 hybridisation of the atomic orbitals gives

(a) square planer structure

(b) triangular structure

(c) tetrahedral structure

(d) octahedral structure

Karnataka-CET-2013

Ans. (d) : When one s and three p and two d-orbitals mixed together to form a six new equivalent sp^3d^2 or d^2sp^3 hybrid orbitals. The type of hybridisation d^2sp^3 or sp^3d. The structure atomic orbitals is octahedral.

250. Which one of the following have linear structure?

(I) I_3^- (II) NO_2^- (III) I_3^+ (IV) SO_2

(V) N_3^-

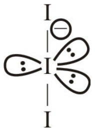
(a) I, II and III (b) I and V

(c) II, III and IV (d) All of these

UPTU/UPSEE-2013

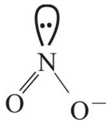
Ans. (b) : The structure of the following are-

(i) I_3^-



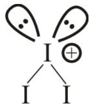
(Linear)

(ii) NO_2^-



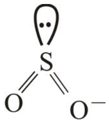
(Bent)

(iii) I_3^+



(Pyramidal)

(iv) SO_2



(Bent)

(v) N_3^-

$^{-}N = \overset{+}{N} = N^{-}$

Linear

Hence, I_3^- and N_3^- have linear structure.

251. Consider the following molecules/ions:

(1) NH_4^+ (2) H_3O^+

(3) NH_3 (4) $SiCl_4$

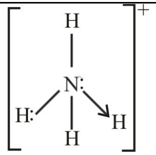
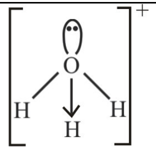
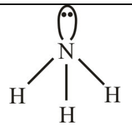
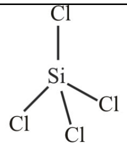
Which pair does not contain a lone pair ?

(a) 1 and 2 (b) 1 and 3

(c) 1 and 4 (d) 2 and 4

SCRA 2012

Ans. (c) : The molecules NH_4^+ and $SiCl_4$ does not contain a lone pair.

Molecules/ions	Lone pair
	0
	1
	1
	0

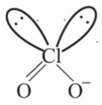
252. The shape of ClO_2^- according to valence shell electron pair repulsion (VSEPR) theory will be

(a) Planar triangle (b) Angular

(c) Tetrahedral (d) Square planar

AIIMS-2012

Ans. (b): The shape of ClO_2^-



The shape of ClO_2^- has angular according to valence shell electron pair repulsion (VSEPR) theory. The hybridization of ClO_2^- is sp^3.

@apna_pdf

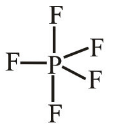
253. In which of the following pairs, the two species are not isostructural?

(a) CO_3^{2-} and NO_3^- (b) $PC\ell_4^+$ and $SiC\ell_4$

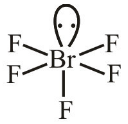
(c) PF_5 and BrF_5 (d) $A\ell F_6^{3-}$ and SF_6

(AIEEE-2012)

Ans. (c) : The two species are not isostructural is PF_5 and BrF_5. PF_5 is trigonal bipyramidal and BrF_5 square pyramidal structure.



(Trigonal Bipyramidal)



(Square Pyramidal)

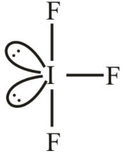
254. Which of the following molecules has trigonal planar geometry?

(a) IF_3 (b) PCl_3

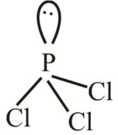
(c) NH_3 (d) BF_3

JCECE - 2012

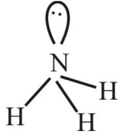
Ans. (d) : (a) IF_3 has bent-T geometry



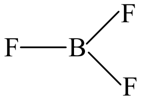
(b) PCl_3 has pyramidal geometry



(c) NH_3 has pyramidal geometry



(d) BF_3 has trigonal planer geometry



($\mu = 0$)

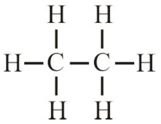
255. The C—H bond and C—C bond in ethane are formed by which of the following types of overlap?

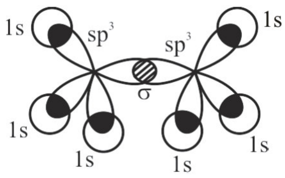
(a) sp^2 - s and sp^2-sp^2 (b) sp-s and sp-sp

(c) p-s and p-p (d) sp^3-s and sp^3- sp^3

Karnataka-CET-2012

Ans. (d) : In ethane the structure is –





In ethane C atom are sp^3 hybridised and attached with single sigma bond.

The H atoms are 1s to form σ-bond. The C–H bond and C–C bond in ethane are formed by sp^3–s and sp^3–sp^3 overlap.

256. Which one of the following statements regarding ammonia is not correct?

(a) NH_3 has sp^2 hybridization

(b) NH_3 acts as a Lewis base

(c) NH_3 gas is highly soluble in water

(d) NH_3 is pyramidal in shape

UP CPMT-2012

Ans. (a) : Ammonia molecule is sp^3 hybridised. It is trigonal pyramidal with the nitrogen atom at the apex. Due to the presence of one lone pair of electrons its shape becomes trigonal pyramidal from tetrahedral.

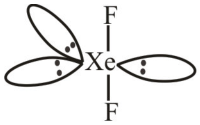
257. In which of the following pairs, the central atoms have the same number of lone pairs of electrons?

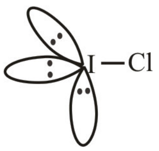
(a) PCl_5, BrF_5 (b) XeF_2, ICl

(c) XeF_4, ClO_4^- (d) SCl_4, CH_4

AP-EAMCET- (Engg.)-2011

Ans. (b) : XeF_2 and ICl have the central atoms are Xe and I respectively have the same number of lone pairs of electrons.





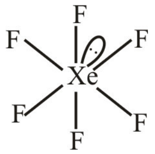
258. The hybridisation of Xe and the number of lone pairs of electrons on it in XeF_6 are

(a) $sp^3d^2, 1$ (b) $sp^3d^3, 2$

(c) $sp^3d^2, 2$ (d) $sp^3d^3, 1$

AP-EAMCET- (Engg.)-2011

Ans. (d) :



XeF_6

XeF_6 has distorted octahedral structure. The hybridisation of Xe is sp^3d^3 and present one lone pair.

259. A σ bonded molecule MX_3 is T-shaped. The number of non bonded pair of electrons is

(a) 0

(b) 2

(c) 1

(d) can be predicted only if atomic number is known

BITSAT 2011

Ans. (b) : For T-shape geometry the molecule must have 3 bonded pair and 2 lone pair of electrons.

260. Pick out the iso-electronic structures from the following

CH_3^+;	H_3O^+;	NH_3;	CH_3^-
I	II	III	IV

(a) I and II (b) I and II

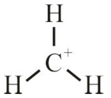
(c) I and IV (d) II,III and IV

CG PET- 2011

@apna_pdf

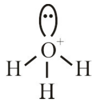
Ans. (d) : The structure of given compound are –

(i) CH_3^+



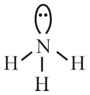
Trigonal planar

(ii) H_3O^+



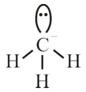
Pyramidal

(iii) NH_3



Pyramidal

(iv) CH_3^-



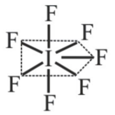
Pyramidal

Hence, the iso-electronic structures are H_3O^+, NH_3 and CH_3^-.

261. The structure of IF_7 is
(a) Square pyramid
(b) Trigonal bipyramid
(c) Octahedral
(d) Pentagonal bipyramidal

(AIEEE-2011)

Ans. (d) The structure of IF_7 is pentagonal bipyramidal. It has sp^3d^3 hybridisation and angle is 90°, 72°.



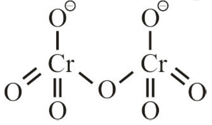
Pentagonal bipyramidal (sp^3d^3)

262. The bonds present in the structure of dichromate ion are
(a) four equivalent Cr—O bonds only
(b) six equivalent Cr—O bonds and one O—O bond
(c) six equivalent Cr—O bonds and one Cr—Cr bond
(d) eight equivalent Cr—O bonds
(e) six equivalent Cr—O bonds and one Cr—O—Cr bond

Kerala-CEE-2011

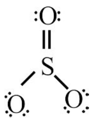
Ans. (e) : The dichromate ion $\left(Cr_2O_7^{2-}\right)$. There is –2 charge on overall molecule. In dichromate ion has two chromium atoms.

The 6 Cr–O bonds have equal length and the charge is on the overall molecule. The structure of the dichromate di-anion can be represented in two forms.

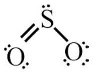


263. Which of the following structures is the most preferred and hence of lowest energy for SO_3?

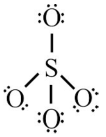
(a)



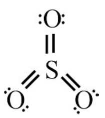
(b)



(c)



(d)

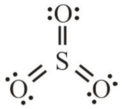


NEET-2011

Ans. (d) : Formal charge decided the lowest energy structure from a number of possible Lewis structure is given species.

Formal charge = Total no. of valence electron – non bonding e^- $-\frac{1}{2}\times$ bonding e^-

In SO_3,



Formal charge of S atom = $6-0-\frac{1}{2}\times 12=0$

Formal charge of O atom = $6-4-\frac{1}{2}\times 4=0$

Hence, the option (d) is most preferred and lowest energy of SO_3.

264. Structure of ICl_2^- is
(a) Trigonal
(b) Octahedral
(c) Square planar
(d) Distorted trigonal bipyramidal

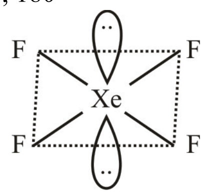
UP CPMT-2011

Ans. (d) : In ICl_2^-, I is sp^3d-hybridised. The structure of ICl_2^- is distorted trigonal bipyramidal due to the presence of lone pair of electrons.

265. XeF_4 has a shape of
(a) spherical (b) trigonal bipyramidal
(c) square planar (d) tetrahedral

CG PET- 2010

Ans. (c): XeF_4 (Xenon tetrafluoride) has a shape of square planar.
- Hybridization : sp^3d^2
- Bond angle : 90°, 180°



266. Match the following.

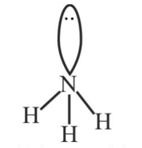
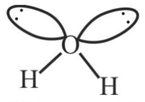
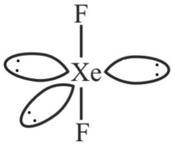
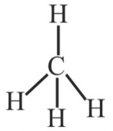
	Column I (Molecules)		**Column II (Number of lone pairs on central atom)**
A.	**NH_3**	**1.**	**Two**
B.	**H_2O**	**2.**	**Three**
C.	**XeF_2**	**3.**	**Zero**
D.	**CH_4**	**4.**	**Four**
		5.	**One**

	A	B	C	D
(a)	5	1	3	2
(b)	3	1	2	5
(c)	5	1	2	3
(d)	1	5	3	4

AP-EAMCET- (Engg.) - 2010

@apna_pdf

Ans. (c) :

Column –I (molecules)	**Column –II (no. of lone pairs on central atom)**
NH_3	 (1 lone pair)
H_2O	 (2 lone pair)
XeF_2	 (3 lone pair)
CH_4	 (0 lone pair)

267. Which one of the following conversions involve change in both hybridization and shape?

(a) $CH_4 \rightarrow C_2H_6$ (b) $NH_3 \rightarrow NH_4^+$

(c) $BF_3 \rightarrow BF_4^-$ (d) $H_2O \rightarrow H_3O^+$

KARNATAKA-CET, 2010

Ans. (c) :

(a) $\underset{\substack{4bp+0lp\\ \text{Hybridisation } sp^3\\ \text{Structure tetrahdral}}}{CH_4} \longrightarrow \underset{\text{tetrahdral}}{\underset{\substack{4bp\\ sp^3}}{CH_3} - \underset{\substack{4bp\\ sp^3}}{CH_3}}$

(b) $\underset{\substack{3bp+1lp\\ \text{Hybridisation } sp^3\\ \text{Structure pyramidal}}}{NH_3} \longrightarrow \underset{\substack{4bp\\ sp^3\\ \text{tetrahedral}}}{NH_4^+}$

(c) $\underset{\substack{3bp\\ \text{Hybridisation } sp^2\\ \text{Structure trigonal}\\ \text{planar}}}{BF_3} \longrightarrow \underset{\substack{4bp\\ sp^3\\ \text{tetrahedral}}}{BF_4^-}$

(d) $\underset{\substack{2bp+2lp\\ \text{Hybridisation } sp^3\\ \text{Structure angular}}}{H_2O} \longrightarrow \underset{\substack{3bp+1lp\\ sp^3\\ \text{pyramidal}}}{H_3O^+}$

Thus, conversion of BF_3 into BF_4^- involves change or both hybridisation and shape.

268. Which of the following statements is false?

(a) H_2 molecule has 1 σ bond

(b) HCl molecule has1 σ bond

(c) Water molecule has 2 σ bonds and two lone pairs

(d) Ethylene molecule has 5 σ bonds and 1π bond

(e) Acetylene molecule has 3π bonds and 3 σ bond

Kerala-CEE-2010

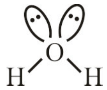
Ans. (e) : (i) H_2 molecule has 1 σ-bond.

H – H

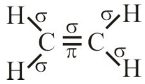
(ii) HCl molecule has 1 σ-bond.

H – Cl

(iii) Water molecule has 2 σ-bond and two lone pairs.



(iii) Ethylene molecule has 5 σ-bond and 1π-bond.



(iv) Acetylene (C_2H_2) molecule has 2π-bond and 3σ-bond.

$$H\overset{\sigma}{-}C\underset{2\pi}{\overset{\sigma}{\equiv}}C\overset{\sigma}{-}H$$

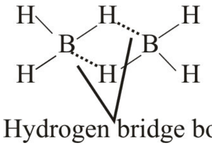
269. In which of the following molecules is hydrogen bridge bond present?

(a) Water (b) Inorganic benzene

(c) Diborane (d) Methanol

WB-JEE-2010

Ans. (c) : Diborane (B_2H_6) is the chemical compound consisting of boron and hydrogen with the formula B_2H_6. If is a colourless and highly unstable gas at room temperature with a repulsively sweet odour. Diborane mixed with air easily and forming explosive mixture.



Hydrogen bridge bond.

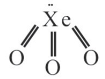
270. The number of pπ – dπ 'pi' bonds present in XeO_3 and XeO_4 molecules, respectively are

(a) 3, 4 (b) 4, 2

(c) 2, 3 (d) 3, 2

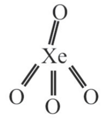
VITEEE- 2009

Ans. (a) : **Structure of XeO_3**



⇒ 3pπ-dπ bonds.

Structure of XeO_4



⇒ 4pπ-dπ bonds.

271. Which of the following specis in non-linear ?

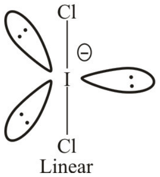
(a) ICl_2^- (b) I_3^-

(c) N_3^- (d) ClO_2^-.

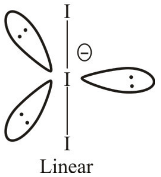
AMU – 2009

Ans. (d) :

(i) ICl_2^- (ii) I_3^-



Linear



Linear

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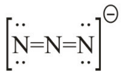
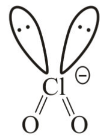
(iii) N_3^-



Linear

(iv) ClO_2^-



V-shaped (angular)

272. A compound has four sp^3 hybridised covalent bonds. Its shape is

(a) linear (b) square planar
(c) octahedral (d) tetrahedral

BCECE-2009

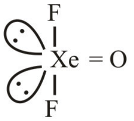
Ans. (d) : A compound has four sp^3 hybridised covalent bonds. It shape is tetrahedral.
When one s-orbital and 3p-orbitals belonging to the same shell of an atom mix together to form four new equivalent orbital, the type of hybridisation is called a tetrahedral and angle is 109°28'.

273. The shape of $XeOF_2$ on the basis of VESPR theory is

(a) See saw (b) V-shaped
(c) Trigonal planar (d) T-shaped

J & K CET-(2009)

Ans. (d) : The structure of $XeOF_2$ on the basis of VSEPR theory.



(sp^3d) (T-shaped)

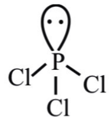
In $XeOF_2$ molecule the shape is T-shaped and hybridisation is sp^3d.

274. The shape of PCl_3 molecule is

(a) trigonal bipyramidal (b) tetrahedral
(c) pyramidal (d) square planar

JCECE - 2009

Ans. (c) : The shape of PCl_3 is trigonal pyramidal. The central atom P has one lone pair of electrons and three bond pairs of electron. The hydridisation of PCl_3 is sp^3.



Trigonal pyromidal

275. Which of the following represents the Lewis structure of N_2 molecule?

(a) ${}^{x}_{x}N \equiv N^{x}_{x}$

(b) ${}^{x}_{x}\overset{xx}{N} \equiv \overset{xx}{N}^{x}_{x}$

(c) ${}^{x}_{x}\overset{xx}{N} \equiv \underset{xx}{\overset{xx}{N}}^{x}_{x}$

(d) ${}^{x}_{x}\underset{xx}{\overset{xx}{N}} \equiv \underset{xx}{\overset{xx}{N}}^{x}_{x}$

JCECE - 2009

Ans. (a) : Diatomic nitrogen (N_2) molecule has a triple bond between the two atoms one σ bond from combining of $2p_z$ atomic orbitals and two π–bonds from the combination of $2p_x$ and $2p_y$ respectively. The lewis structure to N_2 molecule.

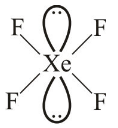
$${}^{x}_{x}N \equiv N^{x}_{x}$$

276. The shape of XeF_4 molecule and hybridization of xenon in it are

(a) tetrahedral and sp^3
(b) square planar and dsp^2
(c) square planar and sp^3d^2
(d) octahedral and sp^3d^2
(e) octahedral and d^2sp^3

Kerala-CEE-2009

Ans. (c) : The structure of XeF_4 is square planar–



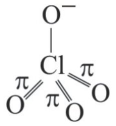
The shape of XeF_4 is square planar and the hybridisation is sp^3d^2.

277. The compound in which the number of dπ-pπ bonds are equal to those present in ClO_4^-, is:

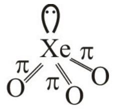
(a) XeF_4 (b) XeO_3
(c) XeO_4 (d) XeF_6

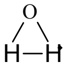
AP-EAMCET/2008

Ans. (b): The structure of ClO_4^-



It contain 3dπ – pπ bonds and XeO_3 contain 3dπ – pπ bonds as:

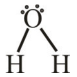


278. The  **bond angle in H_2O is 104.5°. This fact can be best explained with the help of**

(a) Valence Shell Electron Pair Repulsion (VSEPR) Theory
(b) Molecular Orbital Theory
(c) Presence of hydrogen bond
(d) Electronegativity difference between hydrogen and oxygen atoms.

MPPET-2008

Ans. (a) :



H_2O has sp^3 hybridisation and bond angle is 104.5°. It is explained with the help of Valence Shell Electron Pair Repulsion (VSEPR) theory.

279. The actual geometry of NO_2^- is

(a) Planer (b) Linear
(c) V -shape (d) Tetrahedral

MPPET-2008

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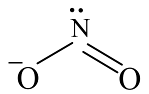
Ans. (c) : the geometry of NO_2^- is



V– shaped geometry.

280. Match the following

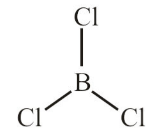
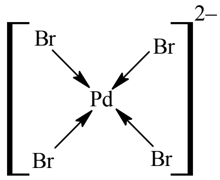
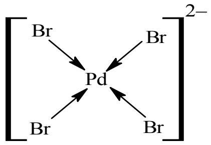
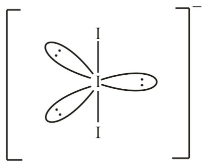
List-I	List-II
(A) BCl_3	(i) Linear
(B) $PdBr_4^{2-}$	(ii) Planar triangular
(C) SF_6	(iii) Tetrahedral
(D) I_3^-	(iv) Octahedral
	(v) Square planer

The correct match is

	A	B	C	D
(a)	(ii)	(iii)	(iv)	(i)
(b)	(v)	(iii)	(ii)	(i)
(c)	(ii)	(v)	(iv)	(i)
(d)	(v)	(iv)	(iii)	(ii)

AP-EAMCET (Medical), 2008

Ans. (c) :

	Compound	Hybridisation	Structure
(A)	BCl_3	sp^2	 Planar Triangular
(B)	$PdBr_4^{2-}$	dsp^2	 (Square planer)
(B)	$PdBr_4^{2-}$	dsp^2	 (Square planer)
(D)	I_3^-	sp^3d	 (Linear)

281. Which one of the following is a correct set with respect to molecule, hybridisation and shape?

(a) $BeCl_2$, sp^2, linear

(b) $BeCl_2$, sp^2, triangular planar

(c) BCl_3, sp^2, triangular planar

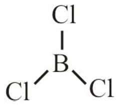
(d) BCl_3, sp^3, tetrahedral

BCECE-2008

Ans. (c) : The structure of the molecule –

Cl – Be – Cl

Linear (sp)



Triangular planar (sp^2)

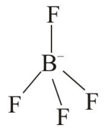
282. Which of the following is not tetrahedral ?

(a) BF_4^- (b) NH_4^+

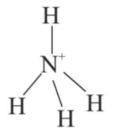
(c) CO_3^{2-} (d) SO_4^{2-}

AP-EAMCET/2007

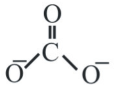
Ans. (c): The structure are given as :



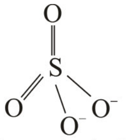
(Tetrahedral)



(Tetrahedral)



Trigonal Planar



(Tetrahedral)

Hence, CO_3^{2-} is a trigonal planar.

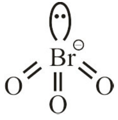
283. In which of the following pairs, the two species are iso-structural?

(a) SO_3^{2-} and NO_3^- (b) BF_3 and NF_3

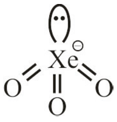
(c) BrO_3^- and XeO_3 (d) SF_4 and XeF_4

NEET-2007

Ans. (c) : The iso-structural species are –



and



Pyramidal Pyramidal

So, the two species BrO_3^- and XeO_3 both are iso-structural.

284. Among the following, the pair in which the two species are not isostructural is

(a) IO_3^- and XeO_3 (b) PF_6^- and SF_6

(c) BH_4^- and NH_4^+ (d) CO_3^{2-} and NO_2^-

(e) SiF_4 and SF_4

Kerala-CEE-2007

Ans. (d&e) :

Species	**Structure**
IO_3^-	Pyramidal
XeO_3	Pyramidal
PF_6^-	Octahedral
SF_6	Octahedral
BH_4^-	Tetrahedral
NH_4^+	Tetrahedral
CO_3^{2-}	Trigonal planar
NO_2^-	V-shaped
SiF_4	Tetrahedral
SF_4	See-saw

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285. Match List-I with List-II and choose the correct matching codes from the choices given.

List-I	List-II
A. PCl_5	1. Linear
B. IF_7	2. pyramidal
C. H_3O^+	3. Trigonal bipyramidal
D. ClO_2	4. Tetrahedral
E. NH_4^+	5. Pentagonal bipyramidal
	6. Angular

Codes

(a) A-3, B-5, C-2, D-1, E-4
(b) A-3, B-5, C-4, D-1, E-2
(c) A-3, B-5, C-6, D-1, E-2
(d) A-3, B-5, C-2, D-6, E-4
(e) A-3, B-5, C-2, D-4, E-1

Kerala-CEE-2007

Ans. (d) :

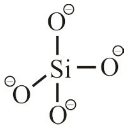
List-I	**List-II**
PCl_5	Trigonal bipyramidal
IF_7	Pentagonal bipyramidal
H_3O^+	Pyramidal
ClO_2	Angular
NH_4^+	Tetrahedral

286. Geometry of SiO_4^{4-} anion is

(a) tetrahedral (b) trigonal
(c) trihedral (d) pentagonal

MHT CET-2007

Ans. (a) : The structure of SiO_4^{4-} anion is –



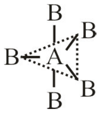
In SiO_4^{4-} has tetrahedral geometry and hybridisation is sp^3. In SiO_4^{4-} have four Si–O bond are present.

287. Which of the following is not a correct statement?

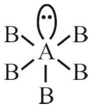
(a) Multiple bonds are always shorter than corresponding single bonds.
(b) The electron deficient molecules can act as Lewis acids
(c) The canonical structures have no real existence
(d) Every AB_5 molecule does in fact have square pyramid structure

NEET-2006

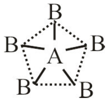
Ans. (d) : Generally AB_5 molecule have trigonal bipyramidal structure due to sp^3d hybridisation but AB_5 molecule have three possible geometries –



Trigonal bipyramidal



Square pyramidal



Planar pentagonal

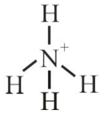
288. Which of the following is not iso-structural with $SiCl_4$?

(a) NH_4^+ (b) SCl_4
(c) SO_4^{2-} (d) PO_4^{3-}

NEET-2006

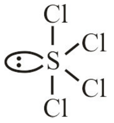
Ans. (b) : The geometry of $SiCl_4$ is tetrahedral and hybridisation is sp^3.

(i) NH_4^+



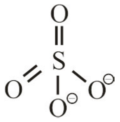
Td

(ii) SCl_4



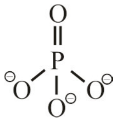
See-saw

(iii) SO_4^{2-}



Td

(iv) PO_4^{3-}



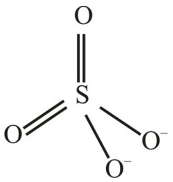
Td

289. The shape of sulphate ion is :

(a) square planar (b) trigonal
(c) trigonal planar (d) tetrahedral

BCECE-2006

Ans. (d) : The sulphate ion is SO_4^{2-} and the structure is



The shape of sulphate ion (SO_4^{2-}) is tetrahedral and hybridisation is sp^3.

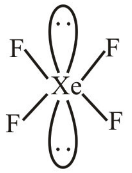
290. Among the following, the species having square planar geometry for central atom are
(i) XeF_4 (ii) SF_4 (iii) $[NiCl_4]^{2-}$ (iv) $[PtCl_4]^{2-}$

(a) (i) and (iv) (b) (i) and (ii)
(c) (ii) and (iii) (d) (iii) and (iv)

AIIMS-2006

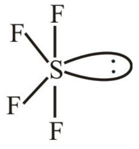
Ans. (a): The shape of the species are–

(i) XeF_4



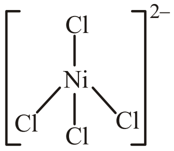
Square planar

(ii) SF_4



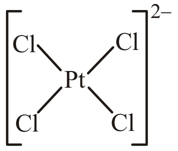
See–saw

(iii) $[NiCl_4]^{2-}$



Tetrahedral

(iv) $[PtCl_4]^{2-}$



Square planar

Hence, the species having square planar geometry for central atom are XeF_4, $[PtCl_4]^{2-}$

@apna_pdf

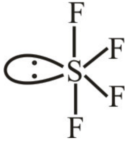
291. In which of the following molecules/ions, all the bonds are not equal?

(a) SF_4 (b) SiF_4

(c) XeF_4 (d) BF_4^-

(AIEEE-2006)

Ans. (a) : In geometry of SF_4 molecule is –



In SF_4 molecule has two type of bond two are axial and two are equatorial. In equatorial position bond length is small in comparison to axial bond length because axial bond has no hindrance (crowding) in environment. So, SF_4 has show two type of bond.

292. Which of the following molecule in its valence shell has three bond pairs of electrons and one lone pair of electron?

(a) NH_3 (b) H_2O

(c) BF_3 (d) CO_2

J & K CET-(2006)

Ans. (a) :

Molecule	Bond Pair	Lone pair
NH_3	3	1
H_2O	2	2
BF_3	3	0
CO_2	2	0

In NH_3 (ammonia) molecule in its valence shell has three bond pairs of electrons and one lone pair of electron.

293. Which is extremely stable?

(a) NF_3 (b) NCl_3

(c) NBr_3 (d) NH_3

JCECE - 2006

Ans. (a) : Nitrogen is belong to 2nd period and smaller in size due to which it can accommodate only atoms which are smaller in size. Fluorine being smaller in size can form a better bond with nitrogen because both belong to 2nd period element. Chlorine belongs to 3rd period element it can overlap is not better. So, NF_3 is a stable compound due to which same shell is involved in overlap.

294. Which of the following species has a linear shape?

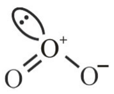
(a) O_3 (b) NO_2^-

(c) SO_2 (d) NO_2^+

NEET-2006

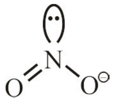
Ans. (d) : The shape of the following species –

(i) O_3



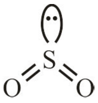
V-shape

(ii) NO_2^-



Bent

(iii) SO_2



V-shape

(iv) NO_2^+

$O=\overset{+}{N}=O$

Linear

295. Assertion: $SeCl_4$ does not have a tetrahedral structure.

Reason: Se in $SeCl_4$ has two lone pairs.

(a) If both Assertion and Reason are correct and the Reason is correct explanation of the Assertion.

(b) If both Assertion and Reason are correct but Reason is not a correct explanation of the Assertion.

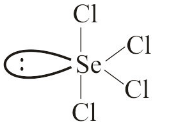
(c) If the Assertion is correct but Reason is incorrect.

(d) If both the Assertion and Reason are incorrect.

(e) If the Assertion is incorrect but the Reason is correct.

AIIMS-2005

Ans. (c): $SeCl_4$ has see-saw geometry, which is regarded as a distorted trigonal bipyramidal structure, one lone pair of electron is equatorial position of trigonal bipyramidal $SeCl_4$ molecules arises due to sp^3d hybridisation of the central atom.



$SeCl_4$ molecule

296. Which of the following molecules has pentagonal bipyramidal shape?

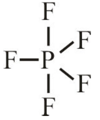
(a) PF_5 (b) SF_6

(c) XeF_6 (d) $[Fe(CN)_6]^{3-}$

AMU-2005

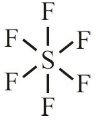
Ans. (c) : The shape of molecule are –

(i) PF_5



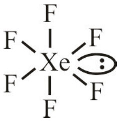
Trigonal bipyramidal

(ii) SF_6



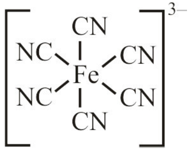
Octahedral

(iii) XeF_6



Pentagonal bipyramidal

(iv) $[Fe(CN)_6]^{3-}$



Octahedral

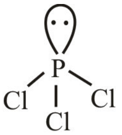
297. The molecule having a pyramidal shape out of the following is

(a) CO_2 (b) PCl_3

(c) SF_4 (d) NH_4^+

J & K CET-(2005)

Ans. (b) : PCl_3 has a pyramidal shape due to phosphorous atom is sp^3 hybridized with three bond pairs and one lone pair.



Pyramidal (sp^3)

@apna_pdf

298. The pair having similar geometry is

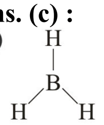
(a) BH_3, NH_3 (b) $BeCl_2$, H_2O

(c) CH_4, CCl_4 (d) IF_5, PF_5

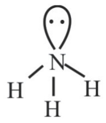
J & K CET-(2005)

Ans. (c) :

(a)



Trigonal Planar

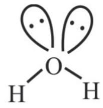


Pyramidal

(b)

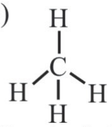
Cl–Be–Cl

linear

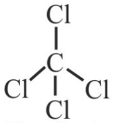


V-shaped

(c)

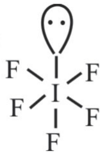


Tetrahedral

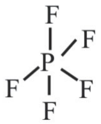


Tetrahedral

(d)



Square pyramidal



Trigonal bipyramidal

Hence, the option (a) and (c) both pair have similar geometry.

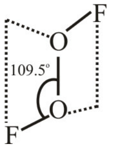
299. Shape of O_2F_2 is similar to that of;

(a) C_2F_2 (b) H_2O_2

(c) H_2F_2 (d) C_2H_2

AIIMS-2004

Ans. (b): The shape of O_2F_2 and H_2O_2 are similar. O_2F_2 and H_2O_2 are peroxides



In O_2F_2 and H_2O_2 , one O–O bond lying in a plane and two O–F bonds lying in different plane. H_2O_2 and O_2F_2 has non–linear and non–planar structure. O_2F_2 and H_2O_2 both have open book type structure.

300. Assertion: All F–S–F angle is SF_4 are greater than 90° but less than 180°,

Reason: The lone pair- bond pair repulsion is weaker than bond pair- bond pair repulsion.

(a) If both Assertion and Reason are correct and the Reason is correct explanation of the Assertion.

(b) If both Assertion and Reason are correct but Reason is not a correct explanation of the Assertion.

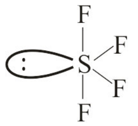
(c) If the Assertion is correct but Reason is incorrect.

(d) If both the Assertion and Reason are incorrect.

(e) If the Assertion is incorrect but the Reason is correct.

AIIMS-2004

Ans. (d): In SF_4 molecule has see-saw structure in which bond angles are different between different S-F atoms. SF_4 molecule has sp^3d hybridisation and non-planar structure. According to VSEPR theory lone pair-lone pair > lone pair-bond pair > bond pair-bond pair repulsion.



SF_4 molecule

301. Identify the correct sequence of increasing number of a bonds in the structures of the following molecules :

I. $H_2S_2O_6$ II. H_2SO_3

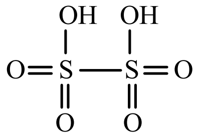
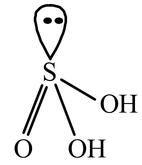
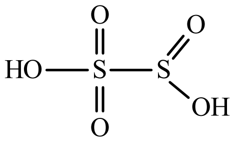
III. $H_2S_2O_5$

(a) I < II < III (b) II < III < I

(c) II < I < III (d) I < III < II

AP-EAMCET (Engg.)-2004

Ans. (b) : The molecules are $H_2S_2O_6$(I), H_2SO_3(II) and $H_2S_2O_5$.

	Structure	Number of bonds
(i)	 (Dithionic acid)	9σ, 4π
(ii)	 (Sulfurous acid)	3σ, 1π
(iii)	 (Disulfurous acid)	8σ, 3π

Hence, the correct sequence of increasing number of a bonds is given as:- II < III < I.

302. Which one of the following has the regular tetrahedral structure?

(Atomic number : B = 5, S = 16, Ni = 28, Xe=54)

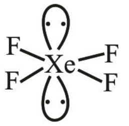
(a) XeF_4 (b) SF_4

(c) BF_4^- (d) $\left[Ni(CN)_4\right]^{2-}$

(AIEEE-2004)

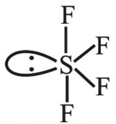
Ans. (c) : The structure of the species are –

(i) XeF_4



(Square planar

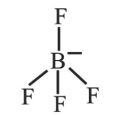
(ii) SF_4



(See- Saw)

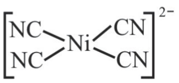
@apna_pdf

(iii) BF_4^-



(Tetrahedral)

(iv) $[Ni(CN)_4]^2$



(Square planar)

In BF_4^- has the regular tetrahedral structure.

303. Two oxides of nitrogen, NO and NO_2 react together at 253K and form a compound of nitrogen, X. X reacts with water to yield another compound of nitrogen, Y. The shape of the anion of Y molecule is

(a) Tetrahedral (b) Angular
(c) Square Planar (d) Pyramidal

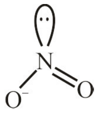
AP EAMCET- 2003

Ans. (b) : When NO and NO_2 react together at 253 K then N_2O_3 is formed. N_2O_3 (X) is react with H_2O to form the hyponitrous acid (HNO_2)

$$NO + NO_2 \xrightarrow{253K} \underset{'X'}{N_2O_3}$$

$$N_2O_3 + H_2O \rightarrow \underset{'Y'}{2HNO_2}$$

$$HNO_2 \rightarrow H^+ + NO_2^-$$



The shape of NO_2^- is shown in figure which is angular in shape.

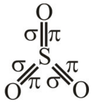
304. Compound X is anhydride of sulphuric acid. The number of σ-bonds and the number of π-bonds present in X are, respectively

(a) 3, 3 (b) 4, 2
(c) 2, 4 (d) 4, 3

AP EAMCET- 2003

Ans. (a) : Sulphuric acid decomposes to give sulphure trioxide, SO_3 and H_2O, thus SO_3 is regarded as anhydride of sulphuric acid

$$H_2SO_4 \xrightarrow[-H_2O]{} H_2O + SO_3$$



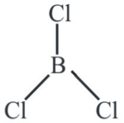
3σ and 3π are present in anhydride of H_2SO_4.

305. Which one of the following is a correct set with respect to molecule hybridisation and shape?

(a) $BeCl_2$, sp^2, linear
(b) $BeCl_2$, sp^2, triangular planar
(c) BCl_3, sp^2, triangular planar
(d) BCl_3, sp^3, tetrahedral

AP-EAMCET (Medical), 2003

Ans. (c) : The molecules are

$BeCl_2$	BCl_3
Cl–Be–Cl Hybridisation = sp Shape = linear	 Hybridisation = sp^2 Shape = Trigonal planer

306. The electronic theory of bonding was proposed by :

(a) Pauling (b) Lewis
(c) Bronsted (d) Mullikan

BCECE-2003

Ans. (b) : The electronic theory of bonding was proposed by Lewis. Pauling gave the scale of electro negativity, Bronsted gave the concept of acid and base. Mullikan gave the determination charge on electron.

307. The geometry of the molecule having s and p-characters equal to 25% and 75% respectively, is:

(a) trigonal (b) linear
(c) tetrahedral (d) octahedral

JCECE - 2003

Ans. (c): The geometry of molecule having S and P-character equal to 25% and 75% respectively is tetrahedral.

308. Which one of the following is the correct with reference to molecular formula, hybridisation of central atom and shape of the molecule?

(a) CO_2, sp^2, bent (b) H_2O, sp^2, bent
(c) $BeCl_2$, sp, linear (d) H_2O, sp^3, linear

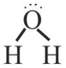
AP-EAMCET (Medical), 2002

Ans. (c) : (a) CO_2, $:\ddot{O} = C = \ddot{O}:$

Hybridisation = sp

Shape = linear

(b) H_2O,



Hybridisation = sp^3

Shape = Angular

(c) $BeCl_2$, Cl — Be — Cl

Hybridisation = sp

Shape = linear

Thus, the correct option is (c).

309. Assertion: Sigma (σ) is a strong bond, while pi (π) is a weak bond.

Reason: Atoms rotate freely about pi (π) bond.

(a) If both Assertion and Reason are correct and the Reason is correct explanation of the Assertion.
(b) If both Assertion and Reason are correct but Reason is not a correct explanation of the Assertion.
(c) If the Assertion is correct but Reason is incorrect.
(d) If both the Assertion and Reason are incorrect.
(e) If the Assertion is incorrect but the Reason is correct.

AIIMS-2002

Ans. (c): Sigma (σ) bonding involves end to end overlapping of two atomic orbitals. eg. s and s, s and p and p and p orbitals.

π-bonding involves sidewise overlapping of the two atomic orbitals. eg. p and p orbital.

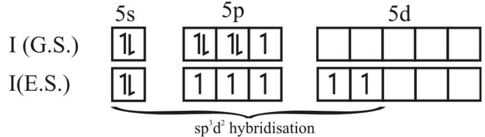
Hence, the overlapping of orbitals is more effective in σ bonding than in π-bonding due to lateral overolap in π- bonding atom cannot rotate freely in π-bond.

@apna_pdf

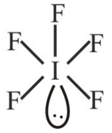
310. The shape of IF_5 is
(a) pentagonal bipyramidal
(b) square pyramidal
(c) octahedral
(d) trigonal planner

UP CPMT-2001

Ans. (b) : Hybridization and lone pair of electrons decide the geometry of molecule.



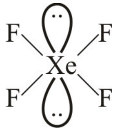
The hybridization in IF_5 molecule is sp^3d^2 but geometry is square pyramidal instead of octahedral due to presence of lone pair of electron in valence shell of iodine.



311. The number of lone pairs of electrons present on Xe in XeF_4 is :
(a) 3
(b) 4
(c) 1
(d) 2

AP EAMCET (Engg.) 2001

Ans. (d): The structure of XeF_4 is square planar:



Number of lone pairs of electrons present on Xe in XeF_4 is 2. The hybridization of Xe is sp^3d^2.

312. Which of the following is the correct pair?
(a) $BeCl_2$ – linear
(b) NH_3 – linear
(c) CO_2 – Tetrahedral
(d) BF_3 – octahedral

AP-EAMCET/2000

Ans. (a):

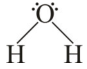
Molecule	Hybridization	Geometry/Shape
$BeCl_2$	sp	Linear
NH_3	sp^3	Pyramidal
CO_2	sp	Linear
BF_3	sp^2	Trigonal planer

Hence, option (a) is correct.

313. According to VSEPR theory the shape of the water molecule is:
(a) linear
(b) planar triangle
(c) V-shaped
(d) octahedral

AP EAMCET (Medical) -1998

Ans. (c): The structure of H_2O–

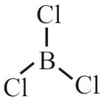


The hybridisation of water molecule is sp^3. There is two lone pair electron present on oxygen atom due to which they acquire the V-shaped.

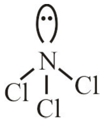
314. The BCl_3 is a planar molecule whereas NCl_3 is pyramidal because
(a) nitrogen atom is smaller than boron atom
(b) BCl_3 has no lone pair but NCl_3 has a lone pair of electrons
(c) B – Cl bond is more polar than N – Cl bond
(d) N – Cl bond is more covalent than B – Cl bond

NEET-1995

Ans. (b) : BCl_3 is planar molecule where as NCl_3 is pyramidal because BCl_3 has no lone pair but NCl_3 has a lone pair of electron.



Trigonal planar



Pyramidal

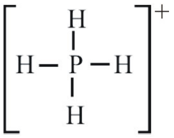
315. d^2sp^3 hybridization represents which of the following configurations?
(a) Tetrahedral
(b) Square planar
(c) Linear
(d) Octahedral

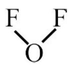
AP-EAMCET/1992

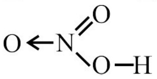
Ans. (d) : Molecule having d^2sp^3 hybridization of central atom is octahedral geometry. This type of hybridization forms the inner orbital complexes.

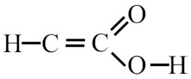
- Tetrahedral geometry has the sp^3 type of hybridization.
- The hybridization of square planer geometry is dsp^2.
- The linear geometry has 180° bond angle with sp hybridization.

316. Which one of the following formulae does not correctly represents the bonding capacities of the two atoms involved?

(a)


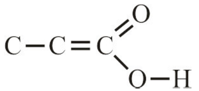
(b)


(c)


(d)


NEET-1990

Ans. (d) : The structure,



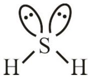
does not correctly represent the bonding capacities of atom because the valency of carbon is four but one carbon has three bonds attached and other carbon have five bond attached.

317. Which of the following molecules does not have a linear arrangement of atoms?
(a) H_2S
(b) C_2H_2
(c) BeH_2
(d) CO_2

NEET-1989

Ans. (a) : The structure of given molecule –

(i) H_2S



V-shaped

(ii) C_2H_2

$\mathrm{H-\underset{sp}{C}\equiv\underset{sp}{C}-H}$

Linear

(iii) BeH_2

$\mathrm{H-\underset{sp}{Be}-H}$

Linear

(iv) CO_2

$\mathrm{O=\underset{sp}{C}=O}$

Linear

H_2S molecule does not have a linear arrangement of atom.

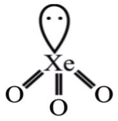
@apna_pdf

318. Among the following molecule
(i) XeO_3 (ii) $XeOF_4$ (iii) XeF_6
Those having same number of lone pairs on Xe are
(a) (i) and (ii) only (b) (i) and (iii) only
(c) (ii) and (iii) only (d) (i), (ii) and (iii)

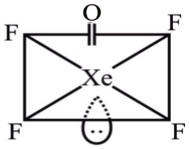
VITEEE 2019

Ans. (d) :

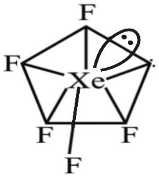
(i) XeO_3



(ii) $XeOF_4$



(iii) XeF_6



All molecule have same number of lone pairs on Xe.

319. Which of the following molecules/ions does not contain unpaired electrons?
(a) O_2^{2-} (b) B_2
(c) N_2^+ (d) O_2

AIEEE 2008

Ans. (a) : According to molecular orbital diagram –

(i) For $O_2^{2-} = \sigma 1s^2, \sigma^* 1s^2, \sigma 2s^2, \sigma^* 2s^2, \sigma 2p_z^2, \pi 2p_x^2$
$= \pi 2p_y^2, \pi^* 2p_x^2 = \pi^* 2p_y^2$

O_2^{2-} molecules/ions does not contain unpaired electrons.

(ii) For $B_2 = \sigma 1s^2, \sigma^* 1s^2, \sigma 2s^2, \sigma^* 2s^2, \pi 2p_x^1 = \pi 2p_y^1$

B_2 molecules/ions contain two unpaired electron.

(iii) For $N_2^+ = \sigma 1s^2, \sigma^* 1s^2, \sigma 2s^2, \sigma^* 2s^2, \pi 2p_x^2$
$= \pi 2p_y^2, \sigma 2p_y^1$

N_2^+ molecule/ions contain one unpaired electron.

(iv) For $O_2 = \sigma 1s^2, \sigma^* 1s^2, \sigma 2s^2, \sigma^* 2s^2, \sigma 2p_z^2, \pi 2p_x^2$
$= \pi 2p_y^2, \pi^* 2p_x^1 = \pi^* 2p_y^1$

O_2 molecule/ions contain two unpaired electron.

3. Magnetic behavior of Molecules

320. The spin–only magnetic moment value of the most basic oxide of vanadium among V_2O_3, V_2O_4 and V_2O_5 is _____ B.M. (Nearest integer)

JEE Main-26.06.2022, Shift-I

Ans. (3) : V_2O_3 is most basic oxide. Total number of unpaired electron in V^{+3} is n = 2.
Hence, the spin only magnetic moment

$$\mu_s = \sqrt{n(n+2)}$$
$$\mu_s = \sqrt{2(2+2)} = \sqrt{8} = 2.87 \text{ BM}$$
$$\approx 3 \text{ BM.}$$

321. which of the following is paramagnetic?
(a) NO^+ (b) CO
(c) CN (d) O_2

Odisha NEET-2019, NEET-2013
JIPMER-2004, AMU–2001

Ans. (d) : Oxygen is a paramagnetic molecule. Its molecular orbital configuration is

$O_2 = (\sigma 2s)^2(\sigma^* 2s)^2(\sigma^* 2p_z)^2(\pi 2p_x^2 = \pi 2p_y^2)$
$(\pi^* 2p_x^1 = \pi^* 2p_y^1)$

O_2 molecule has unpaired electron its show paramagnetic.

322. N_2 and O_2 are converted into monocations, N_2^+ and O_2^+ respectively. Which of the following statements is wrong
(a) In N_2^+, the N–N bond weakens.
(b) In O_2^+, the O–O bond order increases.
(c) In O_2^+, paramagnetism decreases.
(d) N_2^+ becomes diamagnetic.

AIIMS-2013, Kerala CEE-2010
NEET-1997

Ans. (d): Molecular orbital configuration of these are -

(i) $N_2 = \sigma 1s^2, \sigma^* 1s^2, \sigma 2s^2, \sigma^* 2s^2, \pi 2p_x^2 = \pi 2p_y^2, \sigma 2p_z^2$

$$B.O = \frac{10-6}{2} = 3$$

(ii) $O_2 = \sigma 1s^2, \sigma^* 1s^2, \sigma 2s^2, \sigma^* 2s^2, \sigma 2p_z^2, \pi 2p_x^2 = \pi 2p_y^2, \pi^* 2p_x^1$
$= \pi^* 2p_y^1$

$$B.O = \frac{10-6}{2} = 2$$

(iii) $N_2^+ = \sigma 1s^2, \sigma^* 1s^2, \sigma 2s^2, \sigma^* 2s^2, \pi 2p_x^2 = \pi 2p_y^2, \sigma 2p_z^1$

$$B.\ O = B.O = \frac{9-4}{2} = 2.5$$

(iv) $O_2^+ = \sigma 1s^2, \sigma^* 1s^2, \sigma 2s^2, \sigma^* 2s^2, \sigma 2p_z^2, \pi 2p_x^2$
$= \pi 2p_y^2, \pi^* 2p_x^1 = \pi^* 2p_y$

$$B.O = \frac{10-5}{2} = 2.5$$

$\therefore$ Bond order $\propto$ Bond strength.
If bond order increase then bond strength also increase
Thus, N_2^+ is paramagnetic so, the option (d) is correct according to the question.

323. The molecule NO is
(a) paramagnetic
(b) diamagnetic
(c) ferromagnetic
(d) an even electron molecule.

J & K CET-(2012)
CGPET-2010, NEET-1995

@apna_pdf

Ans. (a) : The molecular orbital configuration is –
For,

$$NO = \sigma 1s^2, \sigma^* 1s^2, \sigma 2s^2, \sigma^* 2s^2, \sigma 2p_z^2, \pi 2p_x^2, = \pi 2p_y^2$$

$$\pi^* 2p_x^1 = \pi^* 2p_y$$

In NO has one unpaired electron, it show a paramagnetic.

324. Paramagnetism is shown by

(a) N_2 (b) O_2
(c) F_2 (d) CO_2

Manipal-2018
J & K CET-(2012)
UPTU/UPSEE-2004

Ans. (b) : The paramagnetirm is show by O_2 molecule because it has two unpaired electron. The molecular orbital configuration of

$$O_2 = \sigma 1s^2, \sigma^* 1s^2, \sigma 2s^2, \sigma^* 2s^2, \sigma 2p_z^2, \pi 2p_x^1, = \pi 2p_y^2$$

$$\pi^* 2p_x^1 = \pi^* 2p_y^1$$

325. The paramagnetic behaviour of B_2 is due to the presence of

(a) two unpaired electrons in π_b MO
(b) two unpaired electrons in π^* MO
(c) two unpaired electrons in σ^* MO
(d) two unpaired electrons in σ_b MO

WB-JEE-2012
UPTU/UPSEE-2004

Ans. (a) : The most electronic configuration to

$$B_2 = \sigma 1s^2, \sigma^* 1s^2, \sigma 2s^2, \sigma^* 2s^2, \pi 2p_x^1 = \pi 2p_{y,}^1$$

It is paramagnetic due to two unpaired electron on two unpaired electron π - molecular bonding orbital.

326. In which of the following ionization processes the bond energy increases and the magnetic behaviour changes from paramagnetic to diamagnetic?

(a) $O_2 \to O_2^+$ (b) $C_2 \to C_2^+$
(c) $NO \to NO^+$ (d) $O_2 \to O_2^+$

AP EAPCET 24.08.2021, Shift-I
Karnataka NEET-2013

Ans. (c) :

$$NO \longrightarrow NO^+ + e^\ominus$$

Total electron present in NO is 15. 'NO' is paramagnetic in nature because it have one electron (unparied electron) in 2px orbital. When we remove the one electron from NO we get the NO^+ which is in diamagnetic in nature because unpaired electron are not present.

327. KO_2 exhibits paramagnetic behaviour. This is due to the paramagnetic nature of

(a) KO^- (b) K^+
(c) O_2 (d) O_2^-

AP EAMCET (Engg.) -2014
AIIMS-2003

Ans. (d): KO_2 is a superoxide in which only one electron is released from the dioxygen atom and a superoxide ion is represented as O_2^-. In KO_2 the oxygen atoms bear $-\frac{1}{2}$ oxidation state and they also behave as a free radical species having an unpaired electron. KO_2 is paramagnetic due to presence of unpaired electrons.

328. The species analogous to paramagnetic behaviour like O_2 is

(a) monoclinic sulphur (b) rhombic sulphur
(c) colloidal sulphur (d) gaseous sulphur.

AMU-2019, 2014

Ans. (d) : The formula of gaseous sulphur exists as S_2. The S_2 molecule has two unpaired electron in the antibonding 3p orbital and hence the species analogous to paramagnetic behavior like O_2 is gaseous sulphur.

329. Which one of the following is not paramagetic?

(a) NO (b) N_2^+
(c) CO (d) O_2^-

BCECE-2012
NEET-2000

Ans. (c) : In CO, number of electron = 14
According to molecular orbital configuration is -

$$CO = \sigma 1s^2, \sigma^* 1s^2, \sigma 2s^2, \sigma^* 2s^2, \pi 2p_x^2 = \pi 2p_y^2, \sigma 2P_z^2$$

In CO all electron are paired. Hence, it show diamagnetic not a paramagnetic.

330. Atomic number of Cr, Fe and Co are 24, 26 and 27 respectively. Which of the following inner orbital octahedral complexes are paramagnetic?

(a) $[Co(NH_3)_6]^{3+}$ (b) $[Co(CN)_3]^{3+}$
(c) $[Fe(CN)_6]^{4-}$ (d) $[Cr(CN)_6]^{3-}$

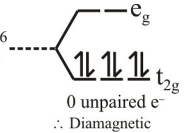
AP EAPCET 23-08-2021 Shift-I

Ans. (d) : All complexes are the inner orbital complexes because of availability of strong field ligand.

(i) $[Co(NH_3)_6]^{3+}$

Let, Oxidation state of Co is x
∴ $x + 6(0) = +3$
or $x = +3$

$Co^{3+} = [Ar]3d^6$ or d^6

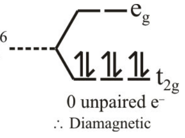


NH_3 show strong field ligand in Co^{+3}

(ii) $[Co(CN)_3]^{3+}$

Let, Oxidation state of Co is x
∴ $x + 3(0) = +3$
or $x = +3$

$Co^{3+} = [Ar]3d^6$ or d^6



(iii) $[Fe(CN)_6]^{4-}$

Let, Oxidation state of Fe is x
∴ $x + 6(-1) = -4$
or $x = +2$

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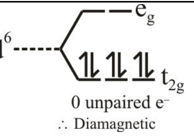
$Fe^{2+} = [Ar]3d^6$ or d^6



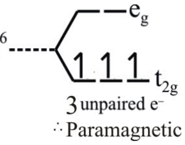
(iv) $[Cr(CN)_6]^{3-}$

Let, Oxidation state of Cr is x

∴ $x + 6(-1) = -3$

or $x = +3$

$Cr^{3+} = [Ar]3d^3$ or d^6



Hence, the correct option is (d).

331. Which of the following is not arranged in the correct sequence?

(a) MO, M_2O_3, MO_2, M_2O_5 – Decreasing basic nature
(b) Sc, V, Cr, Mn – Increasing number of oxidation states
(c) d^5, d^3, d^1, d^4 Increasing magnetic moment
(d) $Mn^{2+}, Fe^{2+}, Cr^{2+}, Co^{2+}$ decreasing stability

AP EAPCET 20.08.2021 Shift-I

Ans. (c) : Magnetic moment $(\mu) = \sqrt{n(n+2}$

Where n = number of 4n paired electro n.

So d^1 : $\mu = \sqrt{1(1+2)} = \sqrt{3} = 1.73\text{BM}$

$d^2 : \mu = \sqrt{2(2+2)} = \sqrt{8} = 2.83$ BM

$d^3 : \mu = \sqrt{3(3+2)} = \sqrt{15} = 3.88$ BM

$d^4 : \mu = \sqrt{4(4+2)} = \sqrt{24} = 4.90$ BM

$d^5 : \mu = \sqrt{5(5+2)} = \sqrt{35} = 5.92$ BM

So the increasing magnetic moment
$d^1 < d^2 < d^3 < d^4 < d^5$.

332. The bond order and magnetic behaviour of O_2^- ion are, respectively

(a) 1.5 and paramagnetic
(b) 1.5 and diamagnetic
(c) 2 and diamagnetic
(d) 1 and paramagnetic

(JEE Main 2021, 26 Aug. Shift-II)

Ans. (a) : The molecular orbital configuration is –

For $O_2^- = \sigma 1s^2, \sigma^* 1s^2, \sigma 2s^2, \sigma^* 2s^2, \sigma 2p_z^2, \pi 2p_x^2, = \pi 2p_y^2$

$\pi^* 2p_x^2 = \pi^* 2p_y^1$

It is a paramagnetic

$$\text{B.O.} = \frac{\text{No.of bonding } e^- - \text{No.of anti bonding } e^-}{2}$$

$$= \frac{10-7}{2} = \frac{3}{2} = 1.5$$

333. The spin-only magnetic moment value of B_2^+ species is .... × 10^{-2} BM. (Nearest integer) [Given, $\sqrt{3} = 1.73$]

(a) 100 (b) 120
(c) 173 (d) 160

(JEE Main 2021, 1 Sep Shift-II)

Ans. (c) : The molecular orbital configuration is –

$B_2^+ = \sigma 1s^2, \sigma^* 1s^2, \sigma 2s^2, \sigma^* 2s^2, \pi 2p_x^1, = \pi 2p_y$

Number of unpaired electron in $B_2^+ = 1$

∴ Magnetic moment $(\mu) = \sqrt{n(n+2)}$

$= \sqrt{1(1+2)}$

$= \sqrt{3} = 1.73$ BM

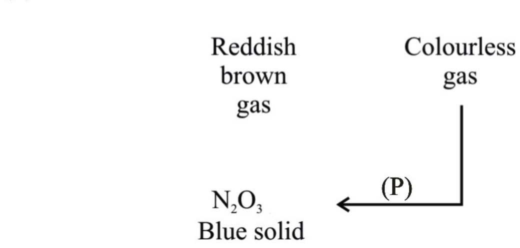
$= 173 \times 10^{-2}$ BM.

334. A colourless, neutral, paramagnetic oxide of nitrogen 'P' on oxidation gives reddish brown gas Q, Q on cooling gives colourless gas R. R on reaction with P gives blue solid S. Identify P, Q, R, S respectively

(a) N_2O, NO, NO_2, N_2O_5
(b) N_2O, NO_2, N_2O_4, N_2O_3
(c) NO, NO_2, N_2O_4, N_2O_3
(d) NO, NO, N_2O_4, N_2O_5

Karnataka-CET-2021

Ans. (c) :



335. The bond order and the magnetic characteristics of CN^- are

(a) 3, diamagnetic (b) $2\frac{1}{2}$, Paramagnetic
(c) 3, paramagnetic (d) $2\frac{1}{2}$, diamagnetic

(JEE Main 2020, 7 Jan. Shift-II)

Ans. (a) : The molecular orbital configuration is–

$CN^- = \sigma 1s^2, \sigma^* 1s^2, \sigma 2s^2, \sigma^* 2s^2, \sigma 2p_x^2 = \pi 2p_y^2, \pi 2p_z^2$

$$\text{Bond order} = \frac{\text{No. of bonding } e^- - \text{No.of antibonding } e^-}{2}$$

$$= \frac{10-4}{2} = 3$$

The magnetic characteristic of CN^- is diamagnetic.

336. If the magnetic moment of a dioxygen species is 1.73 BM, it may be:

(a) O_2, O_2^- or O_2^+ (b) O_2^- or O_2^+
(c) O_2 or O_2^- (d) O_2 or O_2^+

(JEE Main 2020, 9 Jan. Shift-II)

Ans. (b) : The molecular orbital configuration is–

For $O_2^{1-} = \sigma 1s^2, \sigma^* 1s^2, \sigma 2s^2, \sigma^* 2s^2$

$\sigma 2p_z^2, \pi 2p_x^2 = \pi 2p_y^2, \pi^* 2p_x^2 = \pi^* 2p_y^1$

The no. of unpaired e^- in $O_2^- = 1$

Magnetic moment $(\mu) = \sqrt{n(n+2)}$

@apna_pdf

$$=\sqrt{1(1+2)}=\sqrt{3}=1.732$$

For $O_2^+ = \sigma 1s^2, \sigma^* 1s^2, \sigma 2s^2, \sigma^* 2s^2 \sigma 2p_z^2$

$$\pi 2p_x^2 = \pi 2p_y^2, \pi^* 2p_x^1 = \pi^* 2p_y$$

The no. of unpaired e^- in $O_2^+ = 1$

Magnetic moment $(\mu) = \sqrt{n(n+2)}$

$$=\sqrt{1(1+2)}=\sqrt{3}=1.732\,BM$$

337. Which of the compounds among N_2O, NO, N_2O_3, NO_2, N_2O_4, N_2O_5 are diamagnetic ?

(a) NO, NO_2, N_2O_3

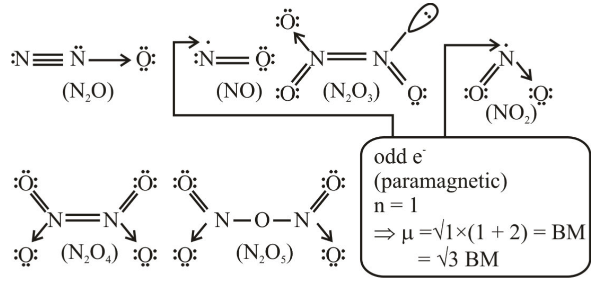
(b) N_2O, N_2O_3, N_2O_4, N_2O_5

(c) NO, NO_2

(d) N2O_4, N_2O_5

AP EAMCET (Engg.) 17.09.2020 Shift-I

Ans. (b) : Let us draw the structure of nitrogen oxides.



N_2O, N_2O_3, N_2O_4, N_2O_5 do not have unpaired electrons (n = 0). So, they are diamagnetic (μ = 0).

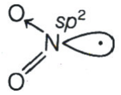
338. The magnetic property of NO_2 is ....

(a) Ferromagnetic (b) Diamagnetic

(c) Non-magnetic (d) Paramagnetic

AP EAMCET (Engg.) 18.9.2020 Shift-I

Ans. (d) : Magnetic property of NO_2 (g) is paramagnetic due to the presence of unpaired electron on N-atom of NO_2.



339. Assertion: In vapour state, S_2 molecule shows paramagnetic behaviour.

Reason: S_2 molecule has two paired electrons in the antibonding t_{2g} orbital like O_2.

(a) If both Assertion and Reason are correct and Reason is the correct explanation of Assertion.

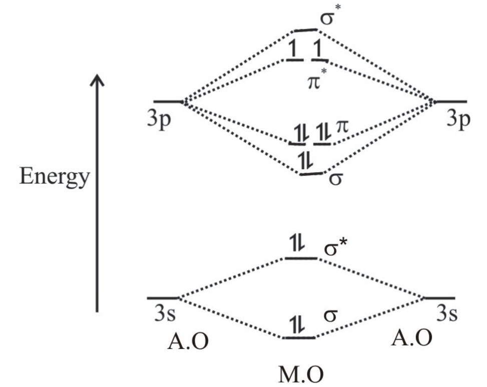
(b) If both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.

(c) If Assertion is correct but Reason is incorrect.

(d) If both the Assertion and Reason are incorrect.

AIIMS 25 May 2019 (Evening)

Ans. (c): : In ordinary condition sulphur exists as S_8 in solid state. In vapour state sulphur partly exists as S_2 molecule. In S_2 molecule has two unpaired electrons in the antibonding π^* orbitals.



340. Assertion: Ferromagnetic compound is more attracted in magnetic field.

Reason: Because all electron are aligned in same direction.

(a) If both Assertion and Reason are correct and Reason is the correct explanation for Assertion.

(b) If both Assertion and Reason are correct, but Reason is not the correct explanation for Assertion.

(c) If Assertion is correct but Reason is incorrect.

(d) If both the Assertion and Reason are incorrect.

AIIMS 26 May 2019 (Morning)

Ans. (a): Ferromagnetic compound is more attracted in magnetic field due to all electron are aligned in same direction.

Magnetic linear force is imaginary in the sense it cannot be seen as a live around the magnet but lines of force are not non-physical in the sense their presence can be detected experimentally.

341. MnO is:

(a) Ferromagnetic (b) Antiferromagnetic

(c) Ferrimagnetic (d) Diamagnetic

AIIMS 26 May 2019 (Morning)

Ans. (b): Mn has a 5 electrons in the d-subshell which make its orbital half-filled. So it has maximum magnetic moment amond 3d elements and has the value of magnetic susceptibility greater than zero. The magnetic susceptibility is greater than magnitude and the electrons are aligned such that they cancel the effects of each other due to opposite direction. Hence, MnO is shown antiferro-magnetism.

Note- Metal like Fe, Co, Ni show ferromagnetism

342. Among the following molecules/ions,

$$\mathbf{C_2^{2-}, N_2^{2-}, O_2^{2-}, O_2}$$

Which one is diamagnetic and has the shortest bond length ?

(a) C_2^{2-} (b) O_2

(c) O_2^{2-} (d) N_2^{2-}

(JEE Main 2019, 8 April Shift-II)

Ans. (a) : The molecular orbital configuration is –

(i) $C_2^{2-} = \sigma 1s^2, \sigma * 1s^2, \sigma 2s^2, \sigma * 2s^2, \pi 2p_x^2 = \pi 2p_y^2, \sigma 2p_z^2$

It is a diamagnetic.

Bond order $= \dfrac{10-4}{2} = 3$

@apna_pdf

(ii) $N_2^{2-} = \sigma 1s^2, \sigma^* 1s^2, \sigma 2s^2, \sigma^* 2s^2, \sigma 2p_z^2, \pi 2p_x^2 = \pi 2p_y^2$

$\pi^* 2p_x^1 = \pi^* 2p_y^1$

It is a paramagnetic

Bond order $= \frac{10-6}{2} = 2$

(iii) $O_2^{2-} = \sigma 1s^2, \sigma^* 1s^2, \sigma 2s^2, \sigma^* 2s^2, \sigma 2p_z^2, \pi 2p_x^2$

$= \pi 2p_y^2, \pi^* 2p_x^2 = \pi^* 2p_y^2$

It is a diamagnetic

Bond order $= \frac{10-8}{2} = 1$

(iv) $O_2 = \sigma 1s^2, \sigma^* 1s^2, \sigma 2s^2, \sigma^* 2s^2, \sigma 2p_z^2, \pi 2p_x^2$

$= \pi 2p_y^2, \pi^* 2p_x^1 = \pi^* 2p_y^1$

It is a paramagnetic

Bond order $= \frac{10-6}{2} = 2$

$\therefore \boxed{\text{Bond order} \propto \frac{1}{\text{Bond length}}}$

When bond order increase then bond length decrease.

Hence, C_2^{2-} has diamagnetic and shortest bond length.

343. Which of these species will have non-zero magnetic moment?

(a) Na^+ (b) Mg
(c) F^- (d) Ar^+

WB-JEE-2019

Ans. (d) : Ar^+ contain unpaired electron having configuration [Ne] $3s^2 3p^5$. All other species do not have unpaired electron.

344. In 3d-series as we move from scandium to zinc, the paramagnetism:

(a) increases
(b) decreases
(c) first increases to a maximum and then decreases
(d) first decreases to a minimum and the increases.

COMEDK 2018

Ans. (c) : In 3d-series, as we move from scandium to manganese, the paramagnetism increases due to increasing the number of unpaired electron but after manganese, the paramagnetic character decreases due to the decreasing number of unpaired electron.

345. Which of the following is the correct order for the theoretical magnetic moment?

(a) $Cr^{3+} > Mn^{2+} = Fe^{3+}$
(b) $Cr^{3+} = Mn^{2+} < Fe^{3+}$
(c) $Cr^{3+} < Mn^{2+} = Fe^{3+}$
(d) $Cr^{3+} < Mn^{2+} < Fe^{3+}$

GUJCET-2017

Ans. (c) : For $Cr^{3+} = \boxed{\upharpoonleft}\boxed{\upharpoonleft}\boxed{\upharpoonleft}\boxed{\ }\boxed{\ }$

n=3 (unpaired electron)

Magnetic moment $= \sqrt{3(3+2)} = \sqrt{15} = 3.83\,\text{BM}$

For $Mn^{2+} = \boxed{\upharpoonleft}\boxed{\upharpoonleft}\boxed{\upharpoonleft}\boxed{\upharpoonleft}\boxed{\upharpoonleft}$

n=5 (unpaired electron)

Magnetic moment $= \sqrt{5(5+2)} = \sqrt{35} = 5.92\,\text{BM}$

For $Fe^{3+} = \boxed{\upharpoonleft}\boxed{\upharpoonleft}\boxed{\upharpoonleft}\boxed{\upharpoonleft}\boxed{\upharpoonleft}$

n=5 (unpaired electron)

Magnetic moment $= \sqrt{5(5+2)} = \sqrt{35} = 5.92\,\text{BM}$

Hence, the order of theoretical magnetic moment is $Cr^{3+} < Mn^{2+} = Fe^{3+}$

346. The ground state magnetic property of B_2 and C_2 molecules will be:

(a) B_2 paramagnetic and C_2 diamagnetic
(b) B_2 diamagnetic and C_2 paramagnetic
(c) Both are dimagnetic
(d) Both are paramagnetic

WB-JEE-2017

Ans. (a) : The molecular orbital configuration is –

(i) $B_2 = \sigma 1s^2, \sigma^* 1s^2, \sigma 2s^2, \sigma^* 2s^2, \pi 2p_x^1 = \pi 2p_{y,}^1$

It is a paramagnetic due to two unpaired electron in B_2 molecule.

(ii) $C_2 = \sigma 1s^2, \sigma^* 1s^2, \sigma 2s^2, \sigma^* 2s^2, \pi 2p_x^2 = \pi 2p_{y,}^2$

It is a diamagnetic due to zero unpaired electron.

347. A transition elements with atomic number 24 will have its magnetic moment

(a) 5.92 B.M.
(b) 6.93 B.M.
(c) it will be diamagnetic
(d) it will be more than 8 B.M.

COMEDK 2015

Ans. (b) : A transition metal element with atomic number 24 is chromium. The electronic configuration of Cr is $[Ar]3d^5 4s^1$. There are six unpaired electron present in outer shell orbit. Hence, The spin only magnetic moment is $\sqrt{6(6+2)} = 6.93\text{BM}$

348. Which one is diamagnetic molecule/ion?

(a) O_2^+ (b) O_2^-
(c) O_2^{2-} (d) O_2

SRMJEEE – 2014

Ans. (c)

(a) $O_2^+ (15) = \sigma 1s^2, \sigma^* 1s^2, \sigma 2s^2, \sigma^* 2s^2 \sigma 2p_z^2$

$\pi 2p_x^2 = \pi 2p_y^2, \pi_2^* p_x^1$

(b) O_2^- (17) $= \sigma 1s^2 \sigma^* 1s^2, \sigma 2s^2, \sigma^* 2s^2$

$\sigma 2p_z^2, \pi 2p_x^2 = \pi 2p_y^2, \pi^* 2p_x^2 = \pi^* 2p_y^1$

unpaired electron = 1 (Paramagnetic)

(c) O_2^{2-} (18) $= \sigma 1s^2, \sigma^* 1s^2, \sigma 2s^2, \sigma^* 2s^2$

$\sigma 2p_z^2, \pi 2p_x^2 = \pi 2p_y^2, \pi^* 2p_x^2 = \pi^* 2p_y^2$

unpaired electron = 0 (diamagnetic)

(d) O_2 (16) $= \sigma 1s^2, \sigma^* 1s^2, \sigma 2s^2, \sigma^* 2s^2$

$\sigma 2p_z^2, \pi 2p_x^2 = \pi 2p_y^2, \pi^* 2p_x^1 = \pi^* 2p_y^1$

unpaired electron = 2 (paramagnetic)

Hence, the correct option is C.

349. The highest magnetic moment is shown by the transition metal ion with the configuration

(a) $3d^2$ (b) $3d^5$
(c) $3d^7$ (d) $3d^9$

SRMJEEE – 2014

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Ans. (b) : The number of unpaired electrons increase, magnetic moment increases.

$\mu = \sqrt{n(n+2)}$ BM

Where n = No. of unpaired electron

(i) $3d^2 \Rightarrow n = 2, \mu = 2.82$ BM

(ii) $3d^5 \Rightarrow n = 5, \mu = 5.92$ BM

(iii) $3d^7 \Rightarrow n = 3, \mu = 3.87$ BM

(iv) $3d^9 \Rightarrow n = 1, \mu = 1.73$ BM

Hence, configuration $3d^5$ has highest magnetic moment.

350. The ratio of magnetic moment (spin only value) between $[FeF_6]^{3-}$ and $[Fe(CN)_6]^{3-}$ is approximately

(a) 4 (b) 2

(c) 5 (d) 3

AMU-2014

Ans. (d) : In $[FeF_6]^{3-}$ and $[Fe(CN)_6]^{3-}$ both have Fe^{3+} In $[FeF_6]^{3-}$, F^- being a weak field ligand. In $[Fe(CN)_6]^{3-}$, CN^- being a strong field ligand.

$[FeF_6]^{3-} = Fe^{3+} = \boxed{\upharpoonleft}\boxed{\upharpoonleft}\boxed{\upharpoonleft}\boxed{\upharpoonleft}\boxed{\upharpoonleft}$

n = 5 (unpaired electron)

$$\text{Magnetic moment } (\mu_1) = \sqrt{n(n+2)} = \sqrt{5(5+2)} = \sqrt{5\times7} = \sqrt{35} = 5.9\text{BM}$$

$[Fe(CN)_6]^{3-} = Fe^{3+} = \boxed{\upharpoonleft\downharpoonright}\boxed{\upharpoonleft\downharpoonright}\boxed{\upharpoonleft}\boxed{}\boxed{}$

n = 1 (unpaired electron)

$$\text{Magnetic moment } (\mu_2) = \sqrt{n(n+2)} = \sqrt{1(1+2)} = \sqrt{3} = 1.73\text{BM}$$

So, Ratio of μ_1 and $\mu_2 = \frac{\mu_1}{\mu_2} = \frac{5.9}{1.73} = 3.41 \simeq 3$

351. Paramagnetism is exhibited due to which one of the following reason?

(a) Presence of unpaired electrons

(b) Presence of completely shell electronic subshell

(c) By non-transition element

(d) By elements with noble gas configuration

J & K CET-(2014)

Ans. (a) : Paramagnetism is exhibited due to presence of unpaired electron.

Paramagnetism refers to the magnetic state at an atom with one or more unpaired electron. The unpaired electron are attracted by a magnetic field due to the electron magnetic dipole moment.

352. The diamagnetic molecule among the following is :

(a) O_2 (b) N_2

(c) N_2^- (d) O_2^-

UP CPMT-2014

Ans. (b) : Molecules having no unpaired electrons are diamagnetic in nature.

$N_2(14) = \sigma1s^2, \sigma^*1s^2, \sigma2s^2, \sigma^*2s^2,$

$\pi2p_x^2 = \pi2p_y^2, \sigma2p_z^2$

No unpaired electron is present, so it is a diamagnetic species.

353. Which one of the following molecules is expected to exhibit diamagnetic behaviour?

(a) C_2 (b) N_2

(c) O_2 (d) S_2

Karnataka-CET-2013

Ans. (a, b) : The molecular orbital configuration are–

(i) $C_2 = \sigma1s^2, \sigma^*1s^2, \sigma2s^2, \sigma^*2s^2, \pi2p_x^2 = \pi2p_y^2$

It is diamagnetic

(ii) $N_2 = \sigma1s^2, \sigma^*1s^2, \sigma2s^2, \sigma^*2s^2, \pi2p_x^2, = \pi2p_y^2, \sigma2p_z^2$

It is a diamagnetic

(iii) $O_2 = \sigma1s^2, \sigma^*1s^2, \sigma2s^2, \sigma^*2s^2, \sigma2p_z^2, \pi2p_x^1, = \pi2p_y^2$

$\pi^*2p_x^1 = \pi^*2p_y^1$

It is paramagnetic.

(iv) $S_2 = \ldots\ldots\ldots\; 3p_z^2, \pi3p_x^2, = \pi3p_y^2, \pi^*3p_x^1, = \pi^*3p_y^1$

It is paramagnetic.

354. For simple molecules NO_2 and S_2, Which one of the following statements is correct?

(a) Both are diamagnetic.

(b) NO_2 is diamagnetic while S_2 is paramagnetic.

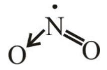
(c) S_2 is diamagnetic while NO_2 is paramagnetic.

(d) Both are paramagnetic.

SCRA 2012

Ans. (d) : Total valence electrons in NO_2 = 17

NO_2 has a free unpaired electron -It is an odd electron molecule. Therefore it is paramagnetic



Diatomic sulphur (S_2) is paramagnetic in nature like as O_2 molecule.

355. The spin only magnetic moment of Ni^{2+} (in B.M) in aqueous solution will be

(a) 1.73 (b) 2.82

(c) 3.42 (d) 2.25

COMEDK-2012

Ans. (b) : The electronic configuration of Ni^{2+} is $[Ar]3d^8$. The number of unpaired electron is 2. Hence the spin only magnetic moment will be $\sqrt{2(2+2)} = 2.8$ B.M

356. Among the following ions, which has the highest spin magnetic moment?
(At. No: Ti = 22; Mn = 25; Ni = 28; Cu = 29)

(a) Cu^{2+} (b) Ti^{3+}

(c) Ni^{2+} (d) Mn^{2+}

SRMJEEE – 2012

Ans. (d) : Magnetic moment is directly proportional to the number of unpaired electrons

(i) Cu^{2+} : n = 1

(ii) Ti^{3+} : n = 1

(iii) Ni^{2+} : n = 2

(iv) Mn^{2+} : n = 5

Therefore Mn^{2+} is highest spin magnetic moment.

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357. The paramagnetic oxides of nitrogen are

(a) dinitrogen monoxide and nitrogen monoxide
(b) nitrogen monoxide and nitrogen dioxide
(c) nitrogen dioxide and dinitrogen trioxide
(d) dinitrogen trioxide and dinitrogen tetraoxide

J & K CET-(2011)

Ans. (b) : Nitrogen monoxide (nitric oxide) is paramagnetic in nature due to one unpaired electron. It can be represented by the following resonance structure. Nitrogen dioxide is also paramagnetic due to one unpaired electron.

358. The pairs of species of oxygen and their magnetic behaviour are noted below. Which of the following presents the correct description?

(a) O_2^-, O_2^{2-} -both diamagnetic
(b) O^+, O_2^{2-} -both diamagnetic
(c) O_2^+, O_2 -both paramagnetic
(d) O, O_2^{2-} -both paramagnetic

NEET-2011

Ans. (c) : The molecular orbital configuration is –

(i) $O_2^+ = (15e^-) \Rightarrow \sigma 1s^2, \sigma^*1s^2, \sigma 2s^2, \sigma^*2s^2, \sigma 2p_z^2,$

$\pi 2p_x^2 = \pi 2p_y^2, \pi^*2p_x^1 = \pi^*2p_y$

It is a paramagnetic and one unpaired electron.

Magnetic moment $(\mu) = \sqrt{1(1+2)} = \sqrt{3} = 1.73\,BM.$

(ii) $O_2 = (16\ e^-) \Rightarrow \sigma 1s^2, \sigma^*1s^2, \sigma 2s^2, \sigma^*2s^2, \sigma 2p_z^2,$

$\pi 2p_x^2 = \pi 2p_y^2, \pi^*2p_x^1 = \pi^*2p_y^1$

It is a paramagnetic due to two unpaired electron.

Magnetic moment $(\mu) = \sqrt{2(2+2)} = \sqrt{8} = 2.83\,BM.$

359. Which of the O_2^-, O_2^{2-}, BN and NN is/are paramagnetic?

(a) NN (b) O_2^{2-}
(c) BN (d) O_2^-

UPTU/UPSEE-2011

Ans. (d) : According to molecular orbital electronic configuration is –

(i) $O_2^- = \sigma 1s^2, \sigma^*1s^2, \sigma 2s^2, \sigma^*2s^2, \sigma 2p_z^2,$

$\pi 2p_x^2 = \pi 2p_y^2,\ \pi^*2p_x^2 = \pi^*2p_y^1$

It is a paramagnetic due to 1 unpaired electron.

(ii) $O_2^{2-} = \sigma 1s^2, \sigma^*1s^2, \sigma 2s^2, \sigma^*2s^2, \sigma 2p_z^2,$

$\pi 2p_x^2 = \pi 2p_y^2,\ \pi^*2p_x^2 = \pi^*2p_y^2$

It is a diamagnetic due to zero unpaired electron

(iii) $BN = \sigma 1s^2, \sigma^*1s^2, \sigma 2s^2, \sigma^*2s^2,$

$\pi 2p_x^2 = \pi 2p_y^2$

It is a diamagnetic due to zero unpaired electron

(iv) $N_2 = \sigma 1s^2, \sigma^*1s^2, \sigma 2s^2, \sigma^*2s^2,$

$\pi 2p_x^2 = \pi 2p_y^2,\ \sigma 2p_z^2$

It is a diamagnetic due to zero unpaired electron

360. Which one of the following species does not exist under normal conditions?

(a) Be_2^+ (b) Be_2
(c) B_2 (d) Li_2

NEET-2010

Ans. (b) : According to molecular orbital configuration

(i) $Be_2^+ = \sigma 1s^2, \sigma^*1s^2, \sigma 2s^2, \sigma^*2s^1$

$$\text{Bond order} = \frac{4-3}{2} = 0.5$$

(ii) $Be_2 = \sigma 1s^2, \sigma^*1s^2, \sigma 2s^2, \sigma^*2s^2$

$$\text{Bond order} = \frac{4-4}{2} = 0$$

Thus Be_2 does not exist under normal condition.

(iii) $B_2 = \sigma 1s^2, \sigma^*1s^2, \sigma 2s^2, \sigma^*2s^2, \pi 2p_x^1 = \pi 2p_y^1$

$$\text{Bond order} = \frac{6-4}{2} = 1$$

(iv) $Li_2 = \sigma 1s^2, \sigma^*1s^2, \sigma 2s^2$

$$\text{Bond order} = \frac{4-2}{2} = 1$$

Hence, Be_2 does not exist under normal condition because bond order is zero.

361. Which one of the following sets correctly represents the increase in the paramagnetic property of the ions?

(a) $Cu^{2+} > V^{2+} > Cr^{2+} > Mn^{2+}$
(b) $Cu^{2+} < Cr^{2+} < V^{2+} < Mn^{2+}$
(c) $Cu^{2+} < V^{2+} < Cr^{2+} < Mn^{2+}$
(d) $V^{2+} < Cu^{2+} < Cr^{2+} < Mn^{2+}$

AP EAMCET (Engg.)-2009

Ans. (c): Paramagnetic property depend on the number of unpaired electron. Maximum the number of unpaired higher the paramagnetic properties.

$Cu^{2+} = [Ar]3d^9$, No. of unpaired $e^- = 1$

$V^{2+} = [Ar]3d^3$, No. of unpaired $e^- = 3$

$Cr^{2+} = [Ar]3d^4$, No. of unpaired $e^- = 4$

$Mn^{2+} = [Ar]3d^5$, No. of unpaired $e^- = 5$

Therefore, the order is -

$Cu^{2+} < V^{2+} < Cr^{2+} < Mn^{2+}$

362. Which one of the following molecules is paramagnetic?

(a) F_2 (b) B_2
(c) Li_2 (d) N_2

J & K CET-(2009)

Ans. (b) : The molecular orbital configuration is –

(i) $F_2 = \sigma 1s^2, \sigma^*1s^2, \sigma 2s^2, \sigma^*2s^2, \sigma 2p_z^2, \pi 2p_x^2, = \pi 2p_y^2$

$\pi^*2p_x^2 = \pi^*2p_y^2$

It is a diamagnetic

(ii) $B_2 = \sigma 1s^2, \sigma^*1s^2, \sigma 2s^2, \sigma^*2s^2, \pi 2p_x^1, = \pi 2p_y^1$

It is a paramagnetic

(iii) $Li_2 = \sigma 1s^2, \sigma^*1s^2, \sigma 2s^2$

It is a diamagnetic

(iv) $N_2 = \sigma 1s^2, \sigma^*1s^2, \sigma 2s^2, \sigma^*2s^2, \pi 2p_x^2, = \pi 2p_y^2, \sigma 2p_z^2$

It is a diamagnetic

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363. **When oxyhaemoglobin changes to de-oxyhaemoglobin, Fe^{2+} ion changes from**

(a) diamagnetic to paramagnetic
(b) paramagnetic to diamagnetic
(c) diamagnetic to ferromagnetic
(d) paramagnetic to ferromagnetic

AP - EAMCET (Medical) - 2007

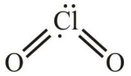
Ans. (a) : When oxyhaemoglobin changes to deoxyhaemoglobin, Fe^{2+} ion changes from diamagnetic to paramagnetic.

364. **Which one of the following oxides is expected to exhibit paramagnetic behavior?**

(a) CO_2 (b) SO_2
(c) ClO_2 (d) SiO_2

JIPMER-2007

Ans. (c) : The structure of ClO_2 is –



In ClO_2 has unpaired electron its show paramagnetic

365. **The transition metals mostly are**

(a) Diamagnetic
(b) Paramagnetic
(c) neither diamagnetic nor paramagnetic
(d) both diamagnetic and paramagnetic

CG PET -2006

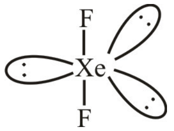
Ans. (b) : Transition metal mostly are show paramagnetic behavior paramagnetism is a property which is shown by the elements having unpaired electrons. In transition metals (n–1) d-orbitals are unpaired electron increases from one of five, the paramagnetic character increases.

366. **The number of paired electrons is Xe atom of XeF_2 is**

(a) 3 (b) 5
(c) 4 (d) 2

CG PET -2006

Ans. (a) : The structure of $XeFe_2$ is–



In XeF_2, the number of lone pair (paired electron) on Xe is three and bond pair is two. The geometry of XeF_2 is trigonal bipyramidol and shape is linear.

367. **The magnetic moment of lanthanide ions is determined from which one of the following relation?**

(a) $\mu = \sqrt{n(n+2)}$ (b) $\mu = g\sqrt{J(J+1)}$
(c) $\mu = g\sqrt{n(n+1)}$ (d) $\mu = 2\sqrt{n(n+1)}$

VITEEE- 2006

Ans. (b) : In case of lanthanoids, 4f–orbitals lie too deep and hence the magnetic effect of the motion of the electron in its orbital is not quenched out. Here spin contribution (S) and orbital contribution (L) couple together to give a new quantum number 'J'.

Thus magnetic moment of lanthanoids is given by,

$\mu = g\sqrt{J(J+1)}$

Where J = L – S when the shell is less than half fill

J = L + S when the shell is more than half fill

and $g = 1\frac{1}{2} + \frac{S(S+1) - L(L+1)}{2J(J+1)}$

368. **Assertion: B_2 molecule is diamagnetic.**
Reason: The highest occupied molecular orbital is of σ type.

(a) If both Assertion and Reason are correct and the Reason is correct explanation of the Assertion.
(b) If both Assertion and Reason are correct but Reason is not a correct explanation of the Assertion.
(c) If the Assertion is correct but Reason is incorrect.
(d) If both the Assertion and Reason are incorrect.
(e) If the Assertion is incorrect but the Reason is correct.

AIIMS-2005

Ans. (d): Molecular orbital diagram of B_2 is-

$B_2 = \sigma 1s^2, \sigma^* 1s^2, \sigma 2s^2, \sigma^* 2s^2, \pi 2p_x^1 = \pi 2p_y^1$

In B_2 it has two unpaired it is paramagnetic and the highest occupied molecular orbital is π-type.

369. **Assertion: Ozone is a powerful oxidising agent in comparison to O_2.**
Reason: Ozone is diamagnetic but O_2 is paramagnetic.

(a) If both Assertion and Reason are correct and the Reason is correct explanation of the Assertion.
(b) If both Assertion and Reason are correct but Reason is not a correct explanation of the Assertion.
(c) If the Assertion is correct but Reason is incorrect.
(d) If both the Assertion and Reason are incorrect.
(e) If the Assertion is incorrect but the Reason is correct.

AIIMS-2005

Ans. (b): Ozone (O_3) is a powerful oxidizing agent in comparison to O_2 due to decomposes readily under normal condition.

$O_3 \xrightarrow{\text{decompose}} O_2 + [O]$ nascent oxygen

O_2 is a paramagnetic due to presence of two unpaired electron, while O_3 is diamagnetic.

370. **Electrons in a paramagnetic compound are:**

(a) Shared (b) Unpaired
(c) Donated (d) Paired

UPTU/UPSEE-2004

Ans. (b) : A paramagnetic electrons is an unpaired electron. An atom is considered paramagnetic if even one orbital has a net spin. An atom could have ten diamagnetic electrons but as long as it also has one paramagnetic electron it is still considered as paramagnetic atom.

@apna_pdf

371. Assertion: Water is liquid but H_2S is a gas.
Reason : Oxygen is paramagnetic.

(a) If both Assertion and Reason are correct and the Reason is correct explanation of the Assertion.
(b) If both Assertion and Reason are correct but Reason is not a correct explanation of the Assertion.
(c) If the Assertion is correct but Reason is incorrect.
(d) If both the Assertion and Reason are incorrect.
(e) If the Assertion is incorrect but the Reason is correct.

AIIMS-1999

Ans. (b): Water is liquid but H_2S is gas due to which hydrogen bond in water.
Gaseous oxygen is paramagnetic because oxygen molecule has two unpaired electron Thus, reason does not justify assertion so, option (b) is correct.

372. Of the species H_2^+, He_2^+, and O_2^+, all are

(a) diamagnetic (b) paramagnetic
(c) stable (d) unstable

J & K CET-(1997)

Ans. (b) : The molecular orbital configuration are
(i) $H_2^+ = \sigma 1s^1$
It is a paramagnetic due to one unpaired electron.
(ii) $He_2^+ = \sigma 1s^2, \sigma^* 1s^1$
It is a paramagnetic due to one unpaired electron.
(iii) $O_2^+ = \sigma 1s^2, \sigma^* 1s^2, \sigma 2s^2, \sigma^* 2s^2, \sigma 2p_z^2, \pi 2p_x^2 =$
$\pi 2p_y^2, = \pi^* 2p_x^1 = \pi^* 2p_y$
It is a paramagnetic due to one unpaired electron.
Hence, the species H_2^+, He_2^+ and O_2^+ are all paramagnetic

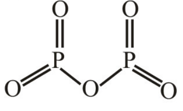
373. Which of the following molecules is paramagnetic?

(a) P_2O_5 (b) NO_2
(c) $H_2S_2O_7$ (d) N_2O_5

AIIMS-1996

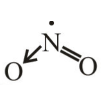
Ans. (b) : The structure of the following are-

(i) P_2O_5



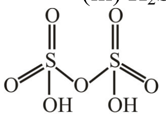
Diamagnetic

(ii) NO_2



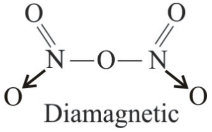
Paramagnetic

(iii) $H_2S_2O_7$



Diamagnetic

(iv) N_2O_5



Diamagnetic

In NO_2 molecule has one paired electrons its paramagnetic in nature.

374. Which of the following species exhibits diamagnetic behavior?

(a) O_2^{2-} (b) O_2^+
(c) O_2 (d) NO

AIEEE 2007

Ans. (a) : The molecular orbital configuration are–
(i) $O_2^{2-} = \sigma 1s^2, \sigma^* 1s^2, \sigma 2s^2, \sigma^* 2s^2$
$\sigma 2p_z^2, \pi 2p_x^2 = \pi 2p_y^2, \pi^* 2p_x^2 = \pi^* 2p_y^2$
It is diamagnetic.
(ii) $O_2^+ = \sigma 1s^2, \sigma^* 1s^2, \sigma 2s^2, \sigma^* 2s^2 \sigma 2p_z^2$
$\pi 2p_x^2 = \pi 2p_y^2, \pi^* 2p_x^1 = \pi^* 2p_y$
It is paramagnetic.
(iii) $O_2 = \sigma 1s^2, \sigma^* 1s^2, \sigma 2s^2, \sigma^* 2s^2$
$\sigma 2p_z^2, \pi 2p_x^2 = \pi 2p_y^2, \pi^* 2p_x^1 = \pi^* 2p_y^1$
It is paramagnetic
(iv) $NO = \sigma 1s^2, \sigma^* 1s^2, \sigma 2s^2, \sigma^* 2s^2, \sigma 2p_z^2, \pi 2p_x^1, = \pi 2p_y^2$
$\pi^* 2p_x^1 = \pi^* 2p_y$
It is paramagnetic

375. Among the following species, the diamagnetic molecule is

(a) CO (b) B_2
(c) NO (d) O_2

JEE Main 2019

Ans. (a) : The molecular orbital configuration are–
(i) $CO = \sigma 1s^2, \sigma^* 1s^2, \sigma 2s^2, \sigma^* 2s^2, \pi 2p_x^2 = \pi 2p_y^2, \sigma 2P_z^2$
It is a diamagnetic
(ii) $B_2 = \sigma 1s^2, \sigma^* 1s^2, \sigma 2s^2, \sigma^* 2s^2, \pi 2p_x^1 = \pi 2p_y^1$
It is a paramagnetic
(iii) $NO = \sigma 1s^2, \sigma^* 1s^2, \sigma 2s^2, \sigma^* 2s^2, \sigma 2p_z^2, \pi 2p_x^1, = \pi 2p_y^2$
$\pi^* 2p_x^1 = \pi^* 2p_y$
It is paramagnetic
(iv) $O_2 = (\sigma 2s)^2(\sigma^* 2s)^2(\sigma^* 2p_z)^2(\pi 2p_x^2 = \pi 2p_y^2)$
$(\pi^* 2p_x^1 = \pi^* 2p_y^1)$
It is a paramagnetic

4. Bond Order, Bond Length, Bond Angle, Bond Energy

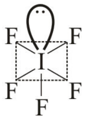
376. Amongst the following which one will have maximum 'lone pair-lone pair' electron repulsions?

(a) IF_5 (b) SF_4
(c) XeF_2 (d) ClF_3

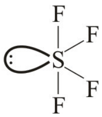
NEET-17.07.2022

Ans. (c) :

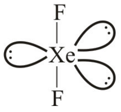
(i) IF_5



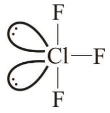
(ii) SF_4



(iii) XeF_2



(iv) ClF_3



In XeF_2 has 3 lone pair and have maximum lone pair-lone pair electron repulsion.

@apna_pdf

377. Which amongst the following is incorrect statement?

(a) C_2 molecule has four electrons in its two degenerate π molecular orbital's.

(b) H_2^+ ion has one electron.

(c) O_2^+ ion is diamagnetic.

(d) The bond orders of O_2^+, O_2, O_2^- and O_2^{2-} are 2.5, 2, 1.5 and 1, respectively.

NEET-17.07.2022

Ans. (c) : O_2^+ is a paramagnetic due to electron are unpaired.

For $O_2^+ = \sigma 1s^2, \sigma^*1s^2, \sigma 2s^2, \sigma^*2s^2, \sigma 2p_z^2, \pi 2p_x^2 = \pi 2p_y^2,$

$\pi^*2p_x^1 = \pi^*2p_y$

$$\text{Bond order} = \frac{\text{No. of bonding } e^- - \text{No. of antibonding } e^-}{2}$$

$$= \frac{10-5}{2}$$

$$= 2.5$$

Hence, O_2^+ is paramagnetic in nature.

378. The correct order of bond orders of C_2^{2-}, N_2^{2-}, O_2^{2-} is respectively

(a) $C_2^{2-} < N_2^{2-} < O_2^{2-}$

(b) $O_2^{2-} < N_2^{2-} < C_2^{2-}$

(c) $C_2^{2-} < O_2^{2-} < N_2^{2-}$

(d) $N_2^{2-} < C_2^{2-} < O_2^{2-}$

JEE Main-24.06.2022, Shift-II

Ans. (b) :

(i) $C_2^{2-} = \sigma 1s^2, \sigma^*1s^2, \sigma 2s^2, \sigma^*2s^2, \ \pi 2p_x^2 = \pi 2p_y^2, \sigma 2p_z^2$

$$\text{Bond order} = \frac{10-4}{2} = 3$$

(ii) $N_2^{2-} = \sigma 1s^2, \sigma^*1s^2, \sigma 2s^2, \sigma^*2s^2, \sigma 2p_z^2$

$\pi 2p_x^2 = \pi 2p_y^2, \pi^*2p_x^1 = \pi^*2p_y^1$

$$\text{Bond order} = \frac{10-6}{2} = 2$$

(iii) $O_2^{2-} = \sigma 1s^2, \sigma^*1s^2, \sigma 2s^2, \sigma^*2s^2, \sigma 2p_z^2,$

$\pi 2p_x^2 = \pi 2p_y^2, \pi^*2p_x^2 = \pi^*2p_y^2$

$$\text{Bond order} = \frac{10-8}{2} = 1$$

Hence, the bond order is

$C_2^{2-} > N_2^{2-} > O_2^{2-}$

379. Consider the following reaction:

$$2HSO_4^-(aq) \xrightarrow[\text{(2) Hydrolysis}]{\text{(1) Electrolysis}} 2HSO_4^- + 2H^+ + A$$

The dihedral angle in product A in its solid phase at 110 K is:

(a) 104°

(b) 111.5°

(c) 90.2°

(d) 111.0°

JEE Main-26.06.2022, Shift-I

Ans. (c) : The electrolysis and hydrolysis of given reaction is as given below–

$$2HSO_4^-(aq) \xrightarrow{\text{electrolysis}} HO_3SOOSO_3H\,(aq)$$

$$\downarrow \text{Hydrolysis}$$

$$2HSO_4^- + 2H^+ + \underset{(A)}{H_2O_2}(aq)$$

Hence, the dihedral angle of (A) is 90.2^0

380. According to molecular orbital theory, bond order in increasing order will be

(a) $O_2^{2+} < O_2 < O_2^- < O_2^{2-}$

(b) $O_2^{2-} < O_2^- < O_2 < O_2^{2+}$

(c) $O_2 < O_2^{2-} < O_2^- < O_2^{2+}$

(d) $O_2 < O_2^{2+} < O_2^- < O_2^{2-}$

JEE Main-26.06.2022, Shift-I
CG PET -2009
(JEE Main 2021, 25 July Shift-II)
Karnataka-CET-2016
NEET-2015, cancelled
Tripura JEE-2021

Ans. (b) : The given species are O_2^{2+}, O_2, O_2^- and O_2^{2-}.

Total number of e^- in $O_2^{2+} = 14$

$\therefore$ MO configuration $= (\sigma 1s)^2 (\sigma^*1s)^2 (\sigma 2s)^2 (\sigma^*2s)^2$

$(\pi 2p_x^2 = \pi 2p_y^2)(\sigma 2p_z)^2$

$$\text{Bond Order} = \frac{\text{No of Bonding } e^- - \text{No of Antibonding } e^-}{2}$$

$$\text{Bond Order} = \frac{10-4}{2} = 3$$

Total number of e^- in $O_2 = 16$

$\therefore$ MO configuration $= (\sigma 1s)^2 (\sigma^*1s)^2 (\sigma 2s)^2 (\sigma^*2s)^2$

$(\sigma 2p_z)^2 (\pi 2p_x^2 = \pi 2p_y^2)(\pi^*2p_x^1 = \pi^*2p_y^1)$

$$\text{Bond Order} = \frac{10-6}{2} = 2$$

Total number of e^- in $O_2^- = 17$

$\therefore$ MO configuration $= (\sigma 1s)^2 (\sigma^*1s)^2 (\sigma 2s)^2 (\sigma^*2s)^2$

$(\sigma 2p_z)^2 (\pi 2p_x^2 = \pi 2p_y^2)(\pi^*2p_x^2 = \pi^*2p_y^1)$

$$\text{Bond Order} = \frac{10-7}{2} = 1.5$$

Total number of e^- in $O_2^{2-} = 18$

Similarly,

$$\text{Bond order} = \frac{10-8}{2} = 1$$

Hence, the order of bond order will be–

$O_2^{2-} < O_2^- < O_2 < O_2^{2+}$

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381. The decreasing order of bond angle is

(a) $NO_2 > NO_2^+ > NO_2^-$

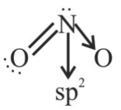
(b) $NO_2^- > NO_2 > NO_2^+$

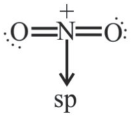
(c) $NO_2^+ > NO_2 > NO_2^-$

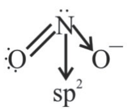
(d) $NO_2^+ > NO_2^- > NO_2$

NEET-2015, cancelled
WB-JEE-2013
NEET-2008
J & K CET-(2004)

Ans. (c) : The species are NO_2, NO_2^+ and NO_2^-







As well as % s character increases, the bond angle of central atom with surrounding atom is also increases. Thus, the decreasing order of bond angle will be–

$NO_2^+ > NO_2 > NO_2^-$

382. The correct order of bond angles (smallest first) in H_2S, NH_3, BF_3, and SiH_4 is

(a) $H_2S < SiH_4 < NH_3 < BF_3$

(b) $NH_3 < H_2S < SiH_4 < BF_3$

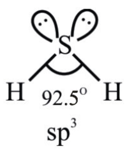
(c) $H_2S < NH_3 < SiH_4 < BF_3$

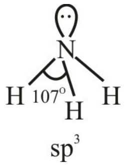
(d) $H_2S < NH_3 < BF_3 < SiH_4$

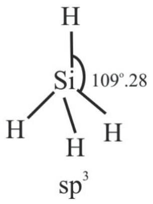
AMU-2016
Assam CEE-2014
AIEEE-2004

Ans. (c) : The structure of the following species –

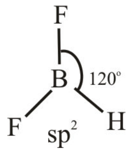
(i) H_2S (ii) NH_3 (iii) SiH_4







(iv) BF_3



Hence, the increasing order of bond angles
$H_2S < NH_3 < SiH_4 < BF_3$

383. The correct bond length order is

(a) $O_2 < O_3 < O_2^{2-}$

(b) $O_2 < O_2^{2-} < O_3$

(c) $O_2^{2-} < O_3 < O_2$

(d) $O_2 = O_2^{2-} > O_3$

BCECE-2018
AIIMS-2017, 2007

Ans. (a): : The MOT electronic configuration is –

$O_2 = \sigma 1s^2, \sigma^*1s^2, \sigma 2s^2, \sigma^*2s^2, \sigma 2pz^2, \pi 2p_x^2 = \pi 2p_y^2, \pi^*2p_x^1 = \pi^*2p_y^1$

Bond order $= \dfrac{10-6}{2} = 2$

$O_2^{2-} = \sigma 1s^2, \sigma^*1s^2, \sigma 2s^2, \sigma^*2s^2, \sigma 2p_z^2, \pi 2p_x^2 = \pi 2p_y^2, \pi^*2p_x^2 = \pi^*2p_y^2$

Bond order $= \dfrac{10-8}{2} = 1$

In O_3 no. of bonds between the atoms is 3. The number of canonical forms of O_3 is 2.

Bond order $= \dfrac{3}{2} = 1.5$

Thus, the increasing order of bond order is

$O_2^{2-} < O_3 < O_2$

Since, bond order inversely proportional to bond length then the order is $O_2^{2-} > O_3 > O_2$

384. The ONO angle is maximum is:

(a) NO_3^-

(b) NO_2^-

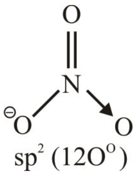
(c) NO_2

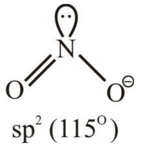
(d) NO_2^+

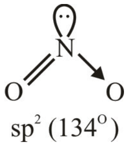
Assam CEE-2014
BCECE-2010
AIIMS-2004

Ans. (d): The bond angle is maximum in NO_2^+ is 180°. It is a linear geometry.

(i) NO_3^- (ii) NO_2^- (iii) NO_2







(iv) NO_2^+

$O = \overset{+}{N} = O$

sp (180°)

385. Which of the following stability order is correct?

(a) $O_2^{2-} > O_2^- > O_2 > O_2^+$

(b) $O_2^+ > O_2 > O_2^- > O_2^{2-}$

(c) $O_2^+ > O_2 > O_2^- > O_2^{2-}$

(d) $O_2 > O_2^+ > O_2^{2-} > O_2^-$

AMU-2014, 2005
BITSAT-2007

Ans. (b) : Bond order is higher it mean that atom are held together more tightly. Therefore the stability is increase.

(i) $O_2^+ = \sigma 1s^2, \sigma^*1s^2, \sigma 2s^2, \sigma^*2s^2, \sigma 2p_z^2,$
$\pi 2p_x^2 = \pi 2p_y^2, \pi^*2p_x^1 = \pi^*2p_y$

Bond order $\dfrac{10-5}{2} = 2.5$

(ii) $O_2 = \sigma 1s^2, \sigma^*1s^2, \sigma 2s^2, \sigma^*2s^2, \sigma 2p_z^2,$
$\pi 2p_x^2 = \pi 2p_y^2, \pi^*2p_x^1 = \pi^*2p_y^1$

Bond order $\dfrac{10-6}{2} = 2$

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(iii) $O_2^- = \sigma 1s^2, \sigma^* 1s^2, \sigma 2s^2, \sigma^* 2s^2, \sigma 2p_z^2,$

$\pi 2p_x^2 = \pi 2p_y^2, \pi^* 2p_x^1 = \pi^* 2p_y^1$

Bond order $\frac{10-7}{2} = 1.5$

(iv) $O_2^{2-} = \sigma 1s^2, \sigma^* 1s^2, \sigma 2s^2, \sigma^* 2s^2, \sigma 2p_z^2,$

$\pi 2p_x^2 = \pi 2p_y^2, \pi^* 2p_x^2 = \pi^* 2p_y^2$

Bond order $\frac{10-8}{2} = 1$

Hence, the stability order is –

$O_2^+ > O_2 > O_2^- > O_2^{2-}$

386. The correct order of C – O bond length among CO, CO_3^{2-} ,CO_2 is

(a) $CO < CO_2 < CO_3^{2-}$ (b) $CO_2 < CO_3^{2-} < CO$

(c) $CO < CO_3^{2-} < CO_2$ (d) $CO_3^{2-} < CO_2 < CO$

BCECE-2016
CG PET- 2015
AMU-2013

Ans. (a) : A bond length is the average distance between the centers of nuclei of two bonded atom. Double or triple bond is always shorter than the corresponding single bond.

In CO_3^{2-} , C–atom is sp^2 hybridised. The bond length in C – O is 133 pm

In CO_2 , C–atom is sp hybridised. The bond length in C–O is 122 pm.

In CO , C–atom is sp hybridised and bond length is 110 pm.

So, the order of C – O bond length is

$CO < CO_2 < CO_3^{2-}$

387. The pair of species that has the same bond order in the following is

(a) CO, NO^+ (b) NO^-,CN^-

(c) O_2, N_2 (d) O_2, B_2

AIIMS-2016
Karnataka NEET-2013

Ans. (a) : CO = 6+8=14 electrons

NO^+= 7+8–1=14 electrons

Both have same electronic configuration is:

$\sigma 1s^2, \sigma^* 1s^2, \sigma 2s^2, \sigma^* 2s^2, \sigma 2p_z^2, \pi 2p_x^2 = \pi 2p_y^2$

So both have bond order = $\frac{10-4}{2} = 3$

388. Assertion: Bond angle of H_2S is smaller than H_2O
Reason: Electronegativity of the central atom increases, bond angle decrease.

(a) If both Assertion and Reason are correct and the Reason is the correct explanation of Assertion

(b) If both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.

(c) If Assertion is correct but Reason is incorrect

(d) If both the Assertion and Reason are incorrect

AIIMS-2013, 2011

Ans. (c): Bond angle of H_2S is 92° and H_2O is 104° 31. As the electronegativity of central atom decreases bond angle decreases. In case of sulphur is less electronegative than oxygen. Thus the bond pair in H_2S are more away from the central atom than in H_2O Since, repulsive force between bond pairs are smaller bond angle.

389. Assertion: Molecular nitrogen is less reactive than molecular oxygen.
Reason: The bond length of N_2 is shorter than that of oxygen.

(a) If both Assertion and Reason are correct and the Reason is correct explanation of the Assertion.

(b) If both Assertion and Reason are correct but Reason is not a correct explanation of the Assertion.

(c) If the Assertion is correct but Reason is incorrect.

(d) If both the Assertion and Reason are incorrect.

(e) If the Assertion is incorrect but the Reason is correct.

AIIMS-2007, 2006

Ans. (a): Molecular nitrogen is less reactive than molecular oxygen because molecular nitrogen to gain octet by 3 electron but molecular oxygen to gain octet by 2 electron. The bond length of N_2 is shorter than oxygen because molecular nitrogen has triple bond between nitrogen atom.

390. In $Fe(CO)_5$, the Fe–C bond possesses

(a) ionic character

(b) σ-character only

(c) π-character only

(d) bond σ and π-character

AMU-2013
AIEEE-2006

Ans. (d) : In metal carbonyl compound possess both σ and π character. In $Fe(CO)_5$, dπ–pπ metal to ligand back bonding in Fe – C bond of $Fe(CO)_5$.

391. Which of the following has the largest bond length?

(a) O_2^+ (b) O_2

(c) O_2^- (d) O_2^{2-}

AMU-2004, 2003

Ans. (d) : Bond order in $O_2^+ = 2.5$

Bond order in $O_2 = 2$

Bond order in $O_2^- = 1.5$

Bond order in $O_2^{-2} = 1$

$\therefore$ O_2^{-2} has the largest bond length.

392. What is the correct sequence of bond order?

(a) $O_2^+ > O_2^- > O_2$ (b) $O_2 > O_2^- > O_2^+$

(c) $O_2^+ > O_2 > O_2^-$ (d) $O_2^- > O_2^+ > O_2$

TS-EAMCET-04.08.2021, Shift-I
AMU 2002

Ans. (c): The species are O_2^+, O_2^- and O_2. The molecular electronic configuration is given below-

O_2^+(Total electron 15)

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$= \sigma 1s^2\, \sigma^* 1s^2\, \sigma 2s^2\, \sigma^* 2s^2\, \sigma 2p_z^2\, \pi 2p_x^2 = \pi 2p_y^2\, \pi^* 2p_x^1$

Bond order $= \dfrac{10-5}{2} = 2.5$

Similarly, O_2^- (Total electron = 17)

Bond order $= \dfrac{10-7}{2} = 1.5$

and O_2 (Total electron)= 16

Bond order $= \dfrac{10-6}{2} = 2$

Thus, the correct sequence of bond order is $O_2^+ > O_2 > O_2^-$.

393. Of the species, NO, NO^+, NO^{2+} and NO^-, the one with minimum bond strength is

(a) NO^+ (b) NO
(c) NO^{2+} (d) NO^-

(JEE Main 2020, 5 Sep. Shift-I)
J & K CET-(2017)

Ans. (d) : As we know, bond order is directly proportional to the bond strength of the molecule. Firstly, we calculate the bond order i.e.

NO (Total e^- = 15) ⇒ B.O.$\dfrac{10-5}{2} = 2.5$

NO^+ (Total e– = 14) ⇒ B. O. $= \dfrac{10-4}{2} = 3$

NO^{2+} (Total e^- = 13) ⇒ B. O. $= \dfrac{9-4}{2} = 2.5$

NO^- (Total e^- = 16) ⇒ B. O. $= \dfrac{10-6}{2} = 2$

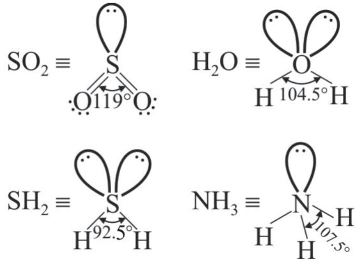
Greater is the bond order, smaller is the bond length. As the bond order increases, the bond strength increases as atoms in bonding come closer to each other. Hence, NO^- has minimum bond strength.

394. Which one of the following compounds has the smallest bond angle ?

(a) SO_2 (b) H_2O
(c) SH_2 (d) NH_3

(AIEEE-2003)
JCECE - 2008

Ans. (c) : The species are given below–



According to the VSEPR theory– SH_2 has two lone pair with two bond pair repulsion due to which they get minimize the angle (S has greater size than oxygen).

395. Increasing order of carbon-carbon bond length for the following is

C_2H_4	C_2H_2	C_6H_6	C_2H_6
(A)	**(B)**	**(C)**	**(D)**

(a) C < B < A < D (b) B < C < A < D
(c) D < C < A < B (d) B < A < C < D

Karnataka-CET-2011
NEET-1992

Ans. (d) : In C_2H_6, carbon-carbon bond is single (1.54 Å).
In C_6H_6, carbon-carbon bond is partially double (1.39 Å).
In C_2H_4, carbon-carbon bond is double (1.34 Å)
In C_2H_2, carbon-carbon bond is triple (1.20 Å)

396. Arrange the following in the increasing order of their bond order

O_2, O_2^+, O_2^- and O_2^{2-} :

(a) $O_2^{2-}, O_2^-, O_2, O_2^+$ (b) $O_2^{2-}, O_2^-, O_2^+, O_2$
(c) $O_2^+, O_2, O_2^-, O_2^{2-}$ (d) $O_2, O_2^+, O_2^-, O_2^{2-}$

Manipal-2019
Karnataka-CET, 2009

Ans. (a) :

Species :	O_2^{2-}	O_2^-	O_2	O_2^+
Bond Order :	1	1.5	2	2.5

397. The calculated bond order of superoxide ion O_2^- is

(a) 2.5 (b) 2
(c) 1.5 (d) 1

J & K CET-(2015)
Karnataka-CET, 2008

Ans. (c) : The MO configuration of superoxide ion is–

$$O_2^- \text{ (total } e^- = 17) = (\sigma 1s)^2 (\sigma^* 1s)^2 (\sigma 2s)^2 (\sigma^* 2s)^2$$
$$(\sigma 2p_z)^2 (\pi 2p_x^2 = \pi 2p_y^2)(\pi^* 2p_x^2 = \pi^* 2p_y^1)$$

Bond order $= \dfrac{N_b - N_a}{2} = \dfrac{10-7}{2} = \dfrac{3}{2} = 1.5$

398. The sequence that correctly describes the relative bond strength pertaining to oxygen molecule and its cation or anions is:

(a) $O_2^{2-} > O_2^- > O_2 > O_2^+$
(b) $O_2 > O_2^+ > O_2^- > O_2^{2-}$
(c) $O_2^+ > O_2 > O_2^{2-} > O_2^-$
(d) $O_2^+ > O_2 > O_2^- > O_2^{2-}$
(e) $O_2 > O_2^- > O_2^{2-} > O_2^+$

Manipal-2018
Kerala-CEE-2006

Ans. (d) : Bond strength or stability of the molecule or ion depends on the bond order. Bond order is directly proportional to the bond strength. The higher is the bond order, the higher will be bond strength or stability of ion.

Molecule / ions	**Bond order**
O_2^{2-}	1
O_2^-	1.5
O_2	2
O_2^+	2.5

Thus, the order of bond strength of the given species will be –

$O_2^+ > O_2 > O_2^- > O_2^{2-}$

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399. Which of the following pair have identical bond order?

(a) CN^- and NO^+ (b) $CN^-$and O_2^-

(c) $CN^-$and CN^+ (d) $NO^+$and O_2^-

(e) O_2^- and CN^+

Kerala-CEE-2017, 2009

Ans. (a) : The molecule which have same number of total electron having the identical bond order.

(a) CN^- and NO^+

$$CN^- \text{ (total } e^- = 14) = (\sigma1s)^2 (\sigma^*1s)^2 (\sigma2s)^2 (\sigma^*2s)^2 (\pi2p_x^2 = \pi2p_y^2)(\sigma2p_z)^2$$

$$\text{Bond order} = \frac{6-4}{2} = 2$$

$$NO^+ \text{ (total } e^- = 14) = \frac{6-4}{2} = 1$$

(b) CN^- (total e^- = 14) (c) CN^- (total e^- = 14)

O_2^- (total e^- = 17) CN^+ (total e^- = 12)

(d) NO^+ (total e^- = 14) (e) O_2^- (total e^- = 17)

O_2^- (total e^- = 17) CN^+ (total e^- = 12)

400. H–O–O bond angle in H_2O_2 is

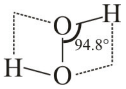
(a) 90° (b) 180°

(c) 109.5° (d) 94.8°

UP CPMT-2005

MHT CET-02.05.2019, SHIFT-II

Ans. (d):



∴ H–O–O bond angle in H_2O_2 is 94.8°.

401. Which among the following species has unequal bond lengths?

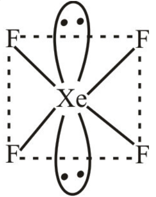
(a) XeF_4 (b) SiF_4

(c) SF_4 (d) BF_4^-

(JEE Main 2021, 25 Feb Shift-II)

Ans. (c) : The Species has regular geometry when there are no any lone pair present on the central atom. The structure of the given species is as under–

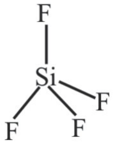
(a) $XeF_4 \equiv$



Hybridisation = 4 + 2 = 6 (sp^3d^2)

All Xe – F bonds are equal due to regular geometry

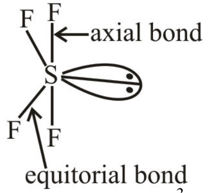
(b) $SiF_4 \equiv$



Hybridisation = 4 + 0 = 4 (sp^3)

All Si–F bonds are equal.

(c) $SF_4 \equiv$



Hybridisation = 4 + 1 = 5 (sp^3d)

The two S – F bond (axial bond) are longer than the two S – F bond (equitorial bond) due to the bond pair – bond pair repulsion. Hence, SF_4 has unequal bond length.

(d) The structure of BF_4^- is same with the SiF_4. Hence, both have regular geometry with same bond length.

402. Given below are two statement : one is labelled as Assertion (A) and the other is labelled as Reason (R).

Assertion (A) : The H—O—H bond angle in water molecule is 104.5°.

Reason (R) : The lone pair-lone pair repulsion of electrons is higher than the bond pair - bond pair repulsion.

(a) A is false but R is true.

(b) Both A and R are true, but R is not the correct explanation of A.

(c) A is true but R is false.

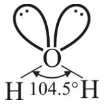
(d) Both A and R are true, and R is the correct explanation of A.

(JEE Main 2021, 16 March Shift-I)

Ans. (d) : The water molecule molecule has two lone pair electron on own central atom. According to the VSEPR theory– the repulsion between two lone pair reduces the bond angle between them i.e. 104.5°. The repulsive interaction of electron pairs decreases in the order.

Lone pair-Lone pair > Lone pair–Bond pair > Bond pair-Bond pair.

Hence, both assertion (A) and reason (R) are true and R is the correct explanation of A.



403. The correct shape and I—I—I bond angles respectively in I_3^-, ion are

(a) Distorted trigonal planar, 135° and 90°

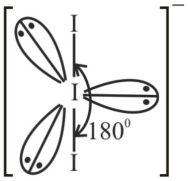
(b) T-shaped, 180° and 90°

(c) Trigonal planar, 120°

(d) Linear, 180°

(JEE Main 2021, 24 Feb Shift-II)

Ans. (d) : The given ions is I_3^-. The hybridization of I_3^- is sp^3d. The geometry of the molecule is linear with 180° bond angle.



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404. Match List-I with List-II.

List-I (Molecule)	List-II (Bond order)
(a) Ne_2	(i) 1
(b) N_2	(ii) 2
(c) F_2	(iii) 0
(d) O_2	(iv) 3

Choose the correct answer from the options given below:

(a) $(a)\to(i),(b)\to(ii),(c)\to(iii),(d)\to(iv)$

(b) $(a)\to(iv),(b)\to(iii),(c)\to(ii),(d)\to(i)$

(c) $(a)\to(ii),(b)\to(i),(c)\to(iv),(d)\to(iii)$

(d) $(a)\to(iii),(b)\to(iv),(c)\to(i),(d)\to(ii)$

JEE Main 26.02.2021,Shift-II

Ans. (d) : According to molecular orbital theory electrons in a molecule are not assigned to individual chemical bonds between atoms.

Molecule	Bond order
Ne_2	0
N_2	3
F_2	1
O_2	2

Note-Bond order is a measurement of the number of electrons involved in bonds between two atoms in a molecule.

405. The molecule which has the maximum bond enthalpy is?

(a) N_2 (b) HF

(c) F_2 (d) CO

TS-EAMCET 09.08.2021, Shift-I

Ans. (d) :

Molecule		Bond Enthalpy (kJ/mol.)
N_2	—	945
HF	—	565
F_2	—	159
CO	—	1070

406. The order of the average bond length of the given bonds is

(a) $C=O<C=N<C\equiv C<N-O$

(b) $C\equiv C<C=O<C=N<N-O$

(c) $C\equiv C<C=O<N-O<C=N$

(d) $C=N<C=O<N-O<C\equiv C$

TS-EAMCET (Engg.), 06.08.2021

Ans. (c): Bond length is defined as the average distance between nuclei of two bonded atoms in a molecule.

$$\therefore \text{ Bond length} \propto \frac{1}{\text{bond order}}$$

So, $\xrightarrow[\text{increasing order of bond length}]{C\equiv C<C=O<N-O<C=N}$

Bond	Bond length
$C\equiv O$	1.20
$C=O$	1.23
$N-O$	1.36
$C=N$	1.38

407. Assertion (A) : The bond dissociation energy increases from F_2 to Cl_2 and then decreases to I_2

Reason (R) : The low bond energy of fluorine is due to the repulsion between the lone pairs of electrons in two fluorine atoms.

The correct option among the following is :

(a) (A) is true, (R) is true and (R) is the correct explanation for (A)

(b) (A) is true, (R) is true but (R) is not the correct explanation for (A)

(c) (A) is true but (R) is false

(d) (A) is false but (R) is true

TS EAMCET 05.08.2021, Shift-I

Ans. (a) : The bond dissociation energy increases from F_2 to Cl_2 and then decreases to I_2

The bond energy of Fluorine is due to the repulsion between the lone pair of electrons in two fluorine atoms. Hence, A and R is true and (R) is the correct explanation for (A).

408. Given below are two statements: one is labeled as Assertion A and the other is labeled as Reason R:

Assertion A : The H–O–H bond angle in water molecule is 104.5^0.

Reason R : The lone pair-lone pair repulsion of electrons is higher than the bond pair -bond pair repulsion.

In the light of the above statements, choose the correct answer from the options given below:

(a) Both A and R are true, and R is the correct explanation of A

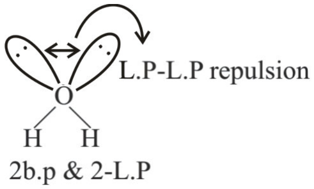
(b) Both A and R are true, but R is not the correct explanation of A

(c) A is true but R is false

(d) A is false but R is true

JEE Main 16.03.2021, Shift-I

Ans. (a) : The given assertion and reason both are true. The H–O–H bond angle in water molecule is 104.5^o because of lone pair-lone pair repulsion the bond angle decreases from 109.5^0 to 104.5^0.



In water O-atom is sp^3 hybridized with 2B.P & 2L.P

409. Which among the following species has unequal bond lengths ?

(a) XeF_4 (b) SiF_4

(c) SF_4 (d) BF_4^-

JEE Main 25.02.2021, Shift-II

Ans. (c) : (i) The hybridisation of

XeF_4 = No. of b.p + No. of l.p

$= 4 + 2 = 6(sp^3d^2)$

Octahedral geometry

(ii) SiF_4 = No. of bond pair

$= 4(sp^3)$ hybridisation

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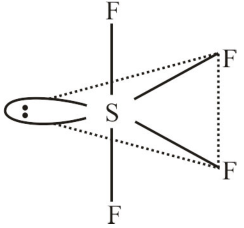
(iii) SF_4 = No. of bond pair + No. of lone pair

= 4+1 = 5(sp^3d)



See–saw shape and axial bond length is more than equatorial bond length.

(iv) BF_4^- = sp^3 i.e, Tetrahedral shape

410. How many among the given species have a bond order of 0.5?

H_2^+. He_2^+. He_2^-. B_2^+. F_2^-. Be_2^{2-}

(a) 2 (b) 3

(c) 1 (d) 4

AP EAPCET 19-08-2021, Shift-II

Ans. (d) : Given species - $H_2^+, He_2^+, He_2^-, B_2^+, F_2^-, Be_2^{2-}$

Total valence electron is written as -

$H_2^+ = 1$, $He_2^+ = 4-1 = 3$, $He_2^- = 4+1 = 5$, $B_2^+ = 6-1 = 5$,

$F_2^- = 14+1 = 15$, $Be_2^{2-} = 4+2 = 6$

Formula -

$$\text{Bond order} = \frac{\text{No.of bonding e}^- - \text{No.of antibonding e}^-}{2}$$

$$\therefore \quad H_2^+ = \frac{1-0}{2} = \frac{1}{2} \qquad B_2^+ = \frac{3-2}{2} = \frac{1}{2}$$

$$He_2^+ = \frac{2-1}{2} = \frac{1}{2} \qquad Fe_2^- = \frac{11-4}{2} = 3.5$$

$$He_2^- = \frac{3-2}{2} = \frac{1}{2} \qquad Be_2^{2-} = \frac{4-2}{2} = 1$$

411. Which of the following is the correct sequence of bond-energies?

(a) (O – O) > (S – S) > (Se – Se) > (Te – Te)

(b) (Te – Te) > (Se – Se) > (S – S) > (O – O)

(c) (S – S) > (Se – Se) > (O – O) > (Te – Te)

(d) (Te – Te) > (O – O) > (Se – Se) > (S – S)

AP- EAPCET- 07-09-2021, Shift-I

Ans. (c) : Bond energy is defined is measure of the bond strength of a chemical bond. So the order is -

S – S > Se – Se > O – O > Te – Te

412. How many among the given species have a bond order of 3?

CO, NO^+, C_2^{2-}, O_2^{2+}, CN^-, NO

(a) 1 (b) 3

(c) 5 (d) 4

AP- EAPCET- 07-09-2021, Shift-I

Ans. (c) : Bond order is the number of chemical bonds between a pair of atoms,

$$\text{Bond order} = \frac{\text{No.of bonding e}^- - \text{No.of anti bonding e}^-}{2}$$

So, CO, NO^+, C_2^2, O_2^{2+}, CN^- has bond order is 3 and NO. has bond order 2.5

413. Which of the following represents the correct order of Cl–O bond lengths in $ClO^-, ClO_2^-, ClO_3^-, ClO_4^-$?

(a) $ClO_4^- = ClO_3^- = ClO_2^- = ClO^-$

(b) $ClO^- < ClO_2^- < ClO_3^- < ClO_4^-$

(c) $ClO_4^- < ClO_3^- < ClO_2^- < ClO^-$

(d) $ClO_3^- < ClO_4^- < ClO_2^- < ClO^-$

[BITSAT-2021]

Ans. (c) : Bond order $\propto \frac{1}{\text{Bond length}}$

When bond order is increase then the bond length decrease,

For ClO^-, ClO_2^-, ClO_3^-, and ClO_4^-, the bond order are 1, 1.5, 1.66 and 1.75 respectively

Therefore, the order of bond length is

$ClO_4^- < ClO_3^- < ClO_2^- < ClO^-$

414. The difference between bond orders of CO and $NO^\oplus$ is x/2 where x = ...

(Round off to the nearest integer).

(a) 1 (b) 2

(c) 3 (d) 0

(JEE Main 2021, 27 July Shift-I)

Ans. (d) : As we know that CO and NO^+ have equal no of total electron so they have same bond order i.e.

Total e^- = 14

$$\therefore \text{MO configuration} = (\sigma 1s)^2 (\sigma^* 1s)^2 (\sigma 2s)^2 (\sigma^* 2s)^2 (\pi 2p_x^2 = \pi 2p_y^2)^2 (\sigma 2P_z)^2$$

$$\text{B.O.} = \frac{10-4}{2} = 3$$

According to the question–

Difference between bond order of CO and NO^+ $= \frac{x}{2}$

or $3-3 = \frac{x}{2}$

or $0 = \frac{x}{2}$

or $x = 0$

415. The amount of energy required to break a bond is same as the amount of energy released when the same bond is formed. In gaseous state, the energy required for homolytic cleavage of a bond is called Bond Dissociation Energy (BDE) or Bond Strength. BDE is affected by s-character of the bond and the stability of the radicals formed. Shorter bonds are typically stronger bonds. BDEs for some bonds are given below :

$H_3C–H(g) \rightarrow H_3C^\bullet(g) + H^\bullet(g)$ ΔH° = 105 kcal mol^{-1}

$Cl–Cl(g) \rightarrow Cl^\bullet(g) + Cl^\bullet(g)$ ΔH° = 58 kcal mol^{-1}

$H_3C–Cl(g) \rightarrow H_3C^\bullet(g) + Cl^\bullet(g)$ ΔH°=85 kcal mol^{-1}

$H–Cl(g) \rightarrow H^\bullet(g) + Cl^\bullet(g)$ ΔH° = 103 kcal mol^{-1}

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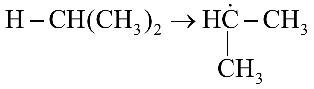
Correct match of the C–H bonds (shown in bold) in Column J with their BDE in Column K is

Column J Molecule	Column K BDE (kcal mol^{-1})
(P) $H-CH(CH_3)_2$	**(i) 132**
(Q) $H-CH_2Ph$	**(ii) 110**
(R) $H-CH=CH_2$	**(iii) 95**
(S) $H-C\equiv CH$	**(iv) 88**

(a) P – iii, Q – iv, R – ii, S – i
(b) P – i, Q – ii, R – iii, S – iv
(c) P – iii, Q – ii, R – i, S – iv
(d) P – ii, Q – i, R – iv, S – iii

JEE advance 2021

Ans. (a) :



$$H-CH(CH_3)_2 \rightarrow H\dot{C}(CH_3)-CH_3$$

$$H-CH_2Ph \rightarrow \dot{C}H_2-Ph$$

$$H-CH=CH_2 \longrightarrow \dot{C}H=CH_2$$

$$H-C\equiv CH \rightarrow \dot{C}\equiv CH$$

Order of stability of free radical is Q > P > R > S

Stability of free radical $\propto \frac{1}{\text{Bond energy}}$

$\therefore$ Order of bond energy– S > R > P > Q

416. Which of the following set contains same bond angle around central atom?

(a) CH_4, SF_4 NH_3
(b) NF_3, BCl_3, NH_3
(c) BF_3, BCl_3, BBr_3
(d) BF_3, NF_3, $AlCl_3$

TS EAMCET 10.08.2021, Shift-I

Ans. (c) : Bond angle depend on hybridization on central atom.

Species	Hybridization
BF_3	sp^2
BCl_3	sp^2
BBr_3	sp^2

417. How many among the given species have the highest bond order? CN^-, CO, NO^+, O_2^+, O_2, N_2

(a) 5
(b) 2
(c) 3
(d) 4

TS EAMCET 10.08.2021, Shift-I

Ans. (d) : Bond Order =

$$\frac{\text{No.of bonding } e^- - \text{No.antibonding } e^-}{2}$$

Species	No. of e-	Bond order
CN^-	14	3
CO	14	3
NO^+	14	3
O_2^+	15	2.5
O_2	16	2.0
N_2	14	3.0

Bond order represent number of bond between two atom.

418. The correct order of Sulphur oxygen bond order in SO_3, $S_2O_3^{2-}$ and SO_4^{2-} are

(a) $SO_4^{2-} < S_2O_3^{2-} < SO_3$
(b) $SO_4^{2-} < SO_3 < S_2O_3^{2-}$
(c) $S_2O_3^{2-} < SO_4^{2-} < SO_3$
(d) $S_2O_3^{2-} < SO_3 < SO_4^{2-}$

AP EAPCET 20.08.2021 Shift-I

Ans. (c) : Bond order is the number of chemical bonds between a pair of atoms.

$SO_3 = 2$

$SO_4^{2-} = 1.5$

$S_2O_3^{2-} = 1.33$

So decreasing order $SO_3 > SO_4^{2-} > S_2O_3^{2-}$

419. Bond order is an inverse measure of —

(a) Bond-length
(b) Bond-angle
(c) Bond dissociation energy
(d) Stability

AP EAPCET 20.08.2021 Shift-I

Ans. (a) : Bond order is the number of chemical bonds between a pair of atoms.

$$\boxed{\text{Bond order} \propto \frac{1}{\text{bond length}}}$$

Since the bond order increases bond length decreases.

420. Assuming AB is an ionic compound and r_c, r_a are the ionic radii of A^+ and B^- respectively. The lattice energy of the compound AB is proportional to:

(a) $\frac{r_c}{r_a}$

(b) $\frac{1}{r_c + r_a}$

(c) $\frac{r_a}{r_c}$

(d) $\sqrt{(r_c + r_a)}$

AP EAPCET-6 Sep. 2021, Shift-II

Ans. (b) : According to Coulomb's law, Lattice energy is inversely proportional to the internuclear distance of the given ionic solid.

$$\text{Lattice energy (U)} \propto \frac{q_c \cdot q_a}{r_c + r_a}$$

The lactic energy of the compound AB is proportional to

$$\Rightarrow \boxed{U \propto \frac{1}{r_c + r_a}}$$

421. The compound that has the largest H—M—H bond angle (M = N, O, S, C) is

(a) H_2O
(b) NH_3
(c) H_2S
(d) CH_4

(JEE Main 2020, 5 Sep Shift-II)

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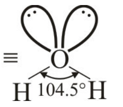
Ans. (d)

(a) $H_2O \equiv$

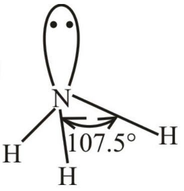


Hybridisation = Bond pair + Lone pair

= 2 + 2

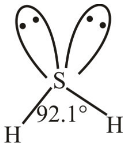
= 4 (sp^3)

(b) $NH_3 \equiv$



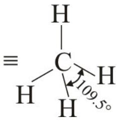
Hybridisation = 3 + 1 = 4 (sp^3)

(c) $H_2S \equiv$



Hybridisation = 2 + 2 = sp^3 (4)

(d) $CH_4 \equiv$

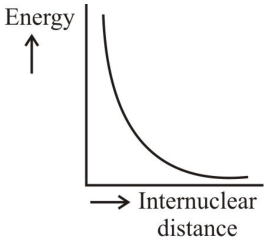


Hybridisation = 4 + 0 = 4 (sp^3)

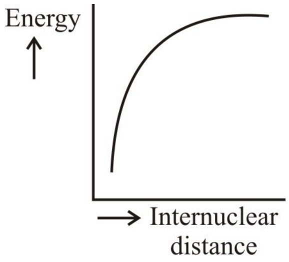
Hence, CH_4 has the largest H–M–H bond angle.

422. The potential energy curve for the H_2 molecule as a function of internuclear distance is

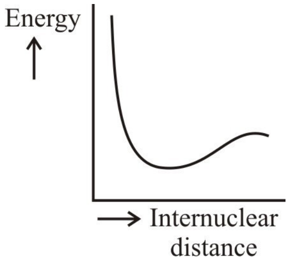
(a)



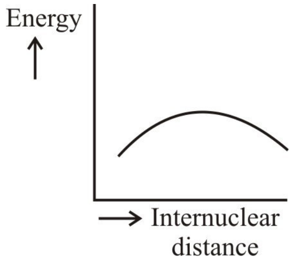
(b)



(c)

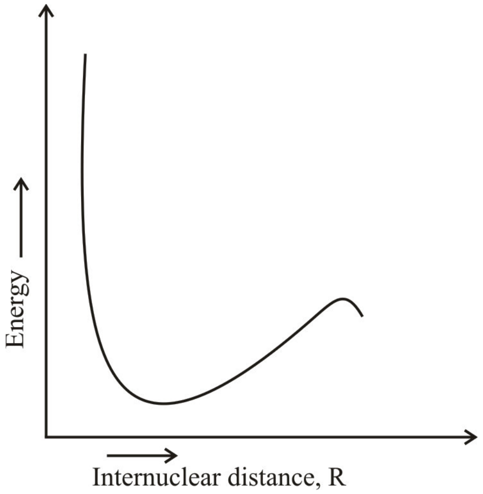


(d)



(JEE Main 2020, 5 Sep. Shift-I)

Ans. (c) : The potential energy curve for the diatomic molecule i.e. H_2 as a function of internuclear distance which is expressed by the Born–Oppenheimer approximation.



423. Arrange the following bonds according to their average bond energies in descending order

C—Cl, C—Br, C—F, C—I

(a) C—F > C—Cl > C—Br > C —I

(b) C—Br > C —I > C —Cl > C — F

(c) C—I > C—Br > C — Cl > C — F

(d) C — Cl > C — Br > C — I > C — F

(JEE Main 2020, 8 Jan. Shift-II)

Ans. (a) : As we move down on the halogen group the electronegativity decreases and size of element increases due to which the average bond energy is also decreases.

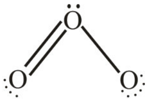
Bond	**Bond enthalpies / $kJmol^{-1}$**
C – F	452
C – Cl	351
C – Br	293
C – I	234

424. The formal charge on central oxygen atom in ozone is

(a) –1
(b) 0
(c) +2
(d) +1

Karnataka-CET-2020

Ans. (d) : The Lewis structure of O_3 may be drawn as :



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$$\text{Formal charge} = \begin{bmatrix}\text{Total no of valence}\\ \text{electrones in the}\\ \text{Free atom}\end{bmatrix} - \begin{bmatrix}\text{Total no. of non -}\\ \text{bonding electron}\end{bmatrix} - 1/2\begin{bmatrix}\text{Total no. of}\\ \text{bonding electron}\end{bmatrix}$$

$$\text{Formal charge} = 6-2-\frac{1}{2}\times 6 = 6-2-3 = +1$$

The Formal charge on central oxygen atom in ozone is +1.

425. Bond angle in PH_4^+ is more than that of PH_3. This is because

(a) lone pair-bond pair repulsion exists in PH_3

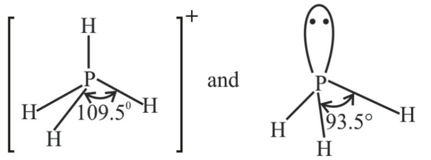
(b) PH_4^+ has square planar structure

(c) PH_3 has planar trigonal structure

(d) hybridisation of P change when PH_3 is converted to PH_4^+.

Karnataka-CET-2020

Ans. (a) : According to the VSEPR theory, the structure of PH_4^+ and PH_3 are drawn below–



Due to the absence of lone pair-bond pair repulsion and presence of four identical bond pair-bond pair interactions, PH_4^+ assumes tetrahedral with 109.5° bond angle whereas PH_3 has lone pair repulsion and it's interaction reduces the angle i.e. 93.5°.

426. The correct order of bond energy (in kJ/mol) of the following molecules is

(a) $O_2<B_2<C_2<N_2$

(b) $B_2<C_2<O_2<N_2$

(c) $C_2<O_2<B_2<N_2$

(d) $B_2<O_2<C_2<N_2$

(e) $B_2<O_2<N_2<C_2$

Kerala-CEE-2020

Ans. (d) : Bond energy is directly proportional to bond order. Here, N_2 has highest bond order equal to 3 and B_2 has lowest bond order equal to 1. So, order will be, $B_2<O_2<C_2<N_2$

427. Which of the following sets of species have similar bond order ?

(a) N_2, O_2^{2-}, NO^+

(b) N_2, F_2, O_2^{2-}

(c) N_2, N_2^-, O_2^-

(d) N_2, CO, NO^+

AP EAMCET (Engg.) 17.09.2020 Shift-I

Ans. (d) : Bond order, $BO = \frac{N_b - N_a}{2}$

$N_2(14e^-) : BO = \frac{10-4}{2} = 3$

$O_2^{2-}(18e^-) : BO = \frac{10-8}{2} = 1$

$NO^+(14e^-) : BO = \frac{10-4}{2} = 3$

$F_2(18e^-) : BO = \frac{10-8}{2} = 1$

$N_2^{2-}(16e^-) : BO = \frac{10-6}{2} = 2$

$O_2^-(17e^-) : BO = \frac{10-7}{2} = 1.5$

$CO(14e^-) : BO = \frac{10-4}{2} = 3$

So, (N_2, CO, NO^+) have similar bond order, 3.

428. Which among the following represents the correct order of variation of bond angles in the given molecules ?

(a) $NH_3 > NF_3 > PCl_3 > BF_3$

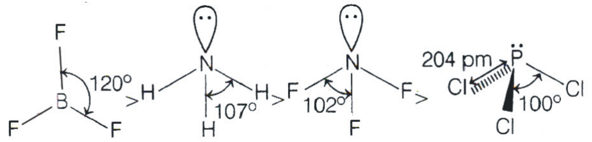
(b) $BF_3 > PCl_3 > NH_3 > NF_3$

(c) $BF_3 > NH_3 > PCl_3 > NF_3$

(d) $BF_3 > NH_3 > NF_3 > PCl_3$

AP EAMCET (Engg.) 21.09.2020, Shift-II

Ans. (d) : Bond angle in BF_3 (120°), NH_3(107°), NF_3(102°) and PCl_3(100°).



Hence, the correct option is (d).

429. The relationship between the dissociation energy of N_2 and N_2^+ is

(a) dissociation energy of N_2 = dissociation energy of N_2^+

(b) dissociation energy of N_2 can either be lower or higher than the dissociation energy of N_2^+

(c) dissociation energy of N_2> dissociation energy of N_2^+

(d) dissociation energy of N_2^+> dissociation energy of N_2.

COMEDK 2019

Ans. (c) : N_2 ($14e^-$) =

$$\sigma 1s^2, \sigma^* 1s^2, \sigma 2s^2, \sigma^* 2s^2, \pi 2p_x^2 = \pi 2p_y^2, \sigma 2p_z^2$$

B.O. of N_2>B.O. of N_2^+

Thus, dissociation energy of N_2> Dissociation energy of N_2^+.

430. The correct order of S-S bond length in following oxyanions is:

(I) $S_2O_4^{2-}$ (II) $S_2O_5^{2-}$ (III) $S_2O_6^{2-}$

(a) I > II > III

(b) I > III > II

(c) III > II > I

(d) III > I > II

AIIMS 25 May 2019 (Evening)

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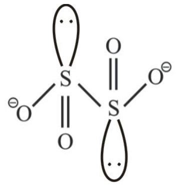
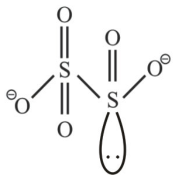
Ans. (a): The structure of the following are

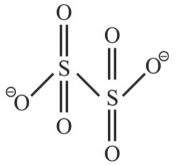
(i) $S_2O_4^{2-}$



(ii) $S_2O_5^{2-}$



(iii) $S_2O_6^{2-}$



2 (lone pair – lone pair) 2 (bond pair – bond pair Repulsion)

1 (lp–lp) 2 (bp – bp)

All (bp –bp) (repulsion)

According to the bent rule repulsion is maximum then bond length is maximum

Hence, the order is I > II > III.

431. Assertion: H_2^+ and H_2^- ions have the same bond order

Reason: H_2^+ is less stable than H_2^-.

(a) If both Assertion and Reason are correct and Reason is the correct explanation of Assertion.
(b) If both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.
(c) If Assertion is correct but Reason is incorrect.
(d) If both the Assertion and Reason are incorrect.

AIIMS 26 May 2019 (Evening)

Ans. (c): The molecular orbital electronic configuration is –

(i) $H_2^+ = \sigma 1s^1$

It has 1 electron on σ bonding molecular orbital.

Bond order =

$$\frac{\text{No. of bonding } e^- - \text{No. of antibonding } e^-}{2}$$

$$= \frac{1-0}{2} = 0.5$$

(ii) $H_2^- = \sigma 1s^2, \sigma^* 1s^1$

Bond order $= \dfrac{2-1}{2} = 0.5$

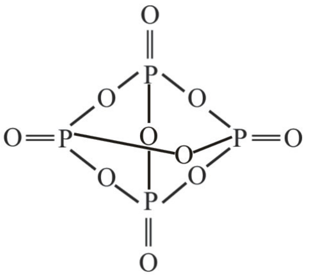
Thus, the bond order for both H_2^+ and H_2^- is same but H_2^+ is more stable than H_2^- due to absence of electron in antibonding orbital of H_2^+.

432. In dimer of phosphorus pentaoxide, in what order number of P – P, P = O & P – O – P bonds are there?

(a) P – O – P > P = O > P – P
(b) P = O > P – O – P > P – P
(c) P – O – P > P – P > P = P
(d) P = O > P – P > P – O – P

AIIMS 26 May 2019 (Evening)

Ans. (a): The structure of dimmer phosphorous penta oxide.



Total no. of P– O – P bond = 6
Total no. of P = O bond = 4
Total no. of P–P bond = O

433. What is the correct order of bond dissociation energy?

(a) $Br_2 > Cl_2$ (b) $F_2 > Cl_2$
(c) $I_2 > F_2$ (d) $F_2 > I_2$

AIIMS 25 May 2019 (Morning)

Ans. (d): Fluorine has a small atomic size and 2p subs bell is compact and close to the nucleus.

On moving down the halogen family and dissociation energy decrease. But in case of fluorine bond dissociation energy of fluorine is lower than chlorine and bromine due to inter electronic repulsion present in the small atom of fluorine

Therefore, the order is –
$Cl_2 > Br_2 > F_2 > I_2$.

434. NO^+ has bond order

(a) 2 (b) 2.5
(c) 3 (d) 3.5
(e) 4

Kerala-CEE-2019

Ans. (c) : In NO^+ total no. of e^- is 14

Bond order$= \dfrac{\text{No of bonding } e^- - \text{No. of antibonding } e^-}{2}$

Bond order $= \dfrac{10-4}{2} = 3$

435. Bond angle is minimum for

(a) H_2O (b) H_2S
(c) H_2Se (d) H_2Te

COMEDK 2018

Ans. (d) : The bond angle of hydride of 16 group elements decreases on increasing the size of elements. Hence, TeH_2 has the least bond angle.

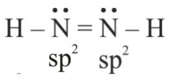
436. % s- character of N- H bonds is maximum in:

(a) N_2H_2 (b) N_2H_4
(c) NH_3 (d) NH_4^+

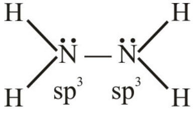
AIIMS-27 May,2018 (E)

Ans. (a): The structure of the following are –

(i) N_2H_2



(ii) N_2H_4

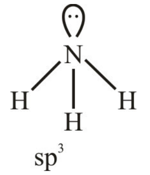


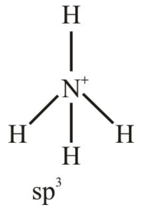
% s – character = 33 %

% s – character = 25%

@apna_pdf

(ii) NH_3 (ii) NH_4^+





% s – character = 25 % % s – character = 25%
So, % s-character of N–H bonds is maximum in N_2H_2.

437. Which pair of diatomic species do not have same bond order?

(a) B_2^-, C_2 (b) O_2^-, B_2^-
(c) N_2^+, O_2^+ (d) O_2^-, C_2

AIIMS-27 May,2018 (M)

Ans. (a): The MOT electronic configuration of the following is –

$B_2^- = \sigma 1s^2, \sigma^* 1s^2, \sigma 2s^2, \sigma^* 2s^2, \ \pi 2p_x^2 = \pi 2p_y^1$

Bond order $= \frac{7-4}{2} = \frac{3}{2} = 1.5$

$C_2 = \sigma 1s^2, \sigma^* 1s^2, \sigma 2s^2, \sigma^* 2s^2, \ \pi 2p_x^2 = \pi 2p_y^2$

Bond order $= \frac{8-4}{2} = 2$

Hence, B_2^- and C_2 pair of diatomic species do not have same bond order.

438. Among the following species, which has zero bond order?

(a) H_2 (b) H_2^+
(c) He_2 (d) He_2^+

Manipal-2018

Ans. (c) : (a) H_2 (total $e^- = 2$) $= (\sigma 1s)^2$

Bond order $= \frac{2-0}{2} = 1$

(b) H_2^+ (total $e^- = 1$) $= (\sigma 1s)^1$

Bond order $= \frac{1-0}{2} = 0.5$

(c) He_2 (total $e^- = 4$) $= (\sigma 1s)^2 \ (\sigma^* 1s)^2$

Bond order $= \frac{2-2}{2} = 0$

(d) He_2^+ (total $e^- = 3$) $= (\sigma 1s)^2 \ (\sigma^* 1s)^1$

Bond order $= \frac{2-1}{2} = 0.5$

Hence, He_2 has the zero bond order.

439. The bond length (pm) of F_2, H_2, Cl_2 and I_2, respectively is

(a) 144, 74, 199, 267 (b) 74, 144, 199, 267
(c) 74, 267, 199, 144 (d) 144, 74, 267, 199

TS EAMCET-2017

Ans. (b) : The size of halogen atom increase on the down the group then the bond length (X-X) of molecule also increase.

440. Which of the following is not a true statements about ozone?

(a) Both the O – O bonds in O_3 are of equal length
(b) Bond order lie in between 1 and 2
(c) O — O — O bond angle in O_3 is approximately 116^0.
(d) Essential for breathing

BCECE-2017

Ans. (d) : In ozone, three oxygen-atoms are arranged in a bent shape. The central oxygen-atom makes one single bond with of the terminal oxygen atom and double bond with the other terminal oxygen atom

(i) Both the O–O bond are equal length.
(ii) Bond order lies between 1 and 2
(iii) O–O–O bond angle is O_3 is approximately 116^o .

441. The bond order in CN^- ion is

(a) 2.5 (b) 3
(c) 2 (d) 3.5

CG PET -2017

Ans. (b) :

Bond Order $= \frac{\text{No of Bonding } e^- - \text{No of Antibonding } e^-}{2}$

Total number of electrons in CN^- ions
$= 6 + 7 + 1 = 14$

MO configuration $= (\sigma 1s)^2 \left(\sigma^* 1s\right)^2 (\sigma 2s)^2 \left(\sigma^* 2s\right)^2$
$\left(\pi 2p_x^2 = \pi 2p_y^2\right) \left(\sigma 2p_z^2\right)$

Number of bonding electrons = 10
Number of anti-bonding electrons = 4

$\therefore$ Bond order $= \frac{10-4}{2} = 3$

442. There are two statements, one labelled as Assertion (A) and the other as Reason (R). Examine both the statements carefully and mark the correct choice.

(A) The H– O–H bond angle in H_2O is greater than H–S–H bond angle in H_2S.
(R) Due to larger size of S, hydrogen bonding does not occur in H_2S.

(a) Both (A) and (R) are correct and (R) is the correct explanation of (A).
(b) Both (A) and (R) are correct but (R) is not the correct explanation of (A).
(c) (A) is correct but (R) is wrong.
(d) (A) is wrong but (R) is correct.

J & K CET-2017

Ans. (b) : H_2O and H_2S both have sp^3 hybridisation. Sulphur is in more atomic size than O. As the size of central atom increases, electronegativity decreases and less repulsion occure between bond pair and lone pair. That's way H_2S has less bond angle than pair H_2O.

443. What will be the correct order of the C–F bond distance among the following?
CHF_3, CF_4, CH_3F and CH_2F_2

(a) $CH_3F < CH_2F_2 < CHF_3 < CF_4$
(b) $CH_2F_2 > CH_3F > CHF_3 > CF_4$
(c) $CH_3F > CH_2F_2 > CHF_3 > CF_4$
(d) $CH_3F > CHF_3 > CF_4 > CH_2F_2$

J & K CET-2017

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Ans. (c) : As the number of F atoms increases, the partial positive charge on the C atom increases. Hence, it more strongly attracts the bond pair of electrons. Hence, the bond strength increases and the bond length decreases. Thus, the correct order of C – F bond length will be– $CH_3F > CH_2F_2 > CHF_3 > CF_4$

444. The common features among CO, CN^- and NO^+ are

(a) Bond order three and isoelectronic.
(b) Bond order three and weak field ligands.
(c) Bond order two and π-acceptors.
(d) Bond order three and π-donors.
(e) Isoelectronic and strong field ligands.

Kerala-CEE-2017

Ans. (a) :

$$CO\ (\text{total } e^- = 14) = (\sigma 1s)^2(\sigma^*1s)^2(\sigma 2s)^2(\sigma^*2s)^2(\pi 2p_x^2 = \pi 2p_y^2)(\sigma 2p_z^2)$$

$$\text{Bond order} = \frac{10-4}{2} = 3$$

$$CN^-\ (\text{total } e^- = 14) \Rightarrow \text{Bond order} = \frac{10-4}{2} = 3$$

$$NO^+\ (\text{total } e^- = 14) \Rightarrow \text{Bond order} = \frac{10-4}{2} = 3$$

All species have 3 bond order. It is also have same electron. So, it is iso-electronic to each other.

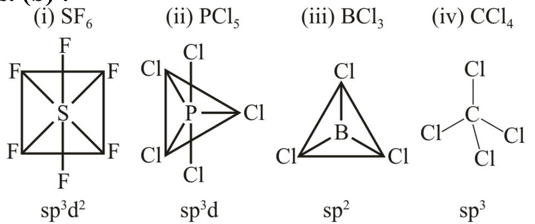
- All the ligand are π-acceptor.

445. In which of the following molecules, all bond lengths are not equal?

(a) SF_6
(b) PCl_5
(c) BCl_3
(d) CCl_4

AP-EAMCET – 2016

Ans. (b) :



In PCl_5, it shows sp^3d hybridisation. It form a 5 equivalent sp^3d orbitals. 3 chlorine atoms are corners of triangle and 2 chlorine atom are axial position.

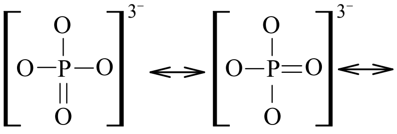
Bond length of axial bond is greater than the length of equatorial bond length. Hence, the correct option is (b).

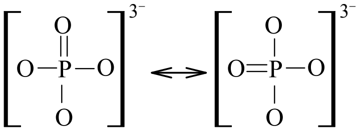
446. In PO_4^{3-}, the formal charge on each oxygen atom and the P – O bond order respectively are

(a) –0.75, 0.6
(b) –0.75, 1.0
(c) –0.75, 1.25
(d) –3, 1.25

BITSAT 2016

Ans. (c) :





$$\text{Bond order} = \frac{\text{Number of bonds}}{\text{Number of resonating structures}} = \frac{5}{4} = 1.25$$

Three unit negative charge is being shared by four O atoms.

Formal charge = –3/4 = –0.75.

447. The correct increasing order of bond order values for the concerned species is

(a) $O_2^- < O_2 < N_2^+ < N_2$
(b) $O_2^- < O_2 < N_2 < N_2^+$
(c) $O_2 < O_2^- < N_2^+ < N_2$
(d) $O_2 < O_2^- < N_2 < N_2^+$

J & K CET-2016

Ans. (a) : The molecules are O_2^-, O_2, N_2^+, N_2.

$$N_2\ (\text{Total } e^- = 14) = (\sigma 1s)^2(\sigma^*1s)^2(\sigma 2s)^2(\sigma^*2s)^2(\pi 2p_x^2 = \pi 2p_y^2)(\sigma 2p_z)^2$$

$$\text{Bond order} = \frac{10-4}{2} = 3$$

$$N_2^+(\text{total } e^- = 13) = (\sigma 1s)^2(\sigma^*1s)^2(\sigma 2s)^2(\sigma^*2s)^2(\pi 2p_x^2 = \pi 2p_y^2)(\sigma 2p_z)^1$$

$$\Rightarrow \text{B.O.} = \frac{9-4}{2} = 2.5$$

$$O_2\ (\text{Total } e^- = 16) = (\sigma 1s)^2(\sigma^*1s)^2(\sigma 2s)^2(\sigma^*2s)^2(\sigma 2p_z)^2(\pi 2p_x^2 = \pi 2p_y^2)(\pi^*2p_x^1 = \pi^*2p_y^1)$$

$$\text{Bond order} = \frac{10-6}{2} = 2$$

Similarly,

$$O_2^-(\text{Total } e^- = 17) = \frac{10-7}{2} = 1.5$$

Hence, the correct increasing order of bond order is–

$$O_2^- < O_2 < N_2^+ < N_2$$

448. Highest bond energy for a single bond among the following is of

(a) F – F
(b) O – O
(c) C – C
(d) N – N

JCECE-2016

Ans. (c) : C—C bond energy is maximum as–

(a) Carbon shows maximum catenation.

(b) During catenation, all the 4 valence electrons of carbon are used in bond formation, thus has no lone pair.

Hence, C—C bond shows maximum bond energy.

449. Consider the following molecules:

(1) CH_3NH_2
(2) CH_3OH
(3) CH_3SH
(4) $CH_3P(CH_3)_2$

Which one of the following bonds has the longest bond length in the above molecules?

(a) C–N
(b) C–O
(c) C–S
(d) C–P

SCRA-2015

@apna_pdf

Ans. (c): C–S bonds have the longest bond because bond length of C–S is 182 Å and other is lower.

450. Consider the nitrogen-oxygen bond lengths in NO_2^+, NO_2^- and NO_3^-. The increasing order of N–O bond length is

(a) $NO_2^+ < NO_2^- < NO_3^-$ (b) $NO_2^+ < NO_3^- < NO_2^-$

(c) $NO_3^- < NO_2^- < NO_2^+$ (d) $NO_3^- < NO_2^+ < NO_2^-$

SCRA-2015

Ans. (c): Bond length is defined as the average distance between nuclei of two bonded atom in a molecule.

$$\text{Bond length} \propto \frac{1}{\text{Bond order}}$$

i.e. Bond length is increased then bond order is decreased.

Bond order of NO_2^+ is 2, NO_2^- is 1.5 and NO_3^- is 1.33

So, the increasing order of N–O bond length is $NO_2^+ > NO_2^- > NO_3^-$.

451. Pick the incorrect statement among those given below.

(a) Multiple covalent bonds are shorter than single covalent bonds between same set of atoms.

(b) Bond strength varies inversely with bond length.

(c) Bond order of isoelectronic species will be same.

(d) Bond enthalpy increases with increasing bond length.

COMEDK 2015

Ans. (d) : Bond enthalpy decreases with increasing bond length.

452. The bond length of Br – Br in Br_2 molecule is equal to

(a) 0.74 Å (b) 1.54 Å

(c) 1.98 Å (d) 2.28 Å

SRMJEEE – 2015

Ans. (d) : The bond length of Br-Br in Br_2 molecule is equal to 2.28 Å

453. The structure of NO_3^- ion is

(a) triangle (b) tetrahedral

(c) equilateral triangle (d) planar.

SRMJEEE – 2015

Ans. (d) : The given molecule is NO_3^-

Hybridisation = number of bond pair + number of lone pair

Hybridisation = 3 + 0 = 3 (sp^2)

The hybridisation of given molecule is sp^2. Hence, the structure is trigonal planar.

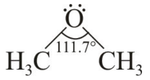
454. The bond angle of bond in methoxy methane is:

(a) 111.7° (b) 109°

(c) 108.9° (d) 180°

AP-EAMCET (Engg.) 2015

Ans. (a) : Methoxy methane and ethanol are functional isomers as they have molecular formula C_2H_6O. But they differ in functional group. The bond angle of methoxy methane is 111.7° and the geometry is V-shaped.



455. Which of the following does not have triple bond between the atoms?

(a) N_2 (b) CO

(c) NO (d) C_2^{2-}

AP-EAMCET (Engg.) 2015

Ans. (c) :

$N_2 \Rightarrow N \equiv N$

$CO \Rightarrow \bar{C} \equiv O^+$

$NO \Rightarrow :N = \ddot{O}$

$C_2^{2-} \Rightarrow [C \equiv C]^{2-}$

Thus, nitric oxide (NO) has 15 electron and its bond order 2.5 and does not contain triple bond.

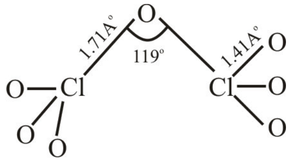
456. What is the bond angle between Cl – O – Cl in Cl_2O_7?

(a) 109° (b) 119°

(c) 108°25′ (d) 120°

BCECE-2015

Ans. (b) : Cl_2O_7 has a bent structure with a bridging O – atom. The terminal Cl–O bonds are substantially shorter than the bridge Cl–O bonds indicating double bonds character



457. The P–P–P angle in P_4 molecule and S–S–S angle in S_8 molecule is (in degree) respectively

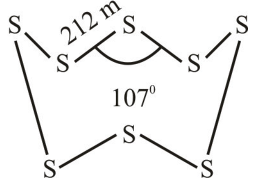
(a) 60^0, 107^0 (b) 107^0, 60^0

(c) 40^0, 60^0 (d) 60^0, 40^0

BITSAT 2015

Ans. (a) : In P_4 molecule, the four sp^3-hybridised phosphorous atoms lie at the corners of a regular tetrahedron with $\angle P - P - P = 60^0$.

In S_8 molecule S-S-S angle is 107^0 rings.



458. Which of the following changes in the respective bond order values are caused by removal of an electron from N_2 and F_2 molecules?

(a) Decrease by 0.5 in both

(b) Increase by 0.5 in both

(c) Increase by 0.5 in the former and decrease by 0.5 in the latter

(d) Decrease by 0.5 in the former and increase by 0.5 in the latter

(e) No change in both

Kerala-CEE-2015

@apna_pdf

Ans. (d)

N_2 (total e^- = 14) = $(\sigma 1s)^2(\sigma^*1s)^2(\sigma 2s)^2(\sigma^*2s)^2$
$(\pi 2p_x^2 = \pi 2p_y^2)\left(\sigma 2p_z^2\right)$

F_2 (total e^-=18)=$(\sigma 1s)^2\left(\sigma^*1s\right)^2(\sigma 2s)^2\left(\sigma^*2s\right)^2(\sigma 2p_z)^2$
$\left(\pi 2p_x^2 = \pi 2p_y^2\right)\left(\pi^*2p_x^2 = \pi^*2p_y^2\right)$

For N_2, the valence orbital is bonding molecular orbital and for F_2, it is antibonding molecular orbital. So, bond order decrease by 0.5 in the former and increase by 0.5 in the later.

459. Select a ferromagnetic material from the following.
(a) Dioxygen
(b) Chromium (IV) oxide
(c) Benzene
(d) Dihydrogen monoxide

MHT CET-2015

Ans. (b) :

	Substance		**Magnetic property**
(A)	Dioxygen	–	Paramagnetic
(B)	Chromium (IV) oxide	–	Ferromagnetic
(C)	Benzene	–	Diamagnetic
(D)	Dihydrogen monoxide	–	Diamagnetic

460. The bond order of H_2^+ is
(a) 1 (b) 0
(c) 0.5 (d) 2

S. C. R. A - 2014

Ans. (c) : Bond order –

$$B.O = \frac{1}{2}(N_b - N_a)$$

N_b = No. of bonding electron
N_a = No. of antibonding electron

$H_2^+ = 1s^1$

$N_b = 1,\ N_a = 0$

$$B.O. = \frac{1}{2}(1-0)$$

$$B.O = \frac{1}{2} = 0.5$$

461. The percentage of ionic character in HCl molecule which has dipole moment of 3.610 × 10^{-30} Coulomb metre and bond length of 123 pm, is
(a) 100% (b) 87%
(c) 24.2% (d) 17.3%

S. C. R. A - 2014

Ans. (d) : Given that-

Dipole moment $(\mu) = 3.6\times10^{-30}\,Cm$

$\text{Bond length} = 123pm = 123\times10^{-12}\,m$

$$\text{Now, Ionic character} = \frac{\mu}{\text{Bond length}\times\text{Charge}}\times100\%$$

$$\text{Ionic character} = \frac{3.6\times10^{-30}}{123\times10^{-12}\times1.69\times10^{-19}}\times100\%$$

Ionic character = 17.3 %

462. Which of these represents the correct order of their increasing bond order?
(a) $C_2^{2-} < He_2^+ < O_2^+ < O_2^-$
(b) $He_2^+ < O_2^- < O_2^+ < C_2^{2-}$
(c) $O_2^- < O_2^- < C_2^{2-} < He_2^+$
(d) $O_2^+ < C_2^{2-} < O_2^- < He_2^+$

COMEDK 2014

Ans. (b) : $He_2^+ : \sigma 1s^2, \sigma^*1s^1$

$$B.O. = \frac{1}{2}\left(N_b - N_a\right) = \frac{1}{2}(2-1) = \frac{1}{2} = 0.5$$

$C_2^{2-} : \sigma 1s^2, \sigma^*1s^2, \sigma 2s^2, \sigma^*2s^2, \pi 2p_x^2 = \pi 2p_y^2, \sigma 2p_z^2$

$$B.O. = \frac{1}{2}(10-4) = \frac{6}{2} = 3.0$$

$\sigma 1s^2, \sigma^*1s^2, \sigma 2s^2, \sigma^*2s^2, \sigma 2p_z^2, \pi 2p_x^2 = \pi 2p_y^2,$
$\pi^*2p_x^1$

$$B.O. = \frac{1}{2}(10-5) = \frac{5}{2} = 2.5$$

$\sigma^*1s^2, \sigma^*2s^2, \sigma 2s^2, \sigma 2p_z^2, \pi 2p_x^2 = \pi 2p_y^2,$
$\pi^*2p_x^2 = \pi^*2p_y^1$

$$B.O. = \frac{1}{2}(10-7) = \frac{3}{2} = 1.5$$

Thus, the correct order of increasing bond order is $He_2^+ < O_2^- < O_2^+ < C_2^{2-}$.

463. Which one of the following has longest covalent bond distance?
(a) C — C (b) C — H
(c) C — N (d) C — O

AP-EAMCET (Engg.) - 2014

Ans. (a) : The average distance between the centre of nuclei of the two bonded atom in a molecule is known as bond length.

(i) C – C	(ii) C – H	(iii) C – N	(iv) C – O
1.53A°	1.03A°	1.48A°	1.43A°

So, C – C(1.53Å) has longest covalent bond distance.

464. The bond order between Ni-C bond in $Ni(CO)_4$ is
(a) one (b) two
(c) less than two (d) more than two

AMU-2014

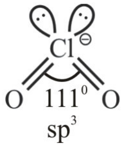
Ans. (c) : In $Ni(CO)_4$, there is a synergic bonding interaction between Ni and CO. As a result there is an increase in the strength of Ni–CO bond and decrease in the bond order. The bond order of Ni–C bond is more than one but less than two.

465. What is the bond angle in ClO_2^- (OClO)?
(a) 90^0 (b) 118^0
(c) 105^0 (d) 111^0

BCECE-2014

@apna_pdf

Ans. (d) : The bond angle of ClO_2^- is 111°. The central atom of Cl has 2 lone pair and Cl is also attached to the 2 sigma bond by oxygen atom the hybridisation of ClO_2^- is sp^3.



466. Which following is same for both hydrogen and deuterium molecules?
(a) Bond energy (b) Melting point
(c) Boiling point (d) Bond length

BCECE-2014

Ans. (d): Bond length is same for both hydrogen and deuterium molecules

Property	Hydrogen	deuterium
Bond length (pm)	74.14	74.14
Bond energy (kJ/mole)	435.88	443.35
Melting Point (K)	13.96	18.73
Boiling Point (K)	20.39	23.69

467. N_2 and O_2 are converted into mono anions N_2^- and O_2^- respectively. Which of the following statements is wrong?
(a) In N_2, the N–N bond weakens
(b) In O_2, the O–O bond order increases
(c) In O_2, bond length decreases
(d) N_2^- becomes diamagnetic

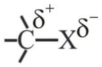
BITSAT 2014

Ans. (b) : We know that in O_2 bond, the order is 2 and in O_2^- bond, the order is 1.5. Therefore the wrong statements is (b).

468. Which of the following is the correct order for strength of C-X bond.
(a) $CH_3F > CH_3Cl > CH_3Br > CH_3I$
(b) $CH_3F > CH_3Br > CH_3I > CH_3F$
(c) $CH_3I > CH_3F > CH_3Cl > CH_3Br$
(d) $CH_3Cl > CH_3Br > CH_3I > CH_3F$

GUJCET-2014

Ans. (a) : Halogen atoms are more electronegative than carbon, therefore, carbon-halogen bond of alkyl halide is polarized, the carbon atom bears a partial positive charge whereas the halogen atom bears a partial negative charge.



As we know, bond length is inversely proportional to the bond strength. As we go down the group in the periodic table, the size of halogen atom increases. Fluorine atom is the smallest and iodine atom is the largest. Consequently the carbon-halogen bond length also increases from C–F to C–I and the bond strength of C–F to C–I decreases. Hence, the correct order for strength of C–X bond is–

$CH_3F > CH_3Cl > CH_3Br > CH_3I.$

469. The correct order of magnitude of bond angles among the compounds CH_4, NH_3 and H_2O is
(a) $CH_4 > H_2O < NH_3$ (b) $H_2O < NH_3 < CH_4$
(c) $NH_3 < CH_4 < H_2O$ (d) $NH_3 < H_2O < CH_4$

JIPMER-2014

Ans. (b) : The given species are CH_4, NH_3 and H_2O. The CH_4 molecule has regular geometry with 109°28' bond angle. Ammonia has one lone pair with 107.5° whereas H_2O has two lone pair with 104.5°. As we know, the availability of one lone pair on central atom, reduces the bond angle by 2.5°. Hence, the order of bond angle will be–

$H_2O < NH_3 < CH_4$.

470. Arrange the following species in the correct order of their stability
C_2, Li, O_2^+, He_2^+
(a) $Li_2 < He_2^+ < O_2^+ < C_2$
(b) $C_2 < O_2^+ < Li_2 < He_2^+$
(c) $He_2^+ < Li_2 < C_2 < O_2^+$
(d) $O_2^+ < C_2 < Li_2 < He_2^+$
(e) $C_2 < Li_2 < He_2^+ < O_2^+$

Kerala-CEE-2014

Ans. (c) : The stability of molecule depends upon the bond order i.e. Bond order is directly proportional to the stability of molecule.

C_2 (total $e^- = 12$) $\Rightarrow \text{Bond order} = \frac{8-4}{2} = 2$

Li_2 (total $e^- = 6$) $\Rightarrow \text{Bond order} = \frac{4-2}{2} = 1$

O_2^+ (total $e^- = 15$) $\Rightarrow \text{Bond order} = \frac{10-5}{2} = 2.5$

He_2^+ (total $e^- = 3$) $\Rightarrow \text{Bond order} = \frac{2-1}{2} = 0.5$

Thus, the order of stability will be–
$He_2^+ < Li_2 < C_2 < O_2^+$

471. Bond order of which among the following molecules is zero?
(a) F_2 (b) O_2
(c) Be_2 (d) Li_2

MHT CET-2014

Ans. (c) :

(a) F_2 (total $e^- = 18$) $= (\sigma 1s)^2 (\sigma^* 1s)^2 (\sigma 2s)^2 (\sigma^* 2s)^2$

$$(\sigma 2p_z)^2 (\pi 2p_x^2 = \pi 2p_y^2)(\pi^* 2p_x^2 = \pi^* 2p_y^2)$$

$$\text{Bond order} = \frac{10-8}{2} = 1$$

(b) O_2 (total $e^- = 16$) $= (\sigma 1s)^2 (\sigma^* 1s)^2 (\sigma 2s)^2 (\sigma^* 2s)^2$

$$(\sigma 2p_z)^2 (\pi 2p_x^2 = \pi 2p_y^2)(\pi^* 2p_x^1 = \pi^* 2p_y^1)$$

$$\text{Bond order} = \frac{10-6}{2} = 2$$

@apna_pdf

(c) Be_2 (total $e^- = 8$) $= (\sigma 1s)^2 (\sigma^* 1s)^2 (\sigma 2s)^2 (\sigma^* 2s)^2$

$$\text{Bond order} = \frac{4-4}{2} = 0$$

(d) Li_2 (total $e^- = 6$) $= (\sigma 1s)^2 (\sigma^* 1s)^2 (\sigma 2s)^2$

$$\text{Bond order} = \frac{4-2}{2} = 1$$

Hence, Be_2 has zero bond order.

472. In which of the following ionization processes the bond energy increases and the magnetic behavior changes from paramagnetic to diamagnetic.

(a) $O_2 \to O_2^+$ (b) $C_2 \to C_2^+$
(c) $NO \to NO^+$ (d) $N_2 \to N_2^+$

KARNATAKA NEET 2013

Ans. (c) : Molecular orbital configuration of

$O_2 = \sigma 1s^2, \sigma * 1s^2, \sigma\, 2s^2, \sigma * 2s^2, \sigma 2p_z^2, \pi 2p_x^2 = \pi 2p_y^2,$
$\pi * 2p_x^1 = \pi * 2p_y^1 {}^{2}$

It is paramagnetic.

$$\text{Bond order} = \frac{10-6}{2} = 2$$

$O_2^+ = \sigma 1s^2, \sigma^* 1s^2, \sigma\, 2s^2, \sigma^* 2s^2, \sigma 2p_z^2, \pi 2p_x^2 = \pi 2p_y^2,$
$\pi * 2p_x^1$

It is paramagnetic.

$$\text{Bond order} = \frac{10-5}{2} = 2.5$$

$C_2 = \sigma 1s^2, \sigma^* 1s^2, \sigma 2s^2, \sigma * 2s^2, \pi 2p_x^2 = \pi 2p_y^2,$

It is paramagnetic.

$$\text{Bond order} = \frac{8-4}{2} = 2$$

$C_2^+ = \sigma 1s^2, \sigma^* 1s^2, \sigma 2s^2, \sigma * 2s^2, \pi 2p_x^2 = \pi 2p_y^1,$

It is paramagnetic.

$$\text{Bond order} = \frac{7-4}{2} = 1.5$$

$NO = \sigma 1s^2, \sigma * 1s^2, \sigma 2s^2, \sigma * 2s^2, \sigma 2p_z^2, \pi 2p_x^2 = \pi 2p_y^2,$
$\pi * 2p_x^1$

It is paramagnetic.

$$\text{Bond order} = \frac{10-5}{2} = 2.5$$

$NO^+ = \sigma 1s^2, \sigma^* 1s^2, \sigma 2s^2, \sigma * 2s^2, \sigma 2p_z^2, \pi 2p_x^2 = \pi 2p_y^2,$

It is diamagnetic.

$$\text{Bond order} = \frac{10-4}{2} = 3$$

$N_2 = \sigma 1s^2, \sigma^* 1s^2, \sigma 2s^2, \sigma * 2s^2, \pi 2p_x^2 = \pi 2p_y^2, \sigma 2p_z^2$

It is paramagnetic.

$$\text{Bond order} = \frac{10-4}{2} = 3$$

$N_2^+ = \sigma 1s^2, \sigma^* 1s^2, \sigma 2s^2, \sigma * 2s^2, \pi 2p_x^2 = \pi 2p_y^2, \sigma 2p_z^1$

It is paramagnetic.

$$\text{Bond order} = \frac{9-4}{2} = 2.5$$

Hence, the magnetic behavior changes form paramagnetic to diamagnetic is options (c).

473. The types of bonds between two carbon atoms in calcium carbide is

(a) one sigma, one pi (b) two sigma, one pi
(c) two sigma, two pi (d) one sigma, two pi

AMU-2013

Ans. (d) : Calcium carbide (CaC_2) is an ionic compound is $C^{2+}C_2^{2-}$. The calcium atom is bonded to the two carbon atoms through ionic bonding.

$[:C \equiv C:]^{2-}\, Ca^{2+}$

It has one sigma and two pi–bonds.

474. The bond order of N_2^+ on the basis of molecular orbital theory is [At. number of N = 7]

(a) 3 (b) 2.5
(c) 2 (d) 1.5

J & K CET-2013

Ans. (b) : N_2^+

Total no of $e^- = 13$

MO configuration of $N_2^+ = (\sigma 1s)^2 (\sigma^* 1s)^2 (\sigma 2s)^2 (\sigma^* 2s)^2$
$(\pi 2p_x^2 = \pi 2p_y^2)(\sigma 2p_z^1)$

$$\text{Bond order} = \frac{9-4}{2} = 2.5$$

475. Which molecule has the shortest bond length?

(a) N_2 (b) O_2
(c) Cl_2 (d) Br_2

SCRA 2012

Ans. (a) : The experimental values of molecules given as –

Molecule	Bond length(Å)
N_2	1.09(Å)
O_2	1.21(Å)
Cl_2	1.98(Å)

476. Bond energy of Cl_2, Br_2 and I_2 follow the order

(a) $Cl_2 > Br_2 > I_2$ (b) $Br_2 > Cl_2 > I_2$
(c) $I_2 > Br_2 > Cl_2$ (d) $I_2 > Cl_2 > Br_2$

AP EAMCET (Engg.) 2012

Ans. (a) : When we move from top to bottom in halogen family the size of atom increases then the bond length also increases and bond energy decreases.

∴ The order of bond energy is–

$Cl_2 > Br_2 > I_2$.

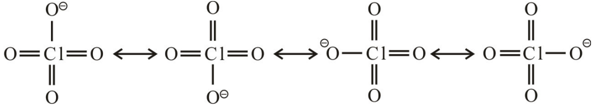
477. Cl-O bond order in perchlorate ion is

(a) 1.33 (b) 1.50
(c) 1.75 (d) 1.90

AMU-2012

@apna_pdf

Ans. (c) : The structure of per chlorate ion is



Total number of resonating structure = 4

$$\therefore \quad \text{Bond order} = \frac{\text{Total no. of bond}}{\text{Total no. of resonating structure}}$$

$$= \frac{7}{4} = 1.75$$

Hence, the bond order of perchlorate ion is 1.75.

478. The molecule having smallest bond angle is

(a) NCl_3 (b) $AsCl_3$

(c) $SbCl_3$ (d) PCl_3

(AIEEE-2012)

Ans. (c) : All the possible trihalides of N, P, As, Sb and Bi are known. The bond angle is decreases from NCl_3 to $SbCl_3$ because the electronegativity and the size of central atom decreases due to which $SbCl_3$ has the smallest bond angle.

479. The correct order of bond energy is

(a) $Cl_2 > Br_2 > F_2 > I_2$ (b) $Cl_2 > F_2 > Br_2 > I_2$

(c) $I_2 > Br_2 > Cl_2 > F_2$ (d) $I_2 > Br_2 > F_2 > Cl_2$

J & K CET-(2012)

Ans. (a) : The elements of halogen all form diatomic molecules. It would be expected that the bond energy in the X_2 molecules would decrease as the atoms become larger, since increased size results in less effective overlap of orbital's. Cl_2 Br_2 and I_2 show the expected trend but the bond energy for F_2 does not fit the expected trend. A reason for this anomaly is the relatively large electron-electron repulsion among the lone pairs in F_2 molecule where they are much closer to each other than in case of Cl_2

Molecules	**Bond Energy ($kJmol^{-1}$)**
F_2	158.8
Cl_2	242.6
Br_2	192.8
I_2	151.1

480. The C-H bond distance is the longest in

(a) C_2H_2 (b) C_2H_4

(c) C_2H_6 (d) $C_2H_2Br_2$

J & K CET-(2012)

Ans. (c) : As we know, if the s character of molecule is more then bonded pair electrons are held more closely, ensuring a smaller bond length and stronger a bond. So, sp has the least bond length and it is the strongest.sp^3 has longest bond distance. Hence, C–H has more bond distance in C_2H_6.

481. The correct order in which the O–O bond length increases in the following is

(a) $H_2O_2 < O_2 < O_3$ (b) $O_3 < H_2O_2 < O_2$

(c) $O_2 < O_3 < H_2O_2$ (d) $O_2 < H_2O < O_3$

JCECE-2012

Ans. (c) : Bond length of O — O in O_2 = 1.21Å

Bond length of O — O in O_3 = 1.278 Å

Bond length of O — O in H_2O_2 = 1.49 Å

Therefore, correct order of O — O bonds length is (bond order decrease in the same order)

$$O_2 < O_3 < H_2O_2$$

482. Which one of the following has the shortest bond length?

(a) C–H (b) C–N

(c) C–O (d) C–C

(e) C–F

Kerala-CEE-2012

Ans. (e) : The more electronegative atom polarize the bond length and the bond length go to decrease in size. In the given species, F is more electronegative atom. So it's electronegative power attract the share electron towards the F. Thus, the bond length getting to shortest.

483. Which of the following has least bond energy?

(a) N_2^{2-} (b) N_2^-

(c) N_2^+ (d) N_2

MHT CET-2012

Ans. (a) : The Bond energy of molecule is directly proportional to the bond order of the molecule.

$$\text{(a) } N_2^{2-} \ (\text{total } e^- = 16) = (\sigma 1s)^2 \left(\sigma^* 1s\right)^2 (\sigma 2s)^2 \left(\sigma^* 2s\right)^2$$
$$(\sigma 2p_z)^2 \left(\pi 2p_x^2 = \pi 2p_y^2\right) \left(\pi^* 2p_x^1 = \pi^* 2p_y^1\right)$$

$$\text{Bond order} = \frac{10-6}{2} = 2$$

$$\text{(b) } N_2^- \ (\text{total } e^- = 15) = (\sigma 1s)^2 \left(\sigma^* 1s\right)^2 (\sigma 2s)^2 \left(\sigma^* 2s\right)^2$$
$$(\sigma 2p_z)^2 \left(\pi 2p_x^2 = \pi 2p_y^2\right) \left(\pi^* 2p_x^1 = \pi * 2py\right)$$

$$\text{Bond order} = \frac{10-5}{2} = 2.5$$

$$\text{(c) } N_2^+ \ (\text{total } e^- = 13) = (\sigma 1s)^2 \left(\sigma^* 1s\right)^2 (\sigma 2s)^2 \left(\sigma^* 2s\right)^2$$
$$\left(\pi 2p_x^2 = \pi 2p_y^2\right) \left(\sigma 2p_z^1\right)$$

$$\text{Bond order} = \frac{9-4}{2} = 2.5$$

$$\text{(d) } N_2 \ (\text{total } e^- = 14) = (\sigma 1s)^2 \left(\sigma^* 1s\right)^2 (\sigma 2s)^2 \left(\sigma^* 2s\right)^2$$
$$\left(\pi 2p_x^2 = \pi 2p_y^2\right) \left(\sigma 2p_z^2\right)$$

$$\text{Bond order} = \frac{10-4}{2} = 3$$

Hence, N_2^{2-} has least bond energy.

484. Which of the following species has highest bond energy?

(a) O_2^{2-} (b) O_2^+

(c) O_2^- (d) O_2

MHT CET-2012

Ans. (b) : The bond energy of diatomic molecule depends upon the bond order. Bond order is directly proportional to the bond energy.

$$\text{(a) } O_2^{2-} \ (\text{total } e^- = 18) \Rightarrow \text{Bond order} = \frac{10-8}{2} = 1$$

$$\text{(b) } O_2^+ \ (\text{total } e^- = 15) \Rightarrow \text{Bond order} = \frac{10-5}{2} = 2.5$$

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(c) O_2^- (total e^- = 17) ⇒ Bond order = $\frac{10-7}{2} = 1.5$

(d) O_2 (total e^- = 16) ⇒ Bond order = $\frac{10-1}{2} = 2$

485. Bond order in nitrogen molecule is

(a) 1 (b) 2
(c) 3 (d) 4

COMEDK 2011

Ans. (c) :

$N_2(14): \sigma 1s^2, \sigma^* 1s^2, \sigma 2s^2, \sigma^* 2s^2, \pi 2p_x^2 = \pi 2p_y^2, \sigma 2p_z^2$

Bond order = $\frac{8-2}{2} = 3$

486. Which of the following is correct comparison of the stability of the molecules?

(a) $CN < O_2^+$ (b) $CN = N_2$
(c) $N_2 < O_2$ (d) $H_2^+ > He_2^+$

VITEEE- 2011

Ans. (d) : If the bond order of two molecules are same then the stability of the molecules can be explain on the number of electron in antibonding molecular orbital, more the electron in antibonding, less be the stability of molecule.

$H_2^+(1) = \sigma 1s^1$

$$\text{Bond order} = \frac{\text{Bonding orbital } e^- - \text{Antibonding orbital } e^-}{2}$$

$$\text{Bond order} = \frac{1-0}{2} = 0.5$$

and $He_2^+(3) = \sigma 1s^2, \sigma^* 1s^1$

$$\text{Bond order} = \frac{2-1}{2} = 0.5$$

So, H_2^+ has the less electron in antibonding whereas He_2^+ has more electron in antibonding so the H_2^+ is more stable than He_2^+.

487. The value of Cl – Cl bond distance is found to be

(a) 1.98 Å (b) 0.99 Å
(c) 0.77 Å (d) 1.76 Å

SRMJEEE – 2011

Ans. (a) : The bond length of Cl – Cl is 1.98 Å

488. The correct bond order in the following species is :

(a) $O_2^{2+} < O_2^- < O_2^+$ (b) $O_2^+ < O_2^- < O_2^{2+}$
(c) $O_2^- < O_2^+ < O_2^{2+}$ (d) $O_2^{2+} < O_2^+ < O_2^-$

BITSAT 2011

Ans. (c) : O_2^+ ion – Total number of electrons (16 – 1) = 15 = $\sigma 1s^2 \sigma^* 1s^2 \sigma 2s^2 \sigma^* 2s^2 \sigma 2p_z^2$

$\pi 2p_x^2 = \pi 2p_y^2 \pi^* 2p_x^1 = \pi^* 2p_y$

Bond order $= \frac{N_b - N_a}{2} = \frac{10-5}{2} = \frac{5}{2} = 2\frac{1}{2}$

O_2^- (Super oxide ion): Total number of electrons (16 + 1) = 17 = $\sigma 1s^2 \sigma^* 1s^2 \sigma 2s^2 \sigma^* 2s^2 \sigma 2p_z^2$

$\pi 2p_x^2 = \pi 2p_y^2 \pi^* 2p_x^2 = x^* 2p_y^1$

Bond order $= \frac{(N_b - N_a)}{2} = \frac{10-7}{2} = \frac{3}{2} = 1\frac{1}{2}$

O_2^{2+} ion : Total number of electrons = (16 – 2) = 14

$\sigma 1s^2 \sigma^* 1s^2 \sigma 2s^2 \sigma^* 2s^2 \pi 2p_x^2 = \pi 2p_y^2 \sigma 2p_z^2$

Bond order $= \frac{(N_b - N_a)}{2} = \frac{10-4}{2} = \frac{6}{2} = 3$

So bond order : $O_2^- < O_2^+ < O_2^{2+}$

489. The bond order of C_2 molecule is

(a) 1 (b) 2
(c) 0 (d) 3

J & K CET-2011

Ans. (b) : The given diatomic molecule is C_2. C_2 has the 12 no. of electron. Now, the molecular orbital configuration is given below–

MO configuration= $(\sigma 1s)^2 (\sigma^* 1s)^2 (\sigma 2s)^2 (\sigma^* 2s)^2 (\pi 2p_x^2 = \pi 2p_y^2)$

Bond order $= \frac{N_b - N_a}{2}$

Where, N_b = no. of e^- in bonding orbital
N_a = no. of e^- in antibonding orbital

Bond order $= \frac{8-4}{2} = 2$

490. The correct statement with regard to H_2^+ and H_2^- is

(a) both H_2^+ and H_2^- are equally stable
(b) both H_2^+ and H_2^- do not exist
(c) H_2^- is more stable than H_2^+
(d) H_2^+ is more stable than H_2^-

JIPMER-2011

Ans. (d) : The species are H_2^+ and H_2^-.

H_2^+ (total e^- = 1) = $(\sigma 1s)^1$
$N_b = 1, N_a = 0$

and H_2^- (total e^- = 3) = $(\sigma 1s)^1$ $(\sigma^* 1s)^1$
$N_b = 2$, $N_a = 1$

According to the application of stability of MOT, H_2^+ has less electron on antibonding molecular orbital than the H_2^- molecule. So, H_2^+ is more stable than the H_2^-.

491. When O_2 is converted into O_2^+

(a) both paramagnetic character and bond order increase
(b) bond order decreases
(c) paramagnetic character increases
(d) paramagnetic character decreases and the bond order increases

Karnataka-CET-2011

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Ans. (d) : (i) $O_2 = (\sigma 1s)^2 \left(\sigma^* 1s\right)^2 (\sigma 2s)^2 \left(\sigma^* 2s\right)^2$

$$(\sigma 2p_z)^2 \left(\pi 2p_x^2 = \pi 2p_y^2\right)\left(\pi^* 2p_x^1 = \pi^* 2p_y^1\right)$$

$$\text{Bond order} = \frac{10-6}{2} = 2$$

O_2 molecule having 2 unpaired electron.

(ii) $O_2^+ = (\sigma 1s)^2 \left(\sigma^* 1s\right)^2 (\sigma 2s)^2 \left(\sigma^* 2s\right)^2 (\sigma 2p_z)^2$

$$\left(\pi 2p_x^2 = \pi 2p_y^2\right)\left(\pi^* 2p_x^1\right)$$

$$\text{Bond order} = \frac{10-5}{2} = 2.5$$

O_2^+ ion having only 1 unpaired electron.

Hence, when O_2 is converted into O_2^+ then paramagnetic character decrease and the bond order increases.

492. Which of the following is not correct with respect to bond length of the species?

(a) $C_2 > C_2^{2-}$ (b) $B_2^+ > B_2$

(c) $Li_2^+ > Li_2$ (d) $N_2^+ > N_2$

(e) $O_2 > O_2^-$

Kerala-CEE-2011

Ans. (e) : The bond order of molecule is inversely proportional to the bond length.

(a) C_2 (total $e^- = 12$) $\Rightarrow \text{Bond order} = \frac{8-4}{2} = 2$

C_2^{2-} (total $e^- = 14$) $\Rightarrow \text{Bond order} = \frac{10-4}{2} = 3$

(b) B_2^+ (total $e^- = 14$) $\Rightarrow \text{Bond order} = \frac{5-4}{2} = 0.5$

B_2 (total $e^- = 10$) $\Rightarrow \text{Bond order} = \frac{6-4}{2} = 1$

(c) Li_2^+ (total $e^- = 5$) $\Rightarrow$ $\text{Bond order} = \frac{3-2}{2} = 0.5$

Li_2 (total $e^- = 6$) $\Rightarrow$ $\text{Bond order} = \frac{4-2}{2} = 1$

(d) N_2^+ (total $e^- = 13$) $\Rightarrow \text{Bond order} = \frac{9-4}{2} = 2.5$

N_2 (total $e^- = 14$) $\Rightarrow \text{Bond order} = \frac{10-4}{2} = 3$

(e) O_2 (total $e^- = 16$) $\Rightarrow \text{Bond order} = \frac{10-6}{2} = 2$

O_2^- (total $e^- = 17$) $\Rightarrow \text{Bond order} = \frac{10-7}{2} = 1.5$

O_2 has maximum bond order than the O_2^-. So, O_2 has less bond length rather than the O_2^-. Thus, the statement is wrong.

493. The bond length of species O_2, O_2^+, and O_2^- are in the order of

(a) $O_2^+ > O_2 > O_2^-$ (b) $O_2^- > O_2 > O_2^+$

(c) $O_2 > O_2^+ > O_2^-$ (d) $O_2 > O_2^- > O_2^+$

UP CPMT-2011

Ans. (b) Bond length decreases, as bond order increases.

Bond order of $O_2 = 2$

Bond order of $O_2^+ = 2.5$

Bond order of $O_2^- = 1.5$

Hence, the order of bond length is

$$O_2^- > O_2 > O_2^+$$

494. The order of bond energies in halogen molecules is

(a) $F_2 < Cl_2 < Br_2 < I_2$ (b) $F_2 > Cl_2 > Br_2 > I_2$

(c) $Cl_2 > Br_2 > F_2 > I_2$ (d) $Cl_2 > F_2 > Br_2 > I_2$

AP- EAMCET(Medical) -2010

Ans. (c): As we know, bond length increases with decreasing of its bond dissociation energy. F_2 has smaller enthalphy of dissociation to that of Cl_2 whereas X–X bond dissociation enthalpies from chlorine onwards show the expected trend : Cl–Cl >Br–Br > I–I. The relatively large electron-electron repulsion among the lone pairs in F_2 molecule where they are much closer to each other them in case of Cl_2. Hence, the correct order will be –

$$Cl_2 > Br_2 > F_2 > I_2.$$

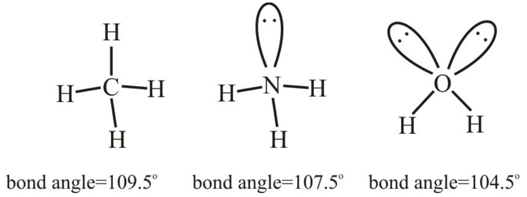
495. The correct order of magnitude of bond angles among the compounds CH_4, NH_3 and H_2O

(a) $CH_4 < H_2O < NH_3$ (b) $H_2O < NH_3 < CH_4$

(c) $NH_3 < CH_4 < H_2O$ (d) $NH_3 < H_2O < CH_4$

AP- EAMCET(Medical) -2010

Ans. (b): The given species are CH_4, NH_3 and H_2O. The structures of given compound are given as follows–



Hence, the correct order of bond angle will be $CH_4 > NH_3 > H_2O$.

496. Which of the following has the highest bond order?

(a) N_2 (b) O_2

(c) He_2 (d) H_2

JIPMER-2010

Ans. (a):

(a) N_2 (Total $e^- = 14$) $= (\sigma 1s)^2 \left(\sigma^* 1s\right)^2 (\sigma 2s)^2 \left(\sigma^* 2s\right)^2$

$$\left(\pi 2p_x^2 = \pi 2p_y^2\right)\left(\sigma 2p_z^2\right)$$

$$\text{Bond Order} = \frac{10-4}{2} = 3$$

(b) O_2 (total $e^- = 16$) $= (\sigma 1s)^2 \left(\sigma^* 1s\right)^2 (\sigma 2s)^2 \left(\sigma^* 2s\right)^2$

$$(\sigma 2p_z)^2 \left(\pi 2p_x^2 = \pi 2p_y^2\right)$$

$$\left(\pi^* 2p_x^1 = \pi^* 2p_y^1\right)$$

$$\text{Bond order} = \frac{10-6}{2} = 2$$

@apna_pdf

(c) He_2 (total $e^- = 4$) $= (\sigma 1s)^2 \, (\sigma^* 1s)^2$

$$\text{Bond order} = \frac{2-2}{2} = 0$$

(d) H_2 (Total $e^- = 2$) $= (\sigma 1s)^2$

$$\text{Bond order} = \frac{2-0}{2} = 1$$

Thus, N_2 has highest bond order.

497. The correct order towards bond angle is

(a) $sp^3 < sp^2 < sp$
(b) $sp < sp^2 < sp^3$
(c) $sp < sp^3 < sp^2$
(d) $sp^2 < sp^3 < sp$

JIPMER-2010

Ans. (a): As we know that the % s character is directly proportional to the bond angle of central atom of the molecule.

Hybridisation	**% s character**	**Bond angle**
sp	50	180°
sp^2	33.3	120°
sp^3	25	109°28'

498. Peroxide ion ....

(i) has five completely filled antibonding molecular orbits
(ii) is diamagnetic
(iii) has bond order one
(iv) is iso-electronic with neon

Which one of these is correct?

(a) (ii) and (iii)
(b) (i), (ii) and (iv)
(c) (i), (ii) and (iii)
(d) (i) and (iv)

KARNATAKA-CET, 2010

Ans. (a) : Peroxide ion is O_2^{2-}

$$O_2^{2-}(18) = (\sigma 1s)^2 \, (\sigma^* 1s)^2 \, (\sigma 2s)^2 \, (\sigma^* 2s)^2 \, (\sigma 2p_z)^2$$
$$(\pi 2p_x^2 = \pi 2p_y^2) \, (\pi * 2p_x^2 = \pi * 2p_y^2)$$

$$\text{Bond order} = \frac{10-8}{2} = 1$$

It contains four completely filled antibonding molecular orbitals. Since, all the electrons are paired, O_2^{2-} is diamagnetic.

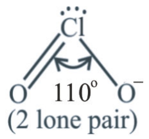
Peroxide ion is isolectronic with Argon, not with Neon.

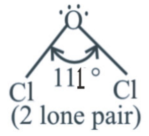
499. The correct order increasing bond angles in the following species is

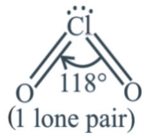
(a) $Cl_2O < ClO_2 < ClO_2^-$
(b) $ClO_2 < Cl_2O < ClO_2^-$
(c) $Cl_2O < ClO_2^- < ClO_2$
(d) $ClO_2^- < Cl_2O < ClO_2$

(NEET-2010)

Ans. (d) :







In ClO_2^-, there are two lone pairs of electrons which repel each other due to which two oxygen atom come closer leading to decrease in bond angle. Therefore, the angle in ClO_2^- is less than 118° which is bond angle in ClO_2^- which has less number of electrons on chlorine.

500. The bond angle in H_2O is 104.5° and in H_2S it is 92.5°. The difference is due to

(a) The smaller size of O atom compared to S atom minimizes electron repulsions and allows the bonds in H_2O to be purely p-type
(b) The larger size of S atom compared to atom minimizes electron repulsions and allows the bonds in H_2S to be purely p-type
(c) The bond pair-lone pair repulsions are large in H_2S
(d) The size of the atom increases and electro negativity decreases while moving from oxygen to sulphur as a result bond pairs closer to the central atom

SCRA - 2009

Ans. (b) : Bond angle is directly proportional to the electronegativity of the central atom.

As Oxygen has more electronegativity value as compared to sulphur. So, bond angle of H_2O is more than H_2S.

Another reason behind this i.e., the bond pair-bond pair resulsion is smaller in magnitude, still the b.p- b.p repulsion in case of H_2O molecule exist while in case of H_2O due to large size of S as compared to O is less and going to decreasing with increase the size of element. So, on moving from top to bottom bond angle decreases.

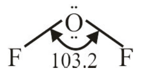
501. Fluorine reacts with dilute NaOH and forms a gaseous product A. The bond angle in the molecule of A is

(a) 104°40'
(b) 103°
(c) 107°
(d) 109°28'

VITEEE- 2009
AP EAMCET (Engg.)-2009

Ans. (b) : $2F_2 + 2\underset{\text{dilute}}{NaOH} \rightarrow 2NaF + \underset{(A)}{OF_2}\uparrow + H_2O$

The structure of 'A' (OF_2) is as



σ bonds made by O = 2

Due to repulsion between two lone pairs of electrons, its shape gets distorted. Therefore, the bond angle in the molecule is 103°.

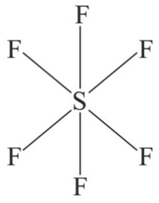
502. The bond angle and % of d-character in SF_6 are

(a) 120°, 20%
(b) 90°, 33%
(c) 109°, 25%
(d) 90°, 25%

AMU – 2009

@apna_pdf

Ans. (b) : For SF_6 molecule.



sp^3d^2 (Octahedral)

$$\% \text{ d character} = \frac{\text{No. of d orbitals involved in hybrid}}{\text{Total no. of orbital}} \times 100$$

$$= \frac{2\times1}{6\times1}\times100$$

$$= 33.3\%$$

503. Which of the following two are isostructural?

(a) XeF_2, IF_2^-
(b) NH_3, BF_3
(c) CO_3^{2-}, SO_3^{2-}
(d) PCI_5, ICI_5

BITSAT 2009

Ans. (a) : XeF_2 and IF_2^- both are linear and have hybridisation sp^3d.

504. **(i) H - C - H angle in CH_4**

(ii) Cl - B - Cl angle in BCl_3

(iii) F - I - F angle in IF_7 in a Plane

(iv) I - I - I angle in I_3^-

Increasing order of above bond angles is

(a) (i) < (ii) < (iii) < (iv)
(b) (ii) < (i) < (iii) < (iv)
(c) (iii) < (i) < (ii) < (iv)
(d) (iv) < (ii) < (i) < (iii)

CG PET -2009

Ans. (c) :

Molecule	**Hybridisation**	**Geometry**	**Bond Angle**
CH_4	sp^3	Tetrahedral	109.5°
BCl_3	sp^2	Trigonal planer	120°
IF_7	sp^3d^3	Pentagonal bipyramidal	72°
I_3^-	sp^3d	Linear	180°

505. H – O – H bond angle in H_2O is 104.5^o and not 109^o 28' because of

(a) lone pair-lone pair repulsion
(b) lone pair-bond pair repulsion
(c) bond pair-bond pair repulsion
(d) high electronegativity of oxygen

JIPMER-2009

Ans. (a) : According to the VSEPR theory, the repulsive interaction of electron pairs decrease in the order : Lone pair-Lone pair > Lone pair-Bond pair > Bond pair – bond pair. Due to the lone pair-lone pair repulsion, the bond angle is reduces from 109°28' to 104.5°.

506. According to MO theory which of the lists ranks the nitrogen species in terms of increasing bond order?

(a) $N_2^{2-} < N_2^- < N_2$
(b) $N_2 < N_2^{2-} < N_2^-$
(c) $N_2^- < N_2^{2-} < N_2$
(d) $N_2^- < N_2 < N_2^{2-}$

NEET-2009

Ans. (a)

(a) N_2 (total e^- = 14) $= (\sigma 1s)^2 \left(\sigma^* 1s\right)^2 (\sigma 2s)^2 \left(\sigma^* 2s\right)^2$
$\left(\pi 2p_x^2 = \pi 2p_y^2\right) \left(\sigma 2p_z^2\right)$

$$\text{Bond order} = \frac{10-4}{2} = 3$$

(b) N_2^{2-} (total e^- = 16) $= (\sigma 1s)^2 \left(\sigma^* 1s\right)^2 (\sigma 2s)^2 \left(\sigma^* 2s\right)^2$
$(\sigma 2p_z)^2 \left(\pi 2p_x^2 = \pi 2p_y^2\right) \left(\pi^* 2p_x^1 = \pi^* 2p_y^1\right)$

$$\text{Bond order} = \frac{10-6}{2} = 2$$

Similarly,

(c) N_2^- (total e^- = 15) $\Rightarrow$ Bond order $= \dfrac{10-5}{2} = 2.5$

Thus, The bond order follow the following sequence

$N_2^{2-} < N_2^- < N_2$

507. Right order of dissociation energy N_2 and N_2^+ is

(a) $N_2 > N_2^+$
(b) $N_2 = N_2^+$
(c) $N_2^+ > N_2$
(d) None

NEET-2009

Ans. (a) $\boxed{\text{Bond order} \propto \text{Bond energy}}$

N_2 (total e^- = 14) $= (\sigma 1s)^2 \left(\sigma^* 1s\right)^2 (\sigma 2s)^2 \left(\sigma^* 2s\right)^2$
$\left(\pi 2p_x^2 = \pi 2p_y^2\right) \left(\sigma 2p_z^2\right)$

$$\text{Bond order} = \frac{10-4}{2} = 3$$

And

N_2^+ (total e^- = 13) $= (\sigma 1s)^2 \left(\sigma^* 1s\right)^2 (\sigma 2s)^2 \left(\sigma^* 2s\right)^2$
$\left(\pi 2p_x^2 = \pi 2p_y^2\right) \left(\sigma 2p_z^1\right)$

$$\text{Bond order} = \frac{9-4}{2} = 2.5$$

Hence, N_2 has the more bond dissociation energy than the N_2^+

508. The carbon-carbon bond distance in benzene is

(a) Longer than a C – C single bond
(b) Longer than a C = C double bond
(c) Sohrter than a C = C double bond
(d) Shorter than a $C \equiv C$ triple bond

MPPET-2008

Ans. (b) : All the carbon-carbon bond distance in benzene are 140 pm i.e. longer than a C = C double bond.

509. Assertion: Fluorine molecule has bond order one.
Reason: The number of electrons in the anti-bonding molecular orbitals is two less than that in bonding molecular orbitals.

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(a) If both Assertion and Reason are correct and the Reason is the correct explanation of Assertion
(b) If both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.
(c) If Assertion is correct but Reason is incorrect
(d) If both the Assertion and Reason are incorrect

AIIMS-2008

Ans. (a): The molecular orbital configuration of

$F_2 = \sigma 1s^2, \sigma^* 1s^2, \sigma 2s^2, \sigma^* 2s^2, \sigma 2p_z^2$

$\pi 2p_x^2 = \pi 2p_y^2, \pi^* 2p_x^2 = \pi^* 2p_y^2$

Bond order $= \dfrac{10-8}{2} = 1$

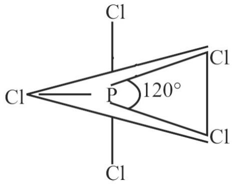
The number of electrons in the anti bonding molecular orbitals is two less than that in bonding molecular orbitals.

510. Cl - P -Cl bond angles in PCl_5 molecule are

(a) 120° and 90°
(b) 60° and 90°
(c) 60° and 120°
(d) 120° and 30°

VITEEE- 2008

Ans. (a) : In PCl_5, phosphorus undergoes sp^3d hybridization and has trigonal bipyramidal geometry. It has two axial chlorine atoms & three equatorial chlorine atoms bonded to the central P.
Hence bond angles for axial are 90°, Cl–P–Cl & for equatorial Cl–P–Cl it is 120°.



511. About the species O_2^+, O_2^{2-}, O_2, O_2^- which one of the following statements is correct?

(a) O_2^+ has the highest bond order and largest bond length.
(b) O_2 has the highest bond order.
(c) The bond order of O_2 equals the average bond orders of O_2^+ and O_2^-.
(d) The sum of bond orders of these species is 1.

SRMJEEE – 2008

Ans. (c) : $\text{B.O.} = \dfrac{N_B - N_A}{2}$

Where N_A and N_B are the number of electrons in antibonding and bonding molecule.

Bond order of $O_2^+ = \dfrac{10-5}{2} = 2.5$

Bond order of $O_2^{2-} = \dfrac{10-8}{2} = 1$

Bond order of $O_2 = \dfrac{10-6}{2} = 2$

Bond order of $O_2^- = \dfrac{10-7}{2} = 1.5$

Average Bond order of O_2^+ and $O_2^- = \dfrac{2.5+1.5}{2} = 2$

Which is equal to the bond order of O_2.

512. In the molecules NO, CO, O_2^- and O_2 the correct sequence of bond order is

(a) $NO = CO > O_2^- > O_2$
(b) $O_2^- > O_2 > NO > CO$
(c) $O_2 > O_2^- > NO > CO$
(d) $CO > NO > O_2 > O_2^-$

AMU – 2008

Ans. (d) : According to molecular orbital electronic configuration ,

$CO = \sigma 1s^2 \sigma^* 1s^2 \sigma 2s^2 \sigma^* 2s^2\ \pi 2p_X^2 = \pi 2p_Y^2\ \sigma 2p_X^2$

$\text{B.O.} = \dfrac{N_b - N_a}{2} = \dfrac{10-4}{2} = 3$

$NO = \sigma 1s^2 \sigma^* 1s^2 \sigma 2s^2 \sigma^* 2s^2\ \sigma 2p_z^2\ \pi 2p_X^2$

$= \pi 2p_y^2 \pi^* 2p_x^1$

$\text{B.O.} = \dfrac{N_b - N_a}{2} = \dfrac{10-5}{2} = 2.5$

$O_2^- = \sigma 1s^2 \sigma^* 1s^2 \sigma 2s^2 \sigma^* 2s^2\ \sigma 2p_z^2\ \pi 2p_X^2$

$= \pi 2p_y^2 \pi^* 2p_x^2 = \pi^* 2p_y^1$

$\text{B.O.} = \dfrac{N_b - N_a}{2} = \dfrac{10-7}{2} = 1.5$

$O_2 = \sigma 1s^2 \sigma^* 1s^2 \sigma 2s^2 \sigma^* 2s^2 \sigma 2p_z^2 \pi 2p_x^2 = \pi 2p_y^2 \pi^* 2p_x^1 = \pi^* 2p_y^1$

$\text{B.O.} = \dfrac{N_b - N_a}{2} = \dfrac{10-6}{2} = 2$

So, the correct sequence of B.O. is
$CO > NO > O_2 > O_2^-$.

513. From the molecular orbital theory, one can show that the bond order in F_2 molecule is

(a) 2
(b) 1
(c) 3
(d) 4

J & K CET-2008

Ans. (b) : Total number of electron in F_2 molecule = 18

$\therefore$ MO configuration $= (\sigma 1s)^2 (\sigma^* 1s)^2 (\sigma 2s)^2 (\sigma^* 2s)^2$

$(\sigma 2p_z)^2 (\pi 2p_x^2 = \pi 2p_y^2) (\pi^* 2p_x^2 = \pi^* 2p_y^2)$

Bond order $= \dfrac{10-8}{2} = 1$

514. What will be the bond angle C–O–H in alcohol if hybridisation of C and O atom possess sp^3 hybridisation?

(a) 109°28'
(b) 111°42'
(c) 109°
(d) 108°30'

GUJCET-2007

Ans. (a) : The given species is $C{-}\ddot{\underset{\cdot\cdot}{O}}{-}H$. The hybridisation of oxygen are sp^3. As we know that the bond angle of sp^3 hybridisation is 109°28'.

515. The strength of bonds formed by s-s, p-p, and s-p overlap is in the order of

(a) s-s < s-p < p-p
(b) s-s < p-p < s-p
(c) s-p < s-s < p-p
(d) p-p < s-s < s-p

SRMJEEE – 2007

@apna_pdf

Ans. (a) : The correct order of strength of bond is s–s>–s–p>p–p
The extent of overlap is higher for s orbital than for p orbital. Higher is the extent of overlap stronger is the bond formed.

516. The order of stability of O_2 and its various ionic species follows the sequence

(a) $O_2^{2-} > O_2^- > O_2 > O_2^+$ (b) $O_2 > O_2^+ > O_2^- > O_2^{2-}$

(c) $O_2^+ > O_2 > O_2^- > O_2^{2-}$ (d) $O_2^- > O_2^+ > O_2 > O_2^{2-}$

AMU – 2007

Ans. (c) **:** Bond order of O_2^+, O_2, O_2^-, O_2^{2-} are 2.5, 2, 1.5, 1 respectively. Thus their stability is in following order

$O_2^+ > O_2 > O_2^- > O_2^{2-}$

517. The bond length between C – C bond in sp^2 hybridised molecule is–

(a) 1.2 Å (b) 1.39 Å

(c) 1.33 Å (d) 1.54 Å

BCECE-2007

Ans. (b) : The bond length between C – C bond in sp^2 hybridised molecule is 1.39 $\overset{\circ}{A}$

518. For a stable molecule, the value of bond order must be

(a) there is no relationship between stability and bond order
(b) zero
(c) positive
(d) negative

Karnataka-CET-2007

Ans. (c) : Bond order ∝ Stability
Hence, for a stable molecule the value of bond order must be positive. When bond order is zero then molecule will not exist.

519. Which of the following paramagnetic with bond order 0.5?

(a) F_2 (b) H_2^+

(c) N_2 (d) O_2^-

(e) B_2

Kerala-CEE-2007

Ans. (b) :

(a) F_2 (total e^- = 18) = $(\sigma 1s)^2 (\sigma^* 1s)^2 (\sigma 2s)^2 (\sigma^* 2s)^2$

$$(\sigma 2p_z)^2 \left(\pi 2p_x^2 = \pi 2p_y^2\right) \left(\pi * 2p_x^2 = \pi * 2p_y^2\right)$$

$$\text{Bond order} = \frac{10-8}{2} = 1, n = 0\ (\text{diamagnetic})$$

(b) H_2^+ (Total e^- = 1) = $(\sigma 1s)^1$

$$\text{Bond order} = \frac{1-0}{2} = 0.5, n = 1\ (\text{paramagnetic})$$

(c) N_2 (Total e^- = 14) = $(\sigma 1s)^2\ (\sigma^* 1s)^2 (\sigma 2s)^2 (\sigma^* 2s)^2$

$$(\pi 2p_x^2 = \pi 2p_y^2)\ (\sigma\, 2p_z)^2$$

$$\text{Bond order} = \frac{10-4}{2} = 3, n = o\ (\text{Diamagnetic})$$

Similary,

(d) O_2^- (total e^- =17)

$$\text{Bond order} = \frac{10-7}{2} = 1.5, n = 1\ (\text{paramagnetic})$$

(e) B_2 (total e^- =10)

$$\text{Bond order} = \frac{6-4}{2} = 1, n = 0\ (\text{Diamagnetic})$$

520. Sequence of bond length of the following

A. ethane **B. ethene**

C. ethyne

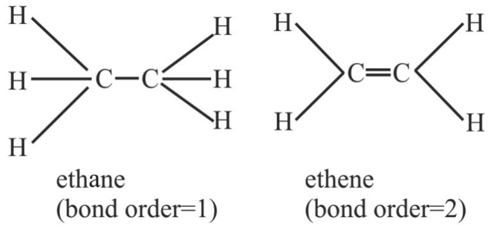
(a) A>B>C (b) B>A>C

(c) C>B>A (d) C>A>B

UP CPMT-2007

Ans. (a) : The bond length decrease with the multiplicity of the bond.

$$\text{Bond length} \propto \frac{1}{\text{Bond order}}$$


ethane
(bond order=1)

ethene
(bond order=2)

$$\underset{\text{ethyne (bond order=3)}}{H-C\equiv C-H}$$

As the bond order sequence is
ethane<ethene<ethyne

∴ The sequence of bond length is
Ethane > Ethene > Ethyne
Hence, A>B>C

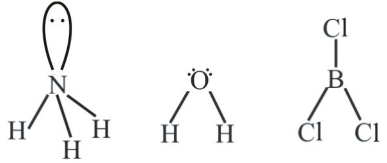
521. The bond angle in AsH_3 is greater than that in:

(a) NH_3 (b) H_2O

(c) BCl_3 (d) None of these

AP-EAMCET (Medical), 2006

Ans. (d) : The given species are: NH_3, H_2O and BCl_3.



Bond angle– 107.5° 104.5° 120°
Hybridization– sp^3 sp^3 sp^2

AsH_3 has the low bond angle due to large size of As. AsH_3 has sp^2 hybridization and having the 92° bond angle.

522. On comparison with H – C – H bond angle of methane, the C – N – C bond angle of trimethylamine is

(a) higher (b) no change

(c) not comparable (d) lower

VITEEE- 2006

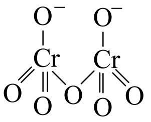
Ans. (b) : In both the cases carbon is sp^3 hybridised and bond angle is 109°28'.

@apna_pdf

523. In the dichromate dianion,
(a) 4 Cr – O bonds are equivalent
(b) 6 Cr – O bonds are equivalent
(c) all Cr – O bonds are equivalent
(d) all Cr – O bonds are nonequivalent

BITSAT 2006

Ans. (b) : The structure of $Cr_2O_7^{2-}$



There are six normal Cr–O bonds and two bridged Cr–O bond.
The six normal Cr–O bonds are expected to be equivalent and different from those of the bridged Cr–O bond.

524. Bond order of N_2 molecule is
(a) 3
(b) 2
(c) 1
(d) 0

CG PET -2006

Ans. (a) : Total number of e^- in N_2 = 14

$$\therefore \text{ MO configuration} = (\sigma 1s)^2 (\sigma^* 1s)^2 (\sigma 2s)^2 (\sigma^* 2s)^2 (\pi 2p_x^2 = \pi 2p_y^2)(\sigma\, 2p_z^2)$$

$$\text{Bond order} = \frac{10-4}{2} = 3$$

Hence, the bond order of N_2 molecule is 3.

525. If the value of bond order is zero, then
(a) molecule will be stable
(b) molecule will be unstable
(c) molecule will be in ionic state
(d) None of the above

CG PET -2006

Ans. (b) : The value of bond order is zero it means the bonding influence and anti-bonding influence are equal and as a result there is no net force of attraction, so molecule will be unstable.

526. The decreasing values of bond angles from NH_3 (107°) to SbH_3 (91°) down group - 15 of the periodic table is due to
(a) Increasing bond pair - bond pair repulsion
(b) Increasing p-orbital character in sp^3
(c) Decreasing lone pair - bond pair repulsion
(d) Decreasing electronegativity

(AIEEE-2006)

Ans. (d) : All the elements of group 15 form hydrides of the type EH_3 where E = N, P, As, Sb or Bi. The bond angles from NH_3 to SbH_3 decreases because as we go down in the group 15 elements, the electronegativity decreases then bonded electron polarizes towards central atom less, so repulsion decreases and bond angle is also be decreases.

527. According to bond order concept, the correct order of stability of O_2, O_2^+ and O_2^- is
(a) $O_2 > O_2^+ > O_2^-$
(b) $O_2^- > O_2 > O_2^+$
(c) $O_2 > O_2^- > O_2^+$
(d) $O_2^+ > O_2 > O_2^-$

J & K CET-2006

Ans. (d) : The total number of electron on O_2, O_2^+ and O_2^- are 16, 15 and 17 respectively.

$$\text{(i) } O_2 \text{ (total } e^- = 16) = (\sigma 1s)^2 (\sigma^* 1s)^2 (\sigma 2s)^2 (\sigma^* 2s)^2 (\sigma 2p_z)^2 (\pi 2p_x^2 = \pi 2p_y^2)(\pi^* 2p_x^1 = \pi^* 2p_y^1)$$

$N_b = 10, N_a = 6$

$$\text{(ii) } O_2^+ \text{ (total } e^- = 15) = (\sigma 1s)^2 (\sigma^* 1s)^2 (\sigma 2s)^2 (\sigma^* 2s)^2 (\sigma 2p_z)^2 (\pi 2p_x^2 = \pi 2p_y^2)(\pi^* 2p_x^1 = \pi * 2py)$$

$N_b = 11, N_a = 5$

$$\text{(iii) } O_2^- \text{ (total } e^- = 17) = (\sigma 1s)^2 (\sigma^* 1s)^2 (\sigma 2s)^2 (\sigma^* 2s)^2 (\sigma 2p_z)^2 (\pi 2p_x^2 = \pi 2p_y^2)(\pi^* 2p_x^2 = \pi^* 2p_y^1)$$

$N_b = 10, N_a = 7$

According to the molecular orbital theory– the stability of molecule depends upon the number of electron in anti bonding molecular orbital (N_a). As well as N_a increases then the molecule goes to unstable. Hence, the correct order of stability will be–

$$O_2^+ > O_2 > O_2^-$$

528. Bond angle in H_2O is:
(a) $109^0 28'$
(b) $107^0 10'$
(c) 104.5^0
(d) 92^0

JCECE - 2006

Ans. (c) : H_2O has the sp^3 hybridisation with two lone pair electron. due to the lone pair– lone pair repulsion the bond angle reduces from 109°28' to 104.5°.

529. Which of the following gives correct arrangement of compounds involved based on their bond strength?
(a) HF > HCl > HBr > HI
(b) HI > HBr > HCl > HF
(c) HF > HBr > HCl > HI
(d) HCl > HF > HBr > HI

JIPMER-2006

Ans. (a) : The halogens atom react with hydrogen to given hydrogen halides but affinity for hydrogen decreases from fluorine to iodine because of increaseness of size of halogens. Thus, the correct order of bond strength of halogen halide is–

HF > HCl > HBr > HI

530. Identify the correct order in which the covalent radius of the following elements increases
I. Ti II. Ca III. Sc
(a) (I), (II), (III)
(b) (III), (II), (I)
(c) (II), (I), (III)
(d) (I), (III), (II)

AP-EAMCET-2005

Ans. (d) : Due to increase in effective nuclear charge (Z_{eff}) atomic size decrease in the following order.
Ca > Sc > Ti
or II > III > I

531. In the nitrogen family the H-M-H bond angle in the hydrides (MH_3) gradually becomes closer to 90° on going from N to Sb. This shows that
(a) the basic strength of hydrides increases
(b) the bond energies of M–H bonds increases

@apna_pdf

(c) almost pure p-orbitals are used for M–H bonding
(d) the bond pairs of electrons come nearer to the central atom

CG PET -2005

Ans. (c) : In the nitrogen family the H-M-H bond angle in the hydrides (MH_3) gradually becomes closer to 90º on going from N to Sb. This shows that almost pure p-orbitals are used for M–H bonding.

532. The angle between two covalent bonds is maximum in

(a) CH_4
(b) H_2O
(c) CO_2
(d) SO_2

CG PET -2005

Ans. (c) : As we know that the percent s character is directly proportional to the bond angle of molecule. The hybridization of molecule is given below–

Molecule	**Hybridisation**	**% S character**
CH_4	sp^3	25
H_2O	sp^3	25
CO_2	sp	50
SO_2	sp^2	33.33

Thus, CO_2 molecule has greater bond angle between two covalent bonds.

533. Which one of the following molecules has the smallest bond angle?

(a) NH_3
(b) PH_3
(c) H_2O
(d) H_2Se
(e) H_2S

Kerala-CEE-2005

Ans. (d) : As the electron density around the central atom decreases the repulsion between electron pair decreases. Hence, the bond angle decreases in the order–

$$NH_3 > PH_3 > H_2S > H_2Se$$

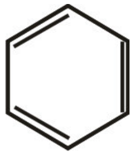
Therefore, H_2Se has the smallest bond angle.

534. Bond order in benzene is

(a) 1
(b) 2
(c) 1.5
(d) None of these

UP CPMT-2005

Ans. (c) : The structure of benzene shows it has 6-carbon-carbon single bonds and 3 carbon-carbon double bonds.



$$\text{Bond order} = \frac{\text{Total bonds}}{\text{Total C-atoms in molecule}} = \frac{9}{6}$$
$$= 1.5$$

535. If the mass defect of ^9_4X is 0.090 AMU then binding energy per nucleon is (1AMU=931.5 Mev)

(a) 9.315 Mev
(b) 931.5 Mev
(c) 83.0 Mev
(d) 8.38 Mev

J & K CET-(2004)

Ans. (a) : Given that,

Mass defect $(\Delta m) = 0.090$ amu
1 amu = 931.5 Mev

$\therefore$ Mass defect $(\Delta m) = 0.090 \times 931.5$ Mev
$\Delta m = 83.835$ Mev

Number of nucleon in given nucleus = 9

Thus, binding energy per nucleon $= \frac{83.835}{9}$
$= 9.315$ Mev

536. The bond-angle in AsH_3 is greater than that in:

(a) NH_3
(b) H_2O
(c) BCl_3
(d) none of these

JCECE - 2004

Ans. (d) : Bond angle of AsH_3 is 91.8° and that of NH_3 is 107.8° BCl_3 is trigonal planar, and therefore the bond angle is 120 whereas H_2O has bond angle of 104.5°. Hence, option (d) is correct.

537. The bond order of O_2^+ same as in

(a) N_2^+
(b) CN^-
(c) CO
(d) NO^+

UP CPMT-2004

Ans. (a) : Write the electronic configuration of each of the species according to the molecular orbital theory and then find bond order with its help.

$$O_2^+ \ (\text{total } e^- = 15) = (\sigma 1s)^2 (\sigma^* 1s)^2 (\sigma 2s)^2 (\sigma^* 2s)^2$$
$$(\sigma 2p_z)^2 (\pi 2p_x^2 = \pi 2p_y^2)(\pi^* 2p_x^1)$$

$$\text{Bond order} = \frac{10-5}{2} = 2.5$$

(a) $N_2^+ = (\text{total } e^- = 13) = (\sigma 1s)^2 (\sigma^* 1s)^2 (\sigma 2s)^2 (\sigma^* 2s)^2$
$$(\pi 2p_x^2 = \pi 2p_y^2)(\sigma 2p_z^1)$$

$$\text{Bond order} = \frac{9-4}{2} = 2.5$$

(b) CN^- (total e^- = 14) $= (\sigma 1s)^2 (\sigma^* 1s)^2 (\sigma 2s)^2 (\sigma^* 2s)^2$
$$(\pi 2p_x^2 = \pi 2p_y^2)(\sigma 2p_z^2)$$

$$\text{Bond order} = \frac{10-4}{2} = 3$$

(c) CO (total e^- =14) $= (\sigma 1s)^2 (\sigma^* 1s)^2 (\sigma 2s)^2 (\sigma^* 2s)^2$
$$(\pi 2p_x^2 = \pi 2p_y^2)(\sigma 2p_z^2)$$

$$\text{Bond order} = \frac{10-4}{2} = 3$$

(d) NO^+ (total e^- =14) $= (\sigma 1s)^2 (\sigma^* 1s)^2 (\sigma 2s)^2 (\sigma^* 2s)^2$
$$(\pi 2p_x^2 = \pi 2p_y^2)(\sigma 2p_z^2)$$

$$\text{Bond order} = \frac{10-4}{2} = 3$$

$\therefore$ Bond order of O_2^+ is same as that of N_2^+

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538. The oxidation state of Xe and XeO_3 and the bond angle in it respectively, are :

(a) + 6, 109° (b) + 8, 103°
(c) + 6, 103° (d) + 8, 120°

AP-EAMCET/2003

Ans. (c): In XeO_3, let the Oxidation state of Xe is x

$$XeO_3$$
$$\therefore\ x + 3(-2) = 0$$
$$x = +6$$

In XeO_3 has sp^3 hybridization with bond angle is 103°.

539. Which of the following molecules is most stable?

(a) H_2 (b) F_2
(c) O_2 (d) N_2

AMU–2003

Ans. (d) : Bond order in H_2=1
Bond order in F_2=1
Bond order in O_2=2
Bond order in N_2= 3
Higher the bond order, more stable is the molecule.

540. N_2 and O_2 are converted to N_2^+ and O_2^+ respectively. Which of the following is not correct?

(a) In N_2^+, the N – N bond weakens.
(b) In O_2^+, O – O bond order increases.
(c) In O_2^+, paramagnetism decreases.
(d) N_2^+ becomes diamagnetic

J & K CET-2003

Ans. (d) : N_2 (Total e^- = 14) $=(\sigma 1s)^2 (\sigma^* 1s)^2 (\sigma 2s)^2$

$$(\sigma^* 2s)^2 (\pi 2p_x^2 = \pi 2p_y^2) (\sigma 2p_z^1)^2$$

$$\text{Bond order of } N_2 = \frac{10-4}{2} = 3$$

O_2 (total e^- = 16) $=(\sigma 1s)^2 (\sigma^* 1s)^2 (\sigma 2s)^2 (\sigma^* 2s)^2$

$$(\sigma 2p_z)^2 (\pi 2p_x^2 = \pi 2p_y^2) (\pi^* 2p_x^1 = \pi^* 2p_y^1)$$

$$\text{Bond order of } O_2 = \frac{10-6}{2} = 2 \qquad \text{unpaired } e^- = 2$$

Similarly,

$$\text{Bond order of } N_2^+ = \frac{9-4}{2} = 2.5, \qquad n = 1 \text{ (Paramagnetic)}$$

$$\text{Bond order of } O_2^+ = \frac{10-5}{2} = 2.5, \qquad \text{Unpaired } e^- = 1$$

According to the above explanations, only one statement is not true i.e. option (d) because N_2^+ becomes paramagnetic.

541. The bond order of O_2^+ is:

(a) 2 (b) 2.5
(c) 1.5 (d) 0.5

JCECE - 2003

Ans. (b): O_2^+

Total electron in O_2^+ = 15

MO configuration of

$$O_2^+ = (\sigma 1s)^2 (\sigma^* 1s)^2 (\sigma 2s)^2 (\sigma^* 2s)^2$$
$$(\sigma 2p_z)^2 (\pi 2p_x^2 = \pi 2p_y^2) (\pi^* 2p_x^1)$$

$$\text{Bond order of } O_2^+ = \frac{10-5}{2} = 2.5$$

Thus, bond order of O_2^+ is 2.5.

542. The bond energies (in kJ mol^{-1}) of P–H, As–H and N–H are respectively

(a) 247, 389 and 318 (b) 247, 318 and 389
(c) 318, 389 and 247 (d) 318, 247 and 389

AP EAMCET- 2002

Ans. (d) : Bond energy increase then the bond length decrease. As–H has bond length is maximum in comparison to N–H and P–H.
So the bond energy is less. The correct order of bond energy is– N – H > P – H > As – H

543. An element M reacts with chlorine to form a compound X. The bond angle in X is 120°. What is M?

(a) Be (b) B
(c) Mg (d) N

AP-EAMCET (Medical), 2002

Ans. (b) : When boron and nitrogen reacts with chlorine to form BCl_3, NCl_3 respectively. The bond angle in BCl_3 is 120° and bond angle in NCl_3 is 107° and hence, the M will be boron.

544. Which of the following molecule has highest bond energy?

(a) F–F (b) N–N
(c) C–C (d) O–O

AIIMS-2002

Ans. (b): The molecular orbital configuration of molecule is –

(i)$F_2 = \sigma 1s^2, \sigma^* 1s^2, \sigma 2s^2, \sigma^* 2s^2, \sigma 2p_z^2, \pi 2p_x^2 = \pi 2p_y^2,$

$$\pi^* 2p_x^2 = \pi^* sp_y^2$$

$$\text{Bond order} = \frac{10-8}{2} = 1$$

(i) $N_2 = \sigma 1s^2, \sigma^* 1s^2, \sigma 2s^2, \sigma^* 2s^2, \pi 2p_x^2 = \pi 2p_y^2, \sigma 2p_z^2$

$$\text{Bond order} = \frac{10-4}{2} = 3$$

(iii) $C_2 = \sigma 1s^2, \sigma^* 1s^2, \sigma 2s^2, \sigma^* 2s^2, \pi 2p_x^2 = \pi 2p_y^2$

$$\text{Bond order} = \frac{8-4}{2} = 2$$

(iv) $O_2 = \sigma 1s^2, \sigma^* 1s^2, \sigma 2s^2, \sigma^* 2s^2, \sigma 2p_z^2, \pi 2p_x^2$

$$= \pi 2p_y^2, \pi^* 2p_x^2 = \pi^* 2p_y^1$$

$$\text{Bond order} = \frac{10-6}{2} = 2$$

$\therefore$ Bond order is directly proportional to bond energy hence, N_2 has maximum bond energies.

@apna_pdf

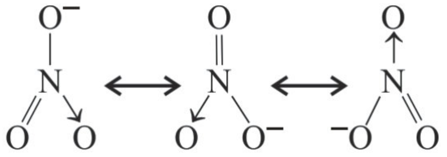
545. Bond order of N—O bonds in nitrate ion is

(a) 1.25 (b) 1.50

(c) 1.33 (d) 1.0

AMU 2002

Ans. (c) : The resonating structure of nitrate ion is given below-



$$\text{Bond order} = \frac{\text{Total number of bonds (N - O) in all resonating structure}}{\text{Number of resonating structure}}$$

$$\text{Bond order} = \frac{4}{3} = 1.33$$

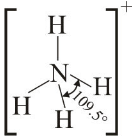
546. Bond angle of 109º28′ is found in

(a) NH_3 (b) H_2O

(c) $\overset{\oplus}{C}H_5$ (d) $\overset{\oplus}{N}H_4$

(AIEEE-2002)

Ans. (d) : Molecules which has regular geometry then they acquire the proper bond angle. Here, NH_4^+ has sp^3 hybridisation with zero lone pair.



Whereas NH_3 and H_2O has one and two lone pair respectively due to which they have less bond angle than NH_4^+.

547. The species containing shortest O – O bond length is

(a) O_2 (b) O_2^-

(c) O_2^{2-} (d) O_2^+

J & K CET-(2002)

Ans. (d) : O_2^+ has 15 e^-. Molecular orbital configuration can be written as–

$$O_2^+\ (15) = (\sigma 1s)^2 \left(\sigma^* 1s\right)^2 (\sigma 2s)^2 \left(\sigma^* 2s\right)^2 \left(\sigma 2p_z\right)^2 \left(\pi 2p_x^2 = \pi 2p_y^2\right)\left(\pi^* 2p_x^1\right)$$

$$\text{Bond order} = \frac{10-5}{2} = 2.5$$

$$\text{Similarly, Bond order of } O_2 = \frac{10-6}{2} = 2$$

$$\text{Bond order of } O_2^- = \frac{10-7}{2} = 1.5$$

$$\text{Bond order of } O_2^{2-} = \frac{10-8}{2} = 1$$

It is very well known that bond length is inversely proportional to the bond order of the molecules. Thus, O_2^+ has shortest bond length.

548. Which one of the following order is correct for the bond energies of halogen molecules?

(a) $I_2>Cl_2>Br_2$ (b) $Br_2>Cl_2>I_2$

(c) $Cl_2>Br_2>I_2$ (d) $I_2>Br_2>Cl_2$

AP EAMCET- 2001

Ans. (c) : On moving from top to down in a group of halogen family bond energies decrease due to distance b/w the electron and nuclei increases thereby decreasing the force of attraction.

∴ The order of bond energies is-

$$Cl_2 > Br_2 > I_2$$

549. The catenation tendency of C, Si and Ge is in the order Ge < Si < C. The bond energies (in kJ mol^{-1}) of C–C, Si–Si and Ge–Ge bonds, respectively, are:

(a) 167, 180, 348 (b) 180, 167,348

(c) 348, 167, 180 (d) 348, 180, 167

AP EAMCET- 2001

Ans. (d) : Catenation tendency ∝ Bond energy.

Hence, catenation tendency of Ge < Si < C is given so the bond energies of C–C, Si–Si and Ge–Ge will be 348, 180, 167 are respectively.

550. Which of the following statements is true?

(a) Hybridization of the central atom in NH_3 and CH_4 is sp^2

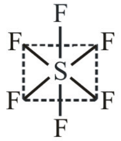
(b) $BeCl_2$ has V-shape while SO_2 is linear

(c) SF_6 is octahedral and F–S–F bond angle 90º

(d) CO_2 has dipole moment

AP-EAMCET/2001

Ans. (c): SF_6 has octahedral structure :



Be bond angle F – S – F is 90º. Statement is true.

- Hybridization of central atom in NH_3 and CH_4 is sp^3.
- $BeCl_2$ is linear and SO_2 is V-shaped structure.
- CO_2 has zero dipole moment.

551. Which of the following has the lowest bond angle?

(a) H_2O (b) CH_4

(c) H_2S (d) NH_3

AP-EAMCET/2000

Ans. (c): H_2S has the lowest bond angle i.e. 92.5º because sulphur has more in size than the oxygen.

Molecule		Bond angle
H_2O	–	104.5°
CH_4	–	109.5°
NH_3	–	107.5°

552. In which of the following compounds the angle between two covalent bonds is highest?

(a) CH_4 (b) NH_3

(c) H_2O (d) H_2O_2

AP-EAMCET (Med.)-1999

Ans. (a) : The hybridisation of CH_4 molecule is sp^3. There is no any lone pair present in the CH_4. Hence, the actual bond angle is 109^{0}28'. Whereas, NH_3, H_2O and

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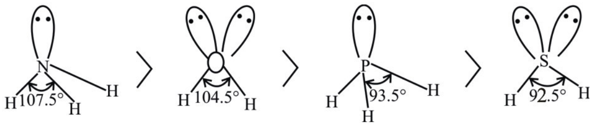
H_2O_2 contains the 1, 2 and 2 lone pair respectively. It are also have sp^3 hybridisation but due to the lone pair-lone pair repulsion bond angle reduces.
CH_4 bond angle is 109.28°
NH_3 bond angle is 107°
H_2O bond angle is 104.5°
H_2O_2 bond angle is 97°

553. The correct order of the bond angles is
(a) $NH_3 > H_2O > PH_3 > H_2S$
(b) $NH_3 > PH_3 > H_2O > H_2S$
(c) $NH_3 > H_2S > PH_3 > H_2O$
(d) $PH_3 > H_2S > NH_3 > H_2O$

J & K CET-(1997)

Ans. (a) : According to the VSEPR theory–the bond angle is inversely proportional to the electronegativity of the substituent and directly proportional to the size of central atom.



554. The bond angle of H_2X (where, X is a sixth group element), as one goes down the group,
(a) Increases (b) Decreases
(c) Does not change (d) Changes irregulary

AP EAMCET- 1996

Ans. (b) : The bond angle of H_2X (where, X is a sixth group element) decreases as we go down the group because of electronegativity decreases.

555. The effect of repulsion between the two lone pairs of electrons present on oxygen in water molecule is :
(a) no change in H–O–H bond angle
(b) increase in H–O–H bond angle
(c) decrease in H–O–H bond angle
(d) All atoms will be in one plane

AP-EAMCET/1996

Ans. (c): According to the Valence Bond Theory (VBT), the repulsion are working in following manner– Lone pair-lone pair > Lone pair-bond pair > Bond pair-bond pair. The repulsion decreases the bond angle. Water molecule which is sp^3 hybridized. It angle is 104.5º. This is due to the presence of two lone pairs of electrons.

556. Which of the following molecules has the highest bond order?
(a) O_2^- (b) O_2
(c) O_2^+ (d) O_2^{2-}

NEET-1994

Ans. (c)

(a) O_2^- (total e^-=17)$\Rightarrow$Bond order $= \frac{10-7}{2} = 1.5$

(b) O_2 (total e^-=16)$\Rightarrow$ Bond order $= \frac{10-6}{2} = 2$

(c) O_2^+ (total e^-=15)$\Rightarrow$ Bond order $= \frac{10-5}{2} = 2.5$

(d) O_2^{2-} (total e^-=18)$\Rightarrow$ Bond order $= \frac{10-8}{2} = 1$

Thus, O_2^+ has maximum bond order

557. Cyclic hydrocarbon 'A' has all the carbon and hydrogen atoms in a single plane. All the carbon-carbon bonds have the same length, less than 1.54 Å, but more than 1.34 Å. The bond angle will be
(a) $109^0 28'$ (b) 100^0
(c) 180^0 (d) 120^0

NEET-1989

Ans. (d) : The cyclic hydrocarbon 'A' is benzene because in benzene bond length is between single and double bond and all the carbon and hydrogen atoms i.e. in a single plane where each C atom is sp^2 hybridised so, C–C–C bond angle is 120°.

558. The Cl–C–Cl angle in 1, 1, 2, 2-tetrachloro-ethene and tetra-chloromethane respectively will be about
(a) 120^0 and 109.5^0 (b) 90^0 and 109.5^0
(c) 109.5^0 and 90^0 (d) 109.5^0 and 120^0

NEET-1988

Ans. (a) : In 1, 1, 2, 2 tetrachloroethene, each carbon is sp^2 hybridised, thus having bond angle 120° and in tetrachloromethane carbon is sp^3- hybridized, hence bond angle is 109.5°.

559. The bond angles of NH_3, NH_4^+ and NH_2^- are in the order
(a) $NH_2^- > NH_3 > NH_4^+$ (b) $NH_4^+ > NH_3 > NH_2^-$
(c) $NH_3 > NH_2^- > NH_4^+$ (d) $NH > NH_4^+ > NH_2^-$

VITEEE 2014

Ans. (b) : On increases the number of lone pairs of electrons, bond angle decreases. Therefore order of bond angle of these species is-

NH_4^+ >	NH_3 >	NH_2^-
↓	↓	↓
Zero lone pair	One lone pair	Two lone pair

560. Which one of the following pairs of species have the same bond order?
(a) CN^- and NO^+ (b) CN^- and CN^+
(c) O_2^- and CN^- (d) NO^+ and CN^+

Kerala CEE 2009, NEET 2017

Ans. (a) : The given species which have equal number of total electron then they have the same bond order. Only CN^- and NO^+ has the same no of total electron i.e. 14. Hence, they have same bond order.

561. Stability of the species Li_2, Li_2^- and Li_2^+ increases in the order of
(a) $Li_2 < Li_2^+ < Li_2^-$ (b) $Li_2^- < Li_2^+ < Li_2$
(c) $Li_2 < Li_2^- < Li_2^+$ (d) $Li_2^- < Li_2 < Li_2^+$

JEE Main 2013

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Ans. (b) : The given species are Li_2, Li_2^+, and Li_2^-

Total no. of e^- in $Li_2(6) = (\sigma 1s)^2 (\sigma^* 1s)^2 (\sigma 2s)^2$

$N_a = 2, N_b = 4$

Total no. of e^- in $Li_2^+ (5) = (\sigma 1s)^2 (\sigma^* 1s)^2 (\sigma 2s)^1$

$N_a = 2, N_b = 3$

Total no. of e^- in $Li_2^- (7)$

$= (\sigma 1s)^2 (\sigma^* 1s)^2 (\sigma 2s)^2 (\sigma^* 2s)^1$

$N_a = 3, N_b = 4$

If N_b is the number of electrons occupying bonding orbitals and N_a is the number of electron occupying the antibonding orbitals then the molecule is stable if N_b is greater than N_a. Hence, the correct order of stability is–

$Li_2^- < Li_2^+ < Li_2$.

562. In which of the following processes, the bond order has increased and paramagnetic character has changed to diamagnetic?

(a) $O_2 \to O_2^+$ (b) $N_2 \to N_2^+$

(c) $O_2 \to O_2^-$ (d) $NO \to NO^+$

JEE Main 2019

Ans. (d) : The species are given below–

(a) $\to O_2$ (Total $e^- = 16$) $= (\sigma 1s)^2 (\sigma^* 1s)^2 (\sigma 2s)^2 (\sigma^* 2s)^2 (\sigma 2P_z)^2$ $(\pi 2p_x^2 = \pi 2p_y^2)(\pi^* 2p_x^1 = \pi^* 2p_y^1)$

$\Rightarrow B.O. = \frac{10-6}{2} = 2$ (paramagnetic)

$\to O_2^+$ (Total $e^- = 15$) $= (\sigma 1s)^2 (\sigma^* 1s)^2 (\sigma 2s)^2 (\sigma^* 2s)^2 (\sigma 2P_z)^2$ $(\pi 2p_x^2 = \pi 2p_y^2)(\pi^* 2p_x^1)$

$\Rightarrow B.O. = \frac{10-5}{2} = 2.5$ (paramagnetic)

Similarly,

(b) $\to N_2$ (total $e^- = 14$) $= (\sigma 1s)^2 (\sigma^* 1s)^2 (\sigma 2s)^2 (\sigma^* 2s)^2 (\pi 2p_x^2 = \pi 2p_y^2)(\sigma 2p_z)^2$

$\Rightarrow B.O. = \frac{10-4}{2} = 3$ (Diamagnetic)

$\to N_2^+$ (total $e^- = 13$) $= B.O. = \frac{9-4}{2} = 2.5$ (Paramagnetic)

(c) $\to O_2$ (Total $e^- = 16$) $= B.O. = \frac{10-6}{2} = 2$ (Paramagnetic)

$\to O_2^-$ (Total $e^- = 17$) $= B.O. = \frac{10-7}{2}$ 1.5 (Paramagnetic)

(d) $\to NO$ (Total $e^- = 15$) $= B.O. = \frac{10-5}{2} = 2.5$ (Paramagnetic)

$\to NO^+$ (Total $e^- = 14$) $= B.O. = \frac{10-4}{2} = 3$ (diamagnetic)

Hence, the correct option is (d).

563. Match List-I with List-II

	List-I (Molecule)		**List-II (Bond order)**
A	**Ne_2**	**(i)**	**1**
B	**N_2**	**(ii)**	**2**
C	**F_2**	**(iii)**	**0**
D	**O_2**	**(iv)**	**3**

Choose the correct answer from the options given below.

	A	B	C	D
(a)	(iii)	(iv)	(i)	(ii)
(b)	(i)	(ii)	(iii)	(iv)
(c)	(ii)	(i)	(iv)	(iii)
(d)	(iv)	(iii)	(ii)	(i)

JEE Main 05.03.2021

Ans. (a) :

Molecule	**N_a and N_b**	**Bond order**
Ne_2	$N_b=10, N_a=10$	$B.O. = \frac{N_b - N_a}{2} = \frac{10-10}{2} = 0$
N_2	$N_b=10, N_a=4$	$B.O. = \frac{10-4}{2} = 3$
F_2	$N_b=10, N_a=8$	$B.O. = \frac{10-8}{2} = 1$
O_2	$N_b=10, N_a=6$	$B.O. = \frac{10-6}{2} = 2$

564. The correct order of bond angles (smallest first) in H_2S, NH_3, BF_3 and SiH_4 is

(a) $H_2S < SiH_4 < NH_3 < BF_3$

(b) $NH_3 < H_2S < SiH_4 < BF_3$

(c) $H_2S < NH_3 < SiH_4 < BF_3$

(d) $H_2S < NH_3 < BF_3 < SiH_4$

AIEEE 2004

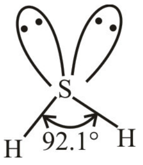
Ans. (c) : The bond angle of the molecules depends upon the hybridization of molecule as well as availability of lone pair of electron on central atom.

H_2S

Hybridisation = Bond pair + Lone pair

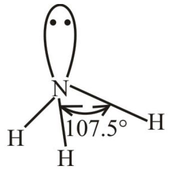
= 2 + 2

= 4 (sp^3)



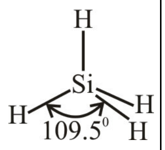
NH_3

Hybridisation = 3 + 1 = 4 (sp^3)



SiH_4

Hybridisation = 4 + 0 = (sp^3)



Hence, the correct order of bond angle is–

$SH_2 < NH_3 < SiH_4 < BF_3$.

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5. Fajan's Rule

565. The correct order of acid strength is

(a) $HClO < HClO_2 < HClO_3 < HClO_4$
(b) $HClO_4 < HClO < HClO_2 < HClO_3$
(c) $HClO_2 < HClO_3 < HClO_4 < HClO$
(d) $HClO_4 < HClO_3 < HClO_2 < HClO$

JEE Main- 2014
BCECE-2010
JIPMER-2007
UP CPMT-2002

Ans. (a) : Oxygen is more electronegative element. The species which have more number of oxygen atoms attached with the chlorine get's more acidic character because oxygen atom pulls the bonding pair of electron due to which the strength of bond (H–X) get weaked and the removal of H easily takes place. Hence, the correct order of acidic strength is–

$HClO < HClO_2 < HClO_3 < HClO_4$

566. The correct sequence of increasing covalent character is represented by

(a) $LiCl < NaCl < BeCl_2$
(b) $BeCl_2 < NaCl < LiCl$
(c) $NaCl < LiCl < BeCl_2$
(d) $BeCl_2 < LiCl < NaCl$

JCECE - 2016, 2012
JIPMER-2007
NEET-2005

Ans. (c) : On the basis of Fajan's rule, lower the size of cation higher will be its polarising power and higher will be covalent character.

$$\therefore \text{ Polarising power} \propto \frac{1}{\text{Size of cation}}$$

Covalent character ∝ Polarising power
So, the correct order is $NaCl < LiCl < BeCl_2$
(The order of size of cation $Na^+ > Li^+ > Be^{2+}$)

567. The charge/size ratio of a cation determines its polarizing power. Which one of the following sequences represents the increasing order of the polarizing power of the cationic species, K^+, Ca^{2+}, Mg^{2+}, Be^{2+}?

(a) $Ca^{2+} < Mg^{2+} < Be^{2+} < K^+$
(b) $Mg^{2+} < Be^{2+} < K^+ < Ca^{2+}$
(c) $Be^{2+} < K^+ < Ca^{2+} < Mg^{2+}$
(d) $K^+ < Ca^{2+} < Mg^{2+} < Be^{2+}$

COMEDK 2017
JIPMER-2015
AIEEE-2007

Ans. (d) : The charge/size ratio of a cation determines its polarizing power. Higher is the charge and lower to size ratio and higher will be the polarizing power of the cation.
As the size of the given cations decreases as
$K^+ > Ca^{2+} > Mg^{2+} > Be^{2+}$
Hence, polarizing power increases as
$K^+ < Ca^{2+} < Mg^{2+} < Be^{2+}$

568. The correct Lewis acid order for boron halides is–

(a) $BBr_3 > BCl_3 > BI_3 > BF_3$
(b) $BI_3 > BF_3 > BBr_3 > BCl_3$
(c) $BF_3 > BCl_3 > BBr_3 > BI_3$
(d) $BI_3 > BBr_3 > BCl_3 > BF_3$

BCECE-2017, 2016

Ans. (d) : According to the Fajan's rule- acidity is directly proportional to the size of anion of the compound Here, I^- has the larger size than the Br, Cl and F.
Hence, the order of lewis acid will be–
$BI_3 > BBr_3 > BCl_3 > BF_3$

569. The correct decreasing order of solubility of the sulphates in water is–

(a) $BeSO_4 > MgSO_4 > CaSO_4 > SrSO_4 > BaSO_4$
(b) $BaSO_4 > SrSO_4 > CaSO_4 > MgSO_4 > BeSO_4$
(c) $BaSO_4 > SrSO_4 > CaSO_4 > MgSO_4 > BeSO_4$
(d) $BaSO_4 > SrSO_4 > MgSO_4 > CaSO_4 > BeSO_4$

Manipal-2020, BCECE-2015

Ans. (a) : With increase in radius of the cation down the group, ΔH_s becomes less and less negative Hence, the solubility decreasing down the group.
Hence, the decreasing order of solubility will be–
$BeSO_4 > MgSO_4 > CaSO_4 > SrSO_4 > BaSO_4$

570. Among Al_2O_3, SiO_2, P_2O_3 and SO_2, the correct order of acid strength is

(a) $SO_2 < P_2O_3 < SiO_2 < Al_2O_3$
(b) $SiO_2 < SO_2 < Al_2O_3 < P_2O_3$
(c) $Al_2O_3 < SiO_2 < SO_2 < P_2O_3$
(d) $Al_2O_3 < SiO_2 < P_2O_3 < SO_2$

Assam CEE-2014, AIEEE- 2004

Ans. (d) : While moving along a group from top to bottom, acidic nature of oxides decreases and along a period from left to right acidic nature increases. Thus, the increasing order will be:–
$Al_2O_3 < SiO_2 < P_2O_3 < SO_2$.

571. The correct order of the increasing basic nature of the given oxides is

(a) $MgO < K_2O < Al_2O_3 < Na_2O$
(b) $Na_2O < K_2O < MgO < Al_2O_3$
(c) $K_2O < Na_2O < Al_2O_3 < MgO$
(d) $Al_2O_3 < MgO < Na_2O < K_2O$

Assam CEE-2014
(AIEEE 2011)

Ans. (d) : According to the Fajan's rule–

$$\text{Polarization power} \propto \frac{1}{\text{Basicity}}$$

or $$\text{No. of cation} \propto \frac{1}{\text{Basicity}}$$

and

size of cation ∝ Basicity

The given compounds are MgO, K_2O, Al_2O_3 and Na_2O.

$$\overset{+2}{Mg}O \quad \overset{+1}{K_2}O \quad \overset{+3}{Al_2}O_3 \quad \overset{+1}{Na_2}O$$

Hence, the order will be-
$Al_2O_3 < MgO < Na_2O < K_2O$

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572. Among LiCl, $BeCl_2$, BCl_3 and CCl_4, the covalent bond character follows the order

(a) $LiCl < BeCl_2 < BCl_3 < CCl_4$
(b) $BCl_3 < CCl_4 < BeCl_2 < LiCl$
(c) $BeCl_2 < LiCl < CCl_4 < BCl_3$
(d) $CCl_4 < BCl_3 < BeCl_2 < LiCl$

JIPMER-2013
NEET-1990

Ans. (a) : According to the Fajan's rule, covalent character is directly proportional charge on cation and inversaly proportional to the size of cation. Among LiCl, $BeCl_2$, BCl_3 and CCl_4 has the +1, +2, +3 and +4 change respectively. Thus, the increasing order of covalevt character will be–

$$LiCl < BeCl_2 < BCl_3 < CCl_4$$

573. Which one of the following has the highest Lewis acid strength?

(a) BI_3
(b) BBr_3
(c) BF_3
(d) BCl_3

Manipal-2016
J & K CET-(2009)

Ans. (a) : According to the Fajan's rule, size of ion is directly proportional to the acidic strength. In the given halogen of borons. I^- ion has large size due to which they have highest lewis acid strength.

574. Which of the following metal hydroxides is strong base ?

(a) $Mg(OH)_2$
(b) $Ca(OH)_2$
(c) $Sr(OH)_2$
(d) $Ba(OH)_2$

UP CPMT-2012
AMU-2007

Ans. (d) : The alkaline metal hydroxides are stronger bases and their basic strength increases from $Be(OH)_2$ to $Ba(OH)_2$ due to corresponding decrease in the ionization enthalpy of the metal as we move down the group. Thus $Ba(OH)_2$ is a strongest base.

575. The correct order of acidic strength is

(a) $K_2O > CaO > MgO$
(b) $Na_2O > MgO > Al_2O_3$
(c) $CO_2 > N_2O_5 > SO_3$
(d) $Cl_2O_7 > SO_2 > P_4O_{10}$

AMU-2012, 2001

Ans. (d) : On moving across the period, the acidic character of the oxides increases.

576. The bond length of HCl molecule is 1.275 Å and its dipole moment is 1.03 D. The ionic character of the molecule (in per cent) (charge of the electron = 4.8×10^{-10} esu) is :

(a) 100
(b) 67.3
(c) 33.66
(d) 16.83

AP-EAMCET/2008, 2003

Ans. (d): Given :

Bond length of HCl molecule = 1.275 Å

$= 1.275 \times 10^{-10}$m

$= 1.275 \times 10^{-8}$ cm.

Observed dipole moment = 1.03 D

Charge of electron $(e^-) = 4.8 \times 10^{-10}$ esu

Calculated dipole moment = e × d

$= 4.8 \times 10^{-10}$ esu $\times 1.275 \times 10^{-8}$ cm.

= 6.12 D

% Ionic character

$$= \frac{\text{Observed dipole moment}}{\text{Calculated dipole moment}} \times 100$$

$$= \frac{1.03}{6.12} \times 100 = 16.83$$

577. The correct set from the following in which both pairs are in correct order of melting point is

(a) LiF > LiCl, MgO > NaCl
(b) LiCl > LiF, NaCl > MgO
(c) LiF > LiCl, NaCl > MgO
(d) LiCl > LiF, MgO > NaCl

[JEE Main-2021, 24 Feb Shift-II]

Ans. (a) : The charge on cation is inversely proportional to the melting point of the compound.

$$\boxed{\text{Charge on cation} \propto \frac{1}{\text{Melting point}}}$$

$$\boxed{\text{Size of anion} \propto \frac{1}{\text{Melting point}}}$$

In the given set LiF and LiCl, F has less atomic size than Cl. Hence, LiF has higher melting point than LiCl.

	MgO	NaCl
Similarly,	Mg→2+	Na→+1
	O→2–	Cl→1–

MgO having +2 charge which is greater than NaCl(+1) charge. So, greater the charge on the ions greater will be lattice energy and hence, melting point order is MgO > NaCl.

578. Which is the most covalent ?

(a) $AlCl_3$
(b) AlI_3
(c) MgI_2
(d) NaI

AP EAPCET 24.08.2021, Shift-I

Ans. (b) : The given species are –

	$AlCl_3$	AlI_3	MgI_2	NaI
Charge –	+3	+3	+2	+1
Anion –	Cl^-	I^-	I^-	I^-

According to the Fajan's rule – the covalent character depends upon the charge of cation and size of anions. As the size of anion increases the covalent character will be also increases. So, AlI_3 have the more covalent character.

579. The correct order of boiling point in the following compounds is

(a) $HF > H_2O > NH_3$
(b) $H_2O > HF > NH_3$
(c) $NH_3 > H_2O > HF$
(d) $NH_3 > HF > H_2O$

Kerala-CEE-29.08.2021

Ans. (b) : Both H_2O and HF have electronegative atom are oxygen and fluorine respectively in their molecule. In fact, fluorine is more electronegative than oxygen, so technically, HF should engage in more hydrogen bonding than water but the scenario is different. Each water molecule has two hydrogen atoms. Whereas, each HF molecule has only one hydrogen atom and water molecule takes part in extensive and more hydrogen bonding than hydrofluoric acid. Water molecule through its extensive hydrogen bonding forms a bulky molecule and it is very difficult to break its bonds. A large amount of energy is required to break all its bonds. Thus, H_2O has a higher boiling point than HF and NH_3.

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580. The correct decreasing order of the basic strength is

(a) $HS^- > CH_3^- > NH_2^- > CN^-$

(b) $HS^- > CN^- > NH_2^- > CN_3^-$

(c) $CH_3^- > NH_2^- > CN^- > HS^-$

(d) $NH_2^- > CN^- > CN_3^- > HS^-$

TS-EAMCET (Engg.), 05.08.2021 Shift-II

Ans. (c) : Decreasing order of basicly is as follow,

$$CH_3^- > NH_2^- > CN^- > HS^-$$

To determine the basic strength of these anions we need to find out the acidic strength of the conjugate acids.

Conjugate acids of $CH_3^-, NH_2^-, CN^-, HS^-$ are CH_4, NH_3, HCN, H_2S respectively.

As we know that,

Acidity $\propto$ Electronegativity

On going from left to right in the period, electronegativity increases.

So, acidity order is $HS^- > CN^- > NH_2^- > CH_3^-$.

Hence, the basicity order of the conjugate acids are–

$$CH_3^- > NH_2^- > CN^- > HS^-$$

581. Which among the following is least covalent in nature?

(a) NF_3 (b) BiF_3

(c) PF_3 (d) SbF_3

AP EAPCET 23-08-2021 Shift-I

Ans. (b) : The covalent character is directly proportional to the no. of charge of cation and inversely proportional to the size of cation. Here, Bi has the more ionic radius due to which they shows the least covalent character.

582. How many of the following oxides are amphoteric?

BeO, ZnO, Sb_2O_3, CO, CaO, SO_2, SO_3

(a) 2 (b) 3

(c) 4 (d) 5

TS-EAMCET (Engg.), 07.08.2021 Shift-II

Ans. (b) : Metal oxides which react with both acids as well as bases to produce salts and water are known as amphoteric oxides. Atom whose oxide show amphoteric nature is Zn, Al, Be, Ga, Pb, Sn, As, Sb and Bi. So, ZnO, Sb_2O_3 & BeO shows amphoteric nature because all three oxide react with both acid and bases.

583. A metal 'M' readily gives MSO_4, which is soluble in water. It forms its oxide MO which is amphoteric. It forms an insoluble hydroxide $M(OH)_2$, which is soluble in NaOH solution. The M is

(a) Be (b) Ba

(c) Ca (d) Mg

TS-EAMCET (Engg.), 05.08.2021 Shift-II

Ans. (a) : Beryllium form Beryllium sulfate ($BeSO_4$) which is water soluble

- Beryllium form Beryllium hydroxide ($Be(OH)_2$) which is insoluble in water.
- Beryllium form Beryllium Oxide (BeO) which becomes inert on heating.
- $Be(OH)_2$ being amphoteric reacts with NaOH.
- Solubility of alkaline earth metal decreases as we move down in the periodic table.

584. The acidic oxide from below is

(a) CO (b) GeO

(c) SnO (d) PbO

TS EAMCET 10.08.2021, Shift-II

Ans. (b) : As we know down in group acidic nature of oxides decrease and basic nature increases.

So,

Neutral oxide – CO

Acidi oxide – GeO

Basic oxide – SnO, PbO

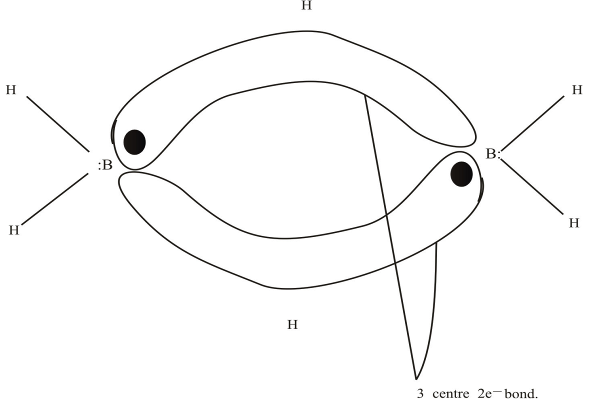
585. The Lewis acid in the following is

(a) PH_3 (b) H_2S

(c) C_2H_4 (d) B_2H_6

TS EAMCET 10.08.2021, Shift-II

Ans. (d) : B_2H_6 is laws acid. In diborane two e^- are Shared between three centers Boron centre is e^- deficient ,so it act as Lewis acid



586. Which of the following statement is incorrect?

(a) Tl^{3+} salts are oxidizing agents.

(b) Ga^+ salts are reducing agents.

(c) Pb^{4+} salts are better oxidizing agents

(d) As^{+5} salts are better oxidizing agents.

AP EAPCET 20.08.2021 Shift-I

Ans. (d) : As^{+5} cannot be reduced.

As^{+5} salts are not a good oxidizing agent.

$As^{+5} + 2e^- \longrightarrow As^{3+}$ (less stable)

587. How many oxides among the following are basic in nature ?

As_2O_3, Na_2O, MgO, Mn_2O_3, CaO, ZnO, N_2O, N_2O_5

(a) 4 (b) 5

(c) 3 (d) 6

AP EAPCET 24.08.2021, Shift-I

Ans. (c) :

Metal Oxide	Nature
As_2O_3	Weak acid
N_2O	Neutral
Na_2O	Basic
MgO	Basic
Mn_2O_3	Amphotric
CaO	Basic
ZnO	Amphoteric

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588. Assertion (A): LiCl and $MgCl_2$ are soluble in ethanol.
Reason (R): Lithium and magnesium are harder than their respective group elements
The correct option among the following is
(a) (A) is true, (R) is true and (R) is the correct explanation for (A)
(b) (A) is true, (R) is true but (R) is not the correct explanation for (A)
(c) (A) is true but (R) is false
(d) (A) is false but (R) is true

TS-EAMCET (Engg.), 06.08.2021

Ans. (b): Ethanol form hydrogen bonding. It is covalent in nature and polar. LiCl and $MgCl_2$ are polar nature, so soluble in polar ethanol.
Both Li and Mg are quite hard. They are harder and lighter than other elements in their respective group.
So (A) is true, (R) is true but (R) is not the correct explanation for (A).

589. Highest covalent character is found in which of the following?
(a) CaF_2 (b) $CaCl_2$
(c) $CaBr_2$ (d) CaI_2

TS EAMCET 04.08.2021, Shift-I

Ans. (d) : According to Fajan's Rules "size of anion increases then covalent character also increases." The size of iodide is maximum than the other halogen atom. So, highest covalent character is found CaI_2.

590. Given below are two statements:
Statement I : Both $CaCl_26H_2O$ and $MgCl_2$ $8H_2O$ undergo dehydration on heating.
Statement II : BeO is amphoteric whereas the oxides of other elements in the same group are acidic.
In the light of the above statements, choose the correct answer from the options given below :
(a) Both statement I and statement II are true
(b) Both statement I and statement II are false
(c) Statement I is true but statement II is false
(d) Statement I is false but statement II is true

JEE Main 16.03.2021, Shift-I

Ans. (b) : The dehydration of $CaCl_2 \cdot 6H_2O$ and $MgCl_2 \cdot 8H_2O$ has been studied with heating.

(a) $CaCl_2 \cdot 6H_2O \xrightarrow{\Delta} \underset{(\text{Anhydrous})}{CaCl_2} + 6H_2O$

(b) $MgCl_2 \cdot 8H_2O \xrightarrow{\Delta} MgCl(OH) + 2HCl + 5H_2O$

Both statement I and statement II are false. BeO is amphoteric in nature and the oxides of same group are basic in nature.

591. Number of amphoteric compounds among the following is______.
1. BeO 2. BaO
3. $Be(OH)_2$ 4. $Sr(OH)_2$
(a) 2 (b) 3
(c) 1 (d) 4

JEE Main 24.02.2021, Shift-I

Ans. (a) : Both beryllium compounds BeO and $Be(OH)_2$ are amphoteric in nature (react with acid and bases) and compound BaO and $Sr(OH)_2$ are basic in nature, they form alkaline solution in water. Hence, BeO and $Be(OH)_2$ are amphoteric compounds.

592. Compound A used as a strong oxidizing agent is amphoteric in nature. It is the part of lead storage batteries. Compound A is:
(a) PbO (b) PbO_2
(c) Pb_3O_4 (d) $PbSO_4$

JEE Main 26.02.2021, Shift-I

Ans. (b) : PbO_2 is the amphoteric and strong oxidizing agent and also a component of lead storage batteries. In this oxidation state of Pb is +4. So it is always reduced and behaves as oxidizing agent.

593. Which pair of oxides is acidic in nature ?
(a) B_2O_3,CaO (b) B_2O_3, SiO_2
(c) N_2O, BaO (d) CaO, SiO_2

(JEE Main 2021, 26 Feb Shift-II)

Ans. (b) : According to the Fajan's rule, acidic character is directly proportional to the charge on ion.

(a)	B_2O_3	CaO
	$B\rightarrow+3$	$Ca\rightarrow+2$
(b)	B_2O_3	SiO_2
	$B\rightarrow+3$	$Si\rightarrow+4$
(c)	N_2O	BaO
	$N\rightarrow+1$	$Ba\rightarrow+2$
(d)	CaO	SiO_2
	$Ca\rightarrow+2$	$Si\rightarrow+4$

In the given set, B and Si has highest number of ions due to which they have highest acidic character.

594. The correct order of boiling points in the following compounds is
(a) $HF>H_2O>NH_3$ (b) $H_2O>HF>NH_3$
(c) $NH_3>H_2O>HF$ (d) $NH_3>HF>H_2O$

Karnataka-CET-2021

Ans. (b) : As we know that more the hydrogen bonding, higher will be boiling point. Each water molecule formed four hydrogen bonds with surrounding water molecule. Thus, H_2O has more boiling point than HF and NH_3. Due to more electronegativity of fluoride ion, the partial positive and negative charge generated and having the more boiling point than NH_3. Hence, The correct order of boiling point is – $H_2O > HF > NH_3$.

595. Amphoteric hydroxide from the following is
(a) $Al(OH)_3$ (b) $In(OH)_3$
(c) $B(OH)_3$ (d) $Tl(OH)_3$

TS-EAMCET (Engg.), 07.08.2021 Shift-II

Ans. (a) :
$Al(OH)_3$ –Amphoteric
$In(OH)_3$– Much more basic than Acidic
$B(OH)_3$–Weak Acid
$Tl(OH)_3$ –Weak base
$Al(OH)_3$ is amphoteric in nature because it can react both acid and bases.
Reaction of $Al(OH)_3$ in acidic solution–

$$HCl_{(aq)} + Al(OH)_{3(aq)} \rightarrow AlCl_{3(aq)} + 3H_2O$$

Reaction of $Al(OH)_3$ in basic medium–

$$Al(OH)_3 + OH^- \rightarrow [Al(OH)_4]^-$$

596. Which of the following molecules is non-polar in nature?
(a) NO_2 (b) $POCl_3$
(c) CH_2O (d) $SbCl_5$

NEET-2021

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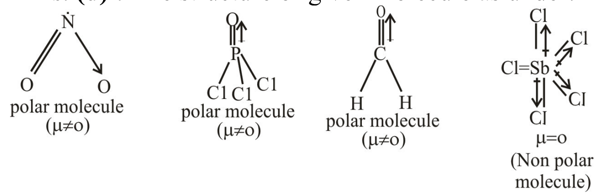
Ans. (d) : The structure of given molecule as under:-



597. Among LiCl, $BeCl_2$, BCl_3 and CCl_4, the covalent bond character varies as

(a) $LiCl<BeCl_2> BCl_3> CCl_4$
(b) $BCl_3>BeCl_2>CCl_4>LiCl$
(c) $LiCl<BeCl_2<BCl_3<CCl_4$
(d) $LiCl>BeCl_2>BCl_3> CCl_4$

COMEDK 2020

Ans. (c) : More the charge density of cation (i.e, smaller size and high magnitude of charge) more is the covalent character.
Order of charge density the thus the covalent character is $CCl_4 >BCl_3>BeCl_2>LiCl$.

598. Which of the following is the correct order?

(a) Acidic strength :
$HClO_4, < HClO_3, < HClO_2, < HClO$
(b) Stability : $HI < HBr < HCl < HF$
(c) Ionic character : $MF < MCl < MBr < MI$
(d) Electron gain enthalpy: $I < Br < Cl < F$

GUJCET-2020

Ans. (b) :
(a) With increase in oxidation number of a particular atom, the acidic character of corresponding oxoacid increases. The increasing order of acidic strength is–
$HClO < HClO_2 < HClO_3 < HClO_4$
Hence, the given order of acidic strength is wrong.
(b) The stability of these halides decreases down the group due to decrease in bond (H–X) dissociation enthalpy in the order Hence, the stability order–
$HI < HBr < HCl < HF$
Hence, the given order is true.
(c) The ionic character of the halides increase in the order MI < MBr < MCl < MF. Where M is a monovalent atom. Hence, the given order is false.
(d) The electron gain enthalpy are of halogen atom in following manner–
$I < Br < F < Cl$.
Hence, the given order is false.

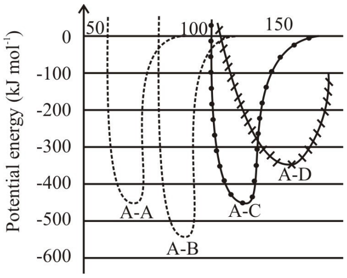
599. If the boiling point of H_2O is 373 K, the boiling point of H_2S will be

(a) less than 300 K
(b) equal to 373 K
(c) more than 373 K
(d) greater than 300 K but less than 373 K

(JEE Main 2020, 3 Sep. Shift-I)

Ans. (a) : Chemical formula of water is H_2O so at room temperature, water molecule is found in liquid because of hydrogen bonding but compound H_2S is found in gas because sulphur atoms don't show hydrogen bonding. Now you know as well, a gas has very low boiling point compare to liquid. Therefore, the boiling point of H_2S should be less than 300 K.

600. The intermolecular potential energy for the molecules A, B, C and D given below suggests that:



(a) A-B has the stiffest bond
(b) D is more electronegative than other atoms
(c) A-A has the largest bond enthalpy
(d) A-D has the shortest bond length

(JEE Main 2020, 4 Sep. Shift-I)

Ans. (a) : From the given graph, potential energy of A–B molecule is minimum. Thus A–B bond is most stable and have strongest bond amongst these.
B→Most electronegative
D→Least electronegative
A–B→ Shortest bond length.
A–B→Largest bond entholpy.

601. Which hydride amongst the following has the least boiling point?

(a) NH_3
(b) PH_3
(c) AsH_3
(d) SbH_3
(e) BiH_3

Kerala-CEE-2019

Ans. (b) : Boiling point depends on the molecular mass of the compound. As we go down the group molecular mass increase so does boiling point but due to presence of hydrogen bonding in H_2O and NH_3 they have exceptionally high boiling point. PH_3 have lowest boiling point among the hydride of group no. 15. NH_3 is higher boiling point due to excessive hydrogen bonding.

602. Which of the following metal halide is more covalent?

(a) $SnCl_2$
(b) $PbCl_2$
(c) $SbCl_3$
(d) $SbCl_5$

MHT CET-03.05.2019, SHIFT-I

Ans. (d) : Charge of cation is directly proportional to the covalent character.

$SnCl_2$	$PbCl_2$	$SbCl_3$	$SbCl_5$
Sn→+2	Pb→+2	Sb→+3	Sb→+5

The penta chloride of antimony has the maximum no. of cation due to which they has more covalent character.

603. Match the oxide given in column I with its property given in column II.

Column I	Column II
(i) Na_2O	A. Neutral
(ii) Al_2O_3	B. Basic
(iii) N_2O	C. Acidic
(iv) Cl_2O_7	D. Amphoteric

Which of the following options has all correct pairs?

(a) (i) -B, (ii)-A, (iii)-D, (iv)-C
(b) (i) -C, (ii)-B, (iii)-A, (iv)-D

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(c) (i) -A, (ii)-D, (iii)-B, (iv)-C
(d) (i) -B, (ii)-D, (iii)-A, (iv)-C

NEET-Odisha 2019

Ans. (d) :

Compound

(i)	Na_2O	–	Basic
(ii)	Al_2O_3	–	Amphoteric
(iii)	N_2O	–	Neutral
(iv)	Cl_2O_7	–	Acidic

604. The melting points of (i) $BeCl_2$ (ii) $CaCl_2$ and (iii) $HgCl_2$ follows the order

(a) i < ii < iii
(b) iii < i < ii
(c) i < iii < ii
(d) ii < i < iii

WB-JEE-2019

Ans. (b) : According to the Fajan's rule-

$$\text{Polarization power} \propto \frac{1}{\text{Melting point}}$$

$BeCl_2$	$CaCl_2$	$HgCl_2$
$Be\rightarrow+2$	$Ca\rightarrow+2$	$Hg\rightarrow+2$

The covalent character will be $HgCl_2 > BeCl_2 > CaCl_2$

Thus, melting point will be $HgCl_2<BeCl_2<CaCl_2$ i.e. iii < i < ii.

605. Which of the following has correct increasing order of hydrolysis?

(a) $CCl_4 < MgCl_2 < AlCl_3 < SiCl_4 < PCl_5$
(b) $PCl_5 < MgCl_2 < AlCl_3 < SiCl_4 < CCl_4$
(c) $PCl_5 < SiCl_2 < MgCl_2 < AlCl_3 < CCl_4$
(d) None of these

[AIIMS-26 May, 2018 (E)]

Ans. (a): The increasing order of extent of hydrolysis is $CCl_4 < MgCl_2 < AlCl_3 < SiCl_4 < PCl_5$. As the number of chlorine atoms increases, the charge on the central metal atom increases and the tendency for the nucleophilic attack increases. Hence, the extent of hydrolysis increases.

606. Which of the following is least basic?

(a) NF_3
(b) NCl_3
(c) NBr_3
(d) NI_3

BCECE-2018

Ans. (a) : The size of anion is inversely proportional to the basicity. NF_3 has least tendency to donate a pair of electrons because of high electronegativity of F. The lewis base strength of the other trihalides increases as the electronegativity of halogen decreases.

607. Which one of the following is least covalent?

(a) VCl_2
(b) VCl_3
(c) VCl_4
(d) $VOCl_3$

BCECE-2018

Ans. (a) : The covalent character is directly proportional to charge on cation and inversely proportional to the size of cation.

The species given below–

$\overset{+2}{V}Cl_2$	$\overset{+3}{V}Cl_3$
$\overset{+4}{V}Cl_4$	$\overset{+5}{V}OCl_3$

In VCl_2, 'V' has the least charge on cation so this have the least covalent character.

608. If Na^+ ion is larger than Mg^{2+} ions and S^{2-}ion is larger than Cl^- ion, which of the following will be stable salt in water?

(a) Sodium chloride
(b) Sodium sulphide
(c) Magnesium sulphide
(d) Magnesium chloride

JIPMER-2018

Ans. (c) : The lattice energy of a salt gives a rough indication of the solubility of the salt in water because it reflects the energy needed to separate the positive and negative ions in a salt. Sodium and potassium salts are soluble in water because they have relatively small lattice energies. Magnesium and aluminum salts are often much less soluble because it takes more energy to separate the positive and negative ions in these salts.

609. Which of the following oxides is most acidic in nature?

(a) MgO
(b) BeO
(c) BaO
(d) CaO

NEET-2018

Ans. (b) : In metals moving down the group metallic character increases, so basic nature increases hence most acidic will BeO as Be is least metallic in group 2 element.

MgO	BeO	BaOCaO	
$Mg\rightarrow+2$	$Be\rightarrow+2$	$Ba\rightarrow+2$	$Ca\rightarrow+2$
$O\rightarrow-2$	$O\rightarrow-2$	$O\rightarrow-2$	$O\rightarrow-2$

Beryllium has less atomic size thus BeO has most acidic in nature.

610. Which of the following oxide is of acidic nature?

(a) B_2O_3
(b) Al_2O_3
(c) Ga_2O_3
(d) In_2O_3

UPTU/UPSEE-2018

Ans. (a) : According to the periodic trends in group 13, on moving down, the nature of oxide changes from acidic to basic. B_2O_3 is the acidic oxide: Acidic character of boron oxide may be explained on the basis of Fajan's rule i.e. small size of boron.

$$\left.B_2O_3\right\}\text{Acidic}$$

$$\left.\begin{matrix}Al_2O_3\\Ga_2O_3\end{matrix}\right\}\text{Amphotoric}$$

$$\left.\begin{matrix}In_2O_3\\Tl_2O_3\end{matrix}\right\}\text{Basic}$$

611. Which among the following is the strongest acid?

(a) HF
(b) HCl
(c) HBr
(d) HI

TS EAMCET-2017

Ans. (d) : As we move down the group, the size of halogen increases, bond length increases hence bond energy decreases. So, HI is releases H^+ ions easily than other. Hence, HI is the strongest acid.

612. Which of the following is the most basic oxide?

(a) SO_3
(b) SeO_3
(c) PoO
(d) TeO

TS EAMCET-2017

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Ans. (c) : On going down the group 16, electronegativity decrease and basic nature of oxide increase. Hence PoO is the most basic oxide.

613. Which of the following substances has the least covalent character?

(a) Cl_2O (b) NCl_3
(c) $PbCl_2$ (d) $BaCl_2$

AIIMS-2017

Ans. (d): The no. of charge on cation is directly proportional to the covalent character and size of cation is inversely proportional to the covalent character.

$$\overset{+2}{Cl_2O} \qquad \overset{+3}{N}Cl_3$$

$$\overset{+2}{Pb}Cl_2 \qquad \overset{+2}{Ba}Cl_2$$

$PbCl_2$, Cl_2O and $BaCl_2$ having same charge so we move in to the size of cation. Barium (Ba) ion has the more size than the other so it has least covalent character.

614. Which of the following has highest hydration energy?

(a) $MgCl_2$ (b) $CaCl_2$
(c) $BaCl_2$ (d) $SrCl_2$

AMU-2017

Ans. (a) : As well as size of alkaline earth metal increases about down the group then the hydration energy is also be decreases. Thus, $MgCl_2$ has more hydration energy.

615. The correct increasing order for basic strength of the following species OH^-, NH_2^-, $H-C\equiv C^-$ and $CH_3CH_2^-$ are

(a) $OH^- < HC\equiv C^- < NH_2^- < CH_3CH_2^-$
(b) $OH^- < HC\equiv C^- < CH_3CH_2^- < NH_2^-$
(c) $CH_3CH_2^- < HC\equiv C^- < OH^- < NH_2^-$
(d) $CH_3CH_2^- < HC\equiv C^- < NH_2^- < OH^-$

BCECE-2017

Ans. (a) : The conjugate base of a strong acid is weaker while the conjugate base of a weak acid is stronger Hence, the correct order of strength of bases is:–

$$OH^- < HC\equiv C^- < NH_2^- < CH_3-CH_2^-$$

$CH_3CH_2^-$ is the conjugate base for ethane and $HC\equiv C^-$ is the conjugate base for ethyne. Since, ethyne has more s-character than ethane, it is more acidic. Thus, the conjugate base of ethyne will be less basic than the conjugate base of ethane.

616. In which of the following the oxidation number of oxygen has been arranged in increasing order?

(a) $BaO_2 < KO_2 < O_3 < OF_2$
(b) $OF_2 < KO_2 < BaO_2 < O_3$
(c) $BaO_2 < O_3 < OF_2 < KO_2$
(d) $KO_2 < OF_2 < O_3 < BaO_2$

JIPMER-2017

Ans. (a) : The given species are–BaO_2, KO_2, O_3 and OF_2. Let, all the oxygen species has x oxidation number.

∴ BaO_2 $\quad$ KO_2 $\quad$ O_3 $\quad$ OF_2
$+2+2x = 0$ $\quad$ $+1+2x=0$ $\quad$ $x = 0$ $\quad$ $x-2 = 0$
or $x = -1$ $\quad$ or $x = \frac{-1}{2}$ $\quad$ or $x = 2$

Hence, the increasing order of oxidation state of the molecule is given below–

$$BaO_2 < KO_2 < O_3 < OF_2$$

617. Which of the following is the correct order of stability for the given superoxides?

(a) $KO_2 < RbO_2 < CsO_2$
(b) $CsO_2 < RbO_2 < KO_2$
(c) $RbO_2 < CsO_2 < KO_2$
(d) $KO_2 < CsO_2 < RbO_2$

JIPMER-2017

Ans. (a) : The increasing stability of the peroxide or superoxide of alkali metal, as the size of metal increases stability of superoxide also increases. It is due to the stabilization of large anions by larger cations through lattice energy effect. Thus, the increasing, stability order of oxide is–

$$KO_2 < RbO_2 < CsO_2.$$

618. Which of the following statement is correct?

(a) BCl_3 and $AlCl_3$ are both Lewis acids and $AlCl_3$ is stronger than BCl_3
(b) BCl_3 and $AlCl_3$ are both equally strong Lewis acid
(c) Both BCl_3 and $AlCl_3$ are not Lewis acids
(d) $BCl_3$and $AlCl_3$ are both Lewis acids and BCl_3 is stronger than $AlCl_3$

UPTU/UPSEE-2017

Ans. (a) : According to the Fajan's rule, the acidity of molecule is directly proportional to the no. of charge and inversely proportional to the size of cation. The acidic character of halides of group 13 decreases down the group due to increase in size.

∴ BCl_3 and $AlCl_3$ both are Lewis acids and BCl_3 is stronger lewis acids than $AlCl_3$.

619. Which of the following compounds has lowest boiling point?

(a) KCl (b) CuCl
(c) $CuCl_2$ (d) CsCl

Manipal-2016

Ans. (c) : The boiling point of the compound is inversely proportional to the no. of charge on cation and directly proportional to the size of cation.

$$\underset{K\to+1}{KCl} \quad \underset{Cu\to+1}{CuCl} \quad \underset{Cu\to+2}{CuCl_2} \quad \underset{Cs\to+1}{CsCl}$$

The copper compound has the maximum no. of charge due to which they get the lowest boiling point.

620. Which one of the following forms a basic oxide?

(a) B (b) Tl
(c) Al (d) Ga

TS-EAMCET-2016

Ans. (b) : Element has more metallic character, more basic its oxide. All the given element are p-block and in p-block on down the group metallic character increase. So, Tl has more basic oxide.

621. The order of covalent character of KF, KI, KCl is

(a) KCl < KF < KI (b) KI < KCl < KF
(c) KF < KI < KCl (d) KF < KCl < KI

TS-EAMCET-2016

@apna_pdf

Ans. (d) : As we know, the covalent character is directly proportional to the polarization power and polarization is directly proportional to size of anion. Iodine has the largest size, therefore KI will have the most covalent character and fluorine has the smallest size, So KF will be least covalent. Therefore, the order of covalent character of KF, KI, KCl is KF < KCl < KI.

622. Among LiCl, RbCl, $BeCl_2$, $MgCl_2$ the compounds with greatest and least ionic character respectively are

(a) LiCl and RbCl
(b) RbCl and $BeCl_2$
(c) RbCl and $MgCl_2$
(d) $MgCl_2$ and $BeCl_2$

AMU-2016

Ans. (b) : The compounds are LiCl, RbCl, $BeCl_2$ and $MgCl_2$.

Covalent character ∝ No. of charge on cation

$$\frac{1}{\text{Ionic charcter}} \propto \text{No.of charge on cation}$$

$$\overset{+}{Li}Cl \quad \overset{+}{Rb}Cl \quad \overset{+2}{Be}Cl \quad \overset{+2}{Mg}Cl_2$$

$\overset{+}{Li}$ and $\overset{+}{Rb}$ has the equal number of cation so we distinguish by the size of cation. The size of cation is directly proportional to the ionic character. The size of Rb is more than the Li. So, RbCl has greatest ionic character.

The charge on Be and Mg are same. The metal which have less size having the least ionic character. Hence, $BeCl_2$ has the least ionic character.

623. Thermal stability of $BaCO_3$, $CaCO_3$ and $MgCO_3$ is–

(a) $BaCO_3 > CaCO_3 > MgCO_3$
(b) $BaCO_3 > MgCO_3 > CaCO_3$
(c) $CaCO_3 > MgCO_3 > BaCO_3$
(d) $MgCO_3 > CaCO_3 > BaCO_3$

BCECE-2016

Ans. (a) : Thermal stability is directly proportional to the size of cation. Thus, the temperature at which a given carbonate gets decomposed depends on the polarising power of the cation. Due to successive increase in the size of alkali earth metal, the thermal stability of these molecules increases as $BaCO_3 > CaCO_3 > MgCO_3$.

624. Which one has highest melting point?

(a) NaCl
(b) NaBr
(c) NaF
(d) NaI

BCECE-2016

Ans. (c) : The size of anion is inversely proportion to the melting point or boiling point. Fluoride ion has the less size then they have high melting point.

625. Correct sequence of acidic character is

(a) $N_2O_5 > CO_2 > CO > SO_2$
(b) $N_2O_5 > SO_2 > CO_2 > CO$
(c) $CO > CO_2 > SO_2 > N_2O_5$
(d) $SO_2 > CO_2 > CO > N_2O_5$

JCECE - 2016

Ans. (b) : (i) Higher be the positive oxidation value of non-metal oxide, higher be the acidic nature.

(ii) For same value of oxidation number, more electro negative element associated with oxygen shows more acidic nature.

Thus, correct order of acidic character is

$$N_2O_5 > SO_2 > CO_2 > CO$$
$$(+5) \quad (+4) \quad (+4) \quad (+2)$$

Note CO is a neutral oxide.

626. Reactivity order of halides for dehydrohalogenation is

(a) R–F > R–Cl > R–Br > R – I
(b) R–I > R – Br > R – Cl > R–F
(c) R–I > R –Cl > R–Br > R – F
(d) R–F > R – I > R – Br > R – Cl

Karnataka-CET-2016

Ans. (b) : As well as we move down on halogen group then size of halogens increases. If halogen group connected with any group, then the bond length also increases down the group, Here, reactivity of R–X depends upon bond length. More be the bond length, easier for the R–X to go for dehydrohalogenation. Thus, correct order is:

R–I > R–Br > R–Cl > R–F.

627. The correct order of increasing polarizing power of the cations in the following $AlCl_3$, $MgCl_2$, NaCl is

(a) $AlCl_3 < MgCl_2 < NaCl$
(b) $MgCl_2 < NaCl < AlCl_3$
(c) $NaCl < MgCl_2 < AlCl_3$
(d) $NaCl < AlCl_3 < MgCl_2$

AMU-2015

Ans. (c) : The cations are given as follows:-

$$AlCl_3 \quad MgCl_2 \quad NaCl$$

The polarizing power is directly proportional to the no. of charge and inversaly proportional to the size of cation.

$$\overset{+3}{Al}Cl_3 \quad \overset{+2}{Mg}Cl_2 \quad \overset{+}{Na}Cl$$

The increasing order of polarizing power is given below-

$NaCl < MgCl_2 < AlCl_3$

628. The solubility of fluorides of alkali metals in water is–

(a) LiF > NaF > KF > RbF > CsF
(b) CsF > RbF > KF > NaF > LiF
(c) LiF > KF > NaF > CsF > RbF
(d) CsF > KF > NaF > RbF > LiF

BCECE-2015

Ans. (b) : In the alkali metal, as well as move down the group then the size of metal increases and the solubility of fluoride is also increases.

$$\boxed{\text{Solubility} \propto \text{Size of cation}}$$

Hence, the decreasing order of solubility will be–

CsF > RbF > KF > NaF > LiF

629. The correct statement is

(a) BF_3 is the strongest Lewis acid among the other boron halides
(b) Bl_3 is the weakest Lewis acid among the boron halides
(c) there is maximum pπ-pπ back bonding in BF_3
(d) there is minimum pπ- pπ back bonding in BF_3

Karnataka-CET-2015

Ans. (c) : The molecular formula of boron trihalides are BF_3, BCl_3, BBr_3 and BI_3. The acidity of boron halide depends upon the charge on cation and size of anion.

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$\boxed{\text{Size of anion} \propto \text{Acidic character}}$

The size of fluoride ion is small rather than other halogen due to which has least acidic character than the other halide. Hence, the statement (a) is false.

The size of iodine ion is greater than the other halide. Hence, BI_3 has more lewis and character.

The boron and fluorine atom belongs to the second period element it has the p orbital due to which $p\pi$–$p\pi$ back bonding occur. Hence, the statement is true.

630. The relative strength of trichlorides of boron group to accept a pair of electron is given by

(a) $GaCl_3 > AlCl_3 > BCl_3$
(b) $AlCl_3 < BCl_3 < GaCl_3$
(c) $AlCl_3 < GaCl_3 < BCl_3$
(d) $BCl_3 < AlCl_3 < GaCl_3$
(e) $GaCl_3 < BCl_3 < AlCl_3$

Kerala-CEE-2015

Ans. (d) : In the third group of boron family, the acidic strength of trichlorides of boron group decreases down the group i.e. $BCl_3 > AlCl_3 > GaCl_3$. Hence, strength of accepting electron is as follows:

$BCl_3 < AlCl_3 < GaCl_3$.

631. Which of one of the following is least covalent in nature?

(a) NF_3 (b) BiF_3
(c) PF_3 (d) SbF_3

AMU-2014

Ans. (b) : Compounds having less charge on cation are less covalent. The covalent character of the molecule is inversely proportional to the size of cation.

$$\text{Covalent character} \propto \frac{1}{\text{size of cation}}$$

The given species are NF_3, BiF_3, PF_3 and SbF_3.
All the compounds have same charge due to which we classify the covalent character from the size of cation. Bi^{3+} has more atomic size than other Thus, BiF_3 has less covalent character.

632. The correct sequence of increasing covalent character is represented by

(a) $LiCl < NaCl < BeCl_2$ (b) $BeCl_2 < NaCl < LiCl$
(c) $NaCl < LiCl < BeCl_2$ (d) $BeCl_2 < LiCl < NaCl$

Assam CEE-2014

Ans. (c) : According to the Fajan's rule, the no of charge on cation is directly proportional to the covalent character.

$$\overset{+1}{Li}Cl \quad \overset{+1}{Na}Cl \quad \overset{+2}{Be}Cl_2$$

$BeCl_2$ has more covalent character than the LiCl and NaCl because Be contains +2 cation whereas Li and Na contains +1 charge.

$$\text{Covalent character} \propto \frac{1}{\text{Size of cation}}$$

∴ The covalent character follow the following order:–

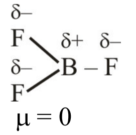
$NaCl < LiCl < BeCl_2$

633. The molecules BF_3 and NF_3 are both covalent compounds, but BF_3 is non polar whereas NF_3 is polar. The reason for this is :

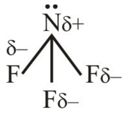
(a) Atomic size of boron is larger than nitrogen
(b) Boron is metal while nitrogen is gas
(c) B–F bonds are non-polar while N–F bonds are plar
(d) BF_3 is planar but NF_3 is pyramidal

BITSAT 2014

Ans. (d) : The shape of BF_3 is trigonal planar. The structure is given below–



Hence, it is non polar.

The shape of NF_3 is pyramidal  and $\mu \neq 0$.

Hence, it is polar.

634. Which of following is the correct order of acidic strength?

(a) $CH_3COOH > ClCH_2COOH > Cl_2CHCOOH > Cl_3C.COOH$
(b) $Cl_3C.COOH > Cl_2CH.COOH > Cl.CH_2COOH > CH_3COOH$
(c) $CH_3COOH > Cl_3.COOH > Cl_2CH.COOH > Cl.CH_2.COOH$
(d) $CH_3COOH > ClCH_2COOH > Cl_2CH.COOH > Cl_3C.COOH$

GUJCET-2014

Ans. (b) : As well as no. of chlorine atom increases which is attached with the α–carbon of carboxylic group, the acidic character increases because Cl is highly electronegative atom and pulls the bonding pair of electron from which the hydrogen atom easily removed. Hence, the decreasing order of acidic character is–

$Cl_3CCOOH > Cl_2CHCOOH > ClCH_2COOH > CH_3COOH.$

635. Which of the following option is the correct order for the basic strength of metallic hydroxides?

(a) $Al(OH)_3 < Lu(OH)_3 < Ce(OH)_3 < Ca(OH)_2$
(b) $Ca(OH)_2 < Al(OH)_3 < Lu(OH)_3 < Ce(OH)_3$
(c) $Lu(OH)_3 < Ce(OH)_3 < Al(OH)_3 < Ca(OH)_2$
(d) $Lu(OH)_3 < Ce(OH)_3 < Ca(OH)_2 < Al(OH)_3$

GUJCET-2014

Ans. (a) : As we know that higher the electropositive character, higher will be basic strength. The order of size of given metallic elements is:

$Al^{3+} < Lu^{3+} < Ce^{3+} < Ca^{2+}$

Thus, the order of basic strength is:

$Al(OH)_3 < Lu(OH)_3 < Ce(OH)_3 < Ca(OH)_2$

636. For BCl_3, $AlCl_3$ and $GaCl_3$ the increasing order of ionic character is

(a) $BCl_3 < AlCl_3 < GaCl_3$
(b) $GaCl_3 < AlCl_3 < BCl_3$
(c) $BCl_3 < GaCl_3 < AlCl_3$
(d) $AlCl_3 < BCl_3 < GaCl_3$

WB-JEE-2013

Ans. (c) : Ionic character is inversely proportional to the charge on cation and directly proportional to size of cation.

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$$BCl_3 \quad AlCl_3 \quad GaCl_3$$

$$B \rightarrow +3 \quad Al \rightarrow +3 \quad Ga \rightarrow +3$$

Hence, the correct order of ionic character will be.
$BCl_3 < GaCl_3 < AlCl_3$.

637. The hydration energy of Mg^{2+} ion is higher than that of

(a) Al^{3+} (b) Be^{2+}
(c) Na^+ (d) None of these

CG PET- 2013

Ans. (c) : Hydration energy depends on charge of ion and ionic radius. Higher the charge, greater the hydration energy. On the other hand, smaller the size, greater the hydration energy. Charge is considered first for comparison. Hence, Mg^{2+} has higher hydration energy than Na^+.

638. Among the elements B, Mg, Al and K the correct order of increasing metallic character is

(a) $B < Al < Mg < K$ (b) $B < Mg < Al < K$
(c) $Mg < B < Al < K$ (d) $Mg < Al < B < K$
(e) $K < Mg < Al < B$

Kerala-CEE-2013

Ans. (a) : In the periodic table, the metallic character of the elements increases as we move down the group and decreases across a period left to right. Hence, the increasing order of metallic character will be $B < Al < Mg < K$.

639. Which of the following is most acidic?

(a) H_2O (b) H_2S
(c) H_2Se (d) H_2Te

UPTU/UPSEE-2013

Ans. (d) : As we move down the group 16 elements, the acidity of hydrides increases down the group Thus, H_2O has least acidic character where as H_2Te has more acidic character.

640. Which one of the following cannot form an amphoteric oxide?

(a) Al (b) Sn
(c) Sb (d) P

AP EAMCET (Engg.) 2012

Ans. (d) : Metal oxides which react with both acids as well as bases to produce salts and water is known as amphoteric oxide. Phosphorus does not form the amphoteric oxide.
P (Phosphorous) being a non-metal always form acidic oxide like P_2O_3, P_5O_{10} etc.

641. Among LiCl, RbCl, $BeCl_2$ and $MgCl_2$ compounds with maximum and minimum ionic character are respectively

(a) LiCl; RbCl (b) RbCl; $BeCl_2$
(c) RbCl; $MgCl_2$ (d) $MgCl_2$; $BeCl_2$

SRMJEEE – 2012

Ans. (b) : Polarisation is inversely proportional to ionic character.
Polarisation order : $BeCl_2 > MgCl_2 > LiCl > RbCl$
so ionic character : $RbCl > LiCl > MgCl_2 > BeCl_2$
Maximum and minimum ionic character are RbCl and $BeCl_2$ respectively.

642. Which of the following sets contains oxides in the sequence of basic, amphoteric and acidic in nature respectively?

(a) CaO, SiO_2, Al_2O_3 (b) Al_2O_3, CO_2, SiO_2
(c) CO, SO_2, P_2O_5 (d) BaO, Al_2O_3, SiO_2

SRMJEEE – 2012

Ans. (d) : Barium oxide (BaO), Alumina (Al_2O_3) and Silica (SiO_2) shows the character of basic nature, amphoteric character and acidic nature respectively.
SiO_2– An amphoteric solution is a substance that can chemically react as either acid or base.

643. The polarizing power of the following anions, N^{3-}, O^{2-} and F^-, follow the order

(a) $N^{3-} > F^- > O^{2-}$ (b) $O^{2-} > N^{3-} > F^-$
(c) $O^{2-} > F^- > N^{3-}$ (d) $N^{3-} > O^{2-} > F^-$

AMU-2012

Ans. (d) : The polarizing power is directly proportional to the size of anion. First of all, we find act the order of size of the ions. More the negative charge, more the size of anions Thus, size of anions follow the following order:–

$$N^{3-} > O^{2-} > F^-$$

Thus, the order of polarizing power will be:-

$$N^{3-} > O^{2-} > F^-$$

644. Which of the following orbitals has zero probability of finding the electron in the xy-plane?

(a) p_x (b) p_z
(c) d_{yz} (d) $d_{x^2-y^2}$

AMU-2012

Ans. (b) : In the p_z orbitals the possibility of finding electrons in the xy-plane will be zero.

645. Which of the following is least hydrolysed?

(a) $BeCl_2$ (b) $MgCl_2$
(c) $CaCl_2$ (d) $BaCl_2$

MHT CET-2012

Ans. (a) : In the alkaline earth metal chloride, $BeCl_2$ and $MgCl_2$ get hydrolyzed due to their covalent nature. Other halides do not get hydrolyzed. Polarization power is inversely proportional to the solubility i.e. size of cation is directly proportional to the solubility. Be^{2+} has least size than Mg^{2+} due to which they having the least hydrolysis.

646. Among the following, the maximum covalent character is shown by the compound

(a) $FeCl_2$ (b) $SnCl_2$
(c) $AlCl_3$ (d) $MgCl_2$

(AIEEE-2011)

Ans. (c) : According to the Fajan's rule, the polarization is directly proportional to the covalent character of the compound and polarization is directly proportional to the charge on cation.
So, we can say that compounds having large charge on cation are more covalent.

$$\overset{+2}{Fe}Cl_2 \qquad \overset{+2}{Sn}2\,Cl_2$$

$$\overset{+3}{Al}Cl_3 \qquad \overset{+2}{Mg}Cl_2$$

Thus, $AICI_3$ has the more covalent character.

647. Among the following the compound that is readily soluble in water is

(a) $BeSO_4$ (b) $CaSO_4$
(c) $SrSO_4$ (d) $BaSO_4$

J & K CET-(2011)

@apna_pdf

Ans. (a) : The solubility of alkaline earth metal sulphates decreases down the group because ionic size increases. $BeSO_4$ is readily soluble in water, because the greater hydration enthalpy of Be^{2+} ion overcomes the lattice enthalpy Factor.

648. Which of the following property does not correspond to the order HI < HBr < HCl < HF?

(a) Thermal stability (b) Reducing power
(c) Ionic character (d) Dipole moment

MHT CET-2011

Ans. (b) : • Thermal stability is inversely proportional to the polarization power. Hence, the given order is true.

• The reducing power of halogen halide increases in the following order i.e. HF < HCl < HBr < HI

Hence, the given order is not true.

• The ionic character is inversely proportional to the size of anion. Hence, the ionic character is true.

• The dipode moment of hydrogen halide decreases down the group because of decreasing of electronegativity.

Hence, the given order is true.

649. Which of the following represents correct acidity order Li_2O, BeO and B_2O_3?

(a) $Li_2O<BeO<B_2O_3$ (b) $B_2O_3<BeO<Li_2O$
(c) $BeO<Li_2O<B_2O_3$ (d) $BeO<B_2O_3<Li_2O$

UPTU/UPSEE-2011

Ans. (a) : The acidic character is directly proportional to the charge on cation and inversely proportional to the size of cation.

$$Li_2O \quad BeO \quad B_2O_3$$
$$Li \rightarrow +1 \quad Be \rightarrow +2 \quad B \rightarrow +3$$

B_2O_3 contains the more charge on cation and Li_2O contains less charge on cation. Hence, the correct order of acidic character will be–

$$Li_2O < BeO < B_2O_3.$$

650. In water or its acidic solution, proton can exist as $H_3O^+, H_9O_4^+, \left[H(H_2O)_n\right]^+$. This is due to more polarizing power of.

(a) H (b) H_2^+
(c) H^+ (d) H_2O

S C R A 2010 (A) CHEMISTRY

Ans. (c) : In water or its acidic solution, proton can exist (hydronium ion), this is because water containing lone pair of e^- on oxygen atom shared electron (co-ordinate bond) with it, forming H_3O^+ ion. This is due to more polarising power of H^+

651. Assertion: Molecules of larger size have higher polarizability.
Reason: Polarizability is observed only in those molecules which has permanent dipole moment.

(a) If both Assertion and Reason are correct and the Reason is the correct explanation of Assertion
(b) If both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.
(c) If Assertion is correct but Reason is incorrect
(d) If both the Assertion and Reason are incorrect

AIIMS-2010

Ans. (c): According to the Fajan's rule, the polarizability is directly proportional to the size of anion. If the size of anion is larger then the polarizability is also will be more. Polarizability is also observed by induced polar atom from another polar atom. Hence, assertion is true but reason is not true.

652. One would expect proton to have very large

(a) ionisation potential (b) radius
(c) charge (d) hydration energy

BCECE-2010

Ans. (d) : Proton have very small size, so have large hydration energy. The degree of hydration depend, upon the size of the cation. Smaller the size of a cation greater the hydration energy.

653. Which of the following is Lewis acid?

(a) OH^- (b) H^+
(c) F^- (d) NH_3

JIPMER-2010

Ans. (b): The electron deficient species with vacant orbital is known by lewis acid. Here, H^+ is the lewis acid whereas OH^-, F and NH_3 are lewis bases.

654. The order of stability of metal xides is

(a) $Al_2O_3 < MgO < Fe_2O_3 < Cr_2O_3$
(b) $Cr_2O_3 < MgO < Al_2O_3 < Fe_2O_3$
(c) $Fe_2O_3 < Cr_2O_3 < Al_2O_3 < MgO$
(d) $Fe_2O_3 < Al_2O_3 < Cr_2O_3 < MgO$

Karnataka-CET, 2009

Ans. (c) : The stability of metal oxide is directly related to lattice energy and lattice energy depends on charge and size of ions. So, the order is–

$$Fe_2O_3 < Cr_2O_3 < Al_2O_3 < MgO$$

655. Which of the following metal oxides is most basic?

(a) ZnO (b) Al_2O_3
(c) As_2O_3 (d) K_2O

J & K CET-(2008)

Ans. (d) : The given species are:–

$$ZnO \quad Al_2O_3 \quad As_2O_3 \quad K_2O$$
$$Zn\rightarrow+2 \quad Al\rightarrow+3 \quad As\rightarrow+3 \quad K\rightarrow+1$$
$$O \rightarrow -2 \quad O \rightarrow -2 \quad O \rightarrow -2 \quad O \rightarrow -2$$

The charge of ion is inversely proportional to the basicity of the compound. Here, oxide, of potassium bearing less charge on cation so that's why it has most basic character.

656. The correct order of heat of formation of halogen acids is

(a) HI > HBr> HCI > HF
(b) HF > HCl > HBr > HI
(c) HCl > HF > HBr > HI
(d) HCl > HBr > HF > HI

UPTU/UPSEE-2008

Ans. (b) : On moving from top to bottom of halogen group the bond dissociation energy of hydrogen halides decreases and so the heat of formation of halogen acids also decreases.

657. Among the following, which is water insoluble?

(a) Sodium fluoride (b) Potassium fluoride
(c) Beryllium fluoride (d) Magnesium fluoride

AP EAMCET (Engg.) -2007

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Ans. (d) : Fluorides of magnesium metals are ionic, have high melting points, and are insoluble in water.
- Sodium fluoride reacts with water forms hydrogen fluoride and NaOH.

658. Assertion (A): NaCl is less soluble in heavy water than in ordinary water.
Reason (R): Dielectric constant of ordinary water is more than that of heavy water.
The correct answer is
(a) Both (A) and (R) are true and (R) is the correct explanation of (A).
(b) Both (A) and (R) are true but (R) is not the correct explanation of (A).
(c) (A) is true, but (R) is not true.
(d) (A) is not true, but (R) is true.

AP EAMCET (Engg.) -2007

Ans. (a) : NaCl is less soluble in heavy water than in ordinary water because dielectric constant of ordinary water (i.e, 81) is more than that of heavy water (i.e 80).

659. The most stable compound is
(a) LiF (b) LiCl
(c) LiBr (d) LiI

JCECE - 2007

Ans. (a) : By Fajan's rule, smaller the size of cation, larger the size of anion then larger the polarizing power and stability of compound is more.

660. The carbonate that will not decompose on heating is
(a) Na_2CO_3 (b) $CaCO_3$
(c) $BaCO_3$ (d) $SrCO_3$
(e) Li_2CO_3

Kerala-CEE-2007

Ans. (a) : The carbonates of alkaline earth metal decompose into CO_2 and metal oxide when heated. All alkali metal carbonates (except Li_2CO_3) are highly stable and do not decompose on heating due to which Na_2CO_3 will not decompose on heating.

661. Which of the following is the most basic oxide?
(a) SeO_2 (b) Al_2O_3
(c) Sb_2O_3 (d) Bi_2O_3

NEET-2006

Ans. (d) : Basicity of oxide depends on the size of the central atom. i.e. basicity is directly proportional to the size of cation . In the given option , Bi has more atomic size due to which they shows the more basic character.

662. Which one is most ionic?
(a) P_2O_5 (b) MnO_2
(c) Mn_2O_7 (d) P_2O_3

JCECE - 2006

Ans. (d) : According to Fajan's rule, compounds having largest charge on cation are more covalent or least electrovalent. So, compounds having lowest charge on cation will be more electrovalent or ionic.

$$\overset{+4}{Mn}O_2 \qquad \overset{+7}{Mn_2}O_7$$

$$\overset{+5}{P_2}O_5 \qquad \overset{+3}{P_2}O_3$$

So, P_2O_3 will be most ionic.

663. Amphoteric oxide are in:
(a) ZnO, K_2O, SO_3 (b) ZnO, P_2O_5, Cl_2O_7
(c) SnO_2, Al_2O_3, ZnO (d) PbO_2, SnO_2, SO_3

UPTU/UPSEE-2006

Ans. (c) : Amphoteric oxides can be defined as oxides that can behave as an acid and a base to produce salt and water. SnO_2 is an amphoteric oxide. Aluminum oxide reacts with both acidic and basic substance to give neutralization reaction and it is called amphoteric oxide. Zinc oxide is amphoteric because it reacts with both acids and bases to form salts.

664. The covalent character of group 15 elements decreases in the sequence
(a) Bi > Sb > As > P (b) P > As > Sb > Bi
(c) Bi > As > Sb > P (d) As > Sb > Bi > P

AMU–2006

Ans. (b) : In group 15 elements, except nitrogen, the electronegativities of other elements are so low that they generally form covalent compounds even with highly electropositive elements. The covalent character of the group 15 elements decreases as P > As > Sb > Bi.

665. Which among the following is strongest acid?
(a) $H(ClO)O_2$ (b) $H(ClO)O_3$
(c) $H(ClO)O$ (d) $H(ClO)$

JIPMER-2006

Ans. (b) : The species which have more no. of oxygen atom attached with chlorine atom, gets more acidic, Here, $H(ClO)O_3$ has more number of oxygen atom, thus, it has more acidic character.

666. Least ionized salt is
(a) KCl (b) AgCl
(c) $MgCl_2$ (d) $CaCl_2$

UP CPMT-2005

Ans. (b) : Least ionised salt will be one which has highest covalent character.
∵ KCl, $MgCl_2$ and $CaCl_2$ are chlorides of members group 1 and group 2 of periodic table. So, they are ionic. AgCl is chloride of d-block elements. So, it is least ionic and least ionised.

667. Based on lattice energy and other considerations which one of the following alkali metal chlorides is expected to have the highest melting point?
(a) RbCl (b) KCl
(c) NaCl (d) LiCl

(AIEEE 2005)

Ans. (c) : Melting point is directly proportional to lattice energy. It depends upon charge of ions and size of ions.

$$\boxed{\text{Melting point} \propto \text{Lattice Energy} \propto \frac{\text{Charge}}{\text{size}}}$$

As we go down in the group, ionic character increases hence, melting point of halides should increase but NaCl has the highest meting point (800°C) due to its high lattice energy.

668. The following salt shows maximum covalent character:
(a) $AlCl_3$ (b) $MgCl_2$
(c) $CsCl$ (d) $LaCl_3$

UPTU/UPSEE-2004

Ans. (a) : According to the Fajan's rule, the covalent character is directly proportional to the amount of cation and inversaly proportional to the size of cation.

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$AlCl_3$ $MgCl_2$ $CsCl$ $LaCl_3$

$Al \rightarrow +3$ $Mg \rightarrow +2$ $Cs \rightarrow +1$ $La \rightarrow +3$

$AlCl_3$ and $LaCl_3$ has the equal amount of charge but Al^{3+} has less atomic size than La^{3+} due to which $AlCl_3$ has maximum covalent character.

669. Which of the following element is most electropositive?

(a) Al (b) Mg

(c) P (d) S

J & K CET-(2003)

Ans. (b) : Atoms which tend to donate electrons are called electropositive atom and the atom convert into a positive ion(M^+) upon donating electrons.

The element Mg is most electropositive.

The electronegativity of aluminium is 1.61 in the Pauling scale.

Hence, if electronegativity is large then electropositivity is less. Hence, magnesium has higher electropositivity.

Note:- Cesium(Cs) is the most electropositive of the stable elements having atomic no. 55.

670. Select the correct statement.

(a) When a covalent bond is formed, transfer of electrons takes place

(b) Pure H_2O does not contain any ion

(c) A bond is formed when attractive forces overcome repulsive forces

(d) HF is less polar than HBr

(AIEEE-2002)

Ans. (c) : The bond forms when attractive forces are more than repulsive forces. To get stability, more attractive forces must be present in it.

671. Which of the following order is wrong?

(a) $NH_3 < PH_3 < AsH_3$ – acidic

(b) $Li < Be < B < C$ – 1st IP

(c) $Al_2O_3 < MgO < Na_2O < K_2O$ – basic

(d) $Li^+ < Na^+ < K^+ < Cs^+$ – ionic radius

NEET-2002

Ans. (b) : NH_3, PH_3 and AsH_3 are basic due to the presence of the lone pair of electrons on the central atom but as the size increase down the group the basic character decrease. Therefore, the acidic strength will increases down the group as–

$$NH_3 < PH_3 < AsH_3$$

- Ionisation energy increases from left to right in a period due to the increases in effective nuclear charge on the element. Be has high I.E than B due to its completely filled 2s orbital that provides stability to the element.

Thus the order of IE_1 is–

$Li < B < Be < C$

672. Which one of the following is the weakest acid?

(a) HCl (b) HBr

(c) HF (d) HI

UP CPMT-2001

Ans. (c) : In gaseous state, HX are covalent and do not show acid character but in aqueous solution, they ionize to give hydronium ion (H_3O^+) and act as acid.

$$HX + H_2O \rightarrow H_3O^+ + X^-$$

The relative strength of acids increases as follows:

$$HF < HCl < HBr < HI$$

The strength of acids depend on bond lengths.

$$\text{Acidity} \propto \frac{1}{\text{Bond strength}}$$

$\therefore$ HF is least acidic because its bond strength (i.e. bond dissociation energy is highest. Hydrogen bonding is another reason for least acidic strength of HF.

673. Which of the following is soluble in excess of NaOH?

(a) $Fe(OH)_3$ (b) $Al(OH)_3$

(c) $Cr(OH)_3$ (d) $Mn(OH)_3$

J & K CET-(1999)

Ans. (b) : In the excess amount of NaOH, $Al(OH)_3$ is soluble. Thus, to separate $Fe(OH)_3$ and $Al(OH)_3$ aqueous NaOH solution is added $Al(OH)_3$ will dissolve in it whereas $Fe(OH)_3$ will remain insoluble. These two can be separated by filtration.

674. Boron compounds behave as Lewis acids because of their

(a) acidic nature

(b) covalent nature

(c) ionization property

(d) electron deficient nature

J & K CET-(1999)

Ans. (d) : The lewis acids has the vacant orbital due to which they show electron deficient nature and attack at the point in which electron density is more.

675. According to Fajan's rule covalent bond is favoured by:

(a) small cation and large anion

(b) small cation and small anion

(c) large cation and large anion

(d) large cation and small anion

AP EAMCET (Medical) -1998

Ans. (a): According to the **Fajan's rule**, covalent bond is favoured by small cation and large anion. Also large charge on cation and cation with pseudo noble gas configuration will favor covalent bond.

676. Among the following oxides, the one which is most basic is

(a) ZnO (b) MgO

(c) Al_2O_3 (d) N_2O_5

NEET-1994

Ans. (b) : Generally metals form basic oxides especially alkaline and alkaline earth metals. Hence, Mgo is most basic among Al_2O_3, ZnO, N_2O_5.

ZnO and Al_2O_3 are amphoteric oxide, N_2O_5 is oxide of non-metal, so it is acidic.

677. Among the following which compound will show the highest lattice energy?

(a) KF (b) NaF

(c) CsF (d) RbF

NEET-1993

Ans. (b) : As we know that in alkali metal, the lattice energy decreases down the group as the size of cation increases. Hence, the NaF has the highest lattice energy.

$$\text{Lattice energy} \propto \frac{1}{r_A + r_B}$$

@apna_pdf

678. Which two sets of reactants best represents the amphoteric character of $Zn(OH)_2$?

Set I $Zn(OH)_2(s)$ and OH^- (aq)
Set II $Zn(OH)_2(s)$ and H_2O (l)
Set III $Zn(OH)_2(s)$ and H^+ (aq)
Set IV $Zn(OH)_2(s)$ and NH_3 (aq)

(a) III and II (b) I and III
(c) IV and I (d) II and IV

VITEEE 2015

Ans. (b) : Zinc hydroxide is amphoteric in nature
It reacts with acid as well as base.

$$Zn(OH)_2(S)+2H^+(aq)\rightarrow ZnO(aq)+2H_2O(l)$$

$$Zn(OH)_2(S)+2OH^-(aq)\rightarrow[Zn(OH)_4]^{2-}(aq)+2H^+$$

The amphoteric character of $[Zn(OH)_4]^{2-}$ is represented by I and III.

679. Which of the following oxides is strongly basic?

(a) Tl_2O (b) B_2O_3
(c) Al_2O_3 (d) Ga_2O_3

VITEEE 2014

Ans. (a) : On moving down the group, the acidic character decreases and the basic character increases so, the Tl_2O is strongly basic

680. Lattice energy of an ionic compound depends upon

(a) Charge on the ion and size of the ion
(b) Packing of ions only
(c) Size of the ion only
(d) Charge on the ion only

AP EAMCET 2009

Ans. (a) : Lattice energy of an ionic compound depends upon charge on the ion and size of the ion i.e.

$$\boxed{\text{Lattice Energy} \propto \frac{\text{Charge}}{\text{Size of ion}}}$$

681. Among the following, the molecule expected to be stabilised by anion formation is C_2, O_2, NO, F_2.

(a) C_2 (b) F_2
(c) NO (d) O_2

JEE Main 2019

Ans. (a) : In case of only C_2, incoming electron will enter in the bonding moleculer orbital which increases the bond order and stability too. Whereas rest of all takes electrons in their antibonding molecular orbital which decreases bond order and stability.

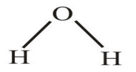
6. Dipole Moment

682. Amongst BeF_2, BF_3, H_2O, NH_3, CCl_4 and HCl, the number of molecules with non-zero net dipole moment is——

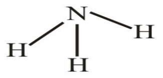
JEE Main-25.06.2022, Shift-II

Ans. (3) : Polar Molecules - H_2O, NH_3, HCl

(i)



(ii) NH_3



(iii) HCl

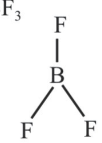
H—Cl

Non- Polar molecules = BeF_2, BF_3 CCl_4

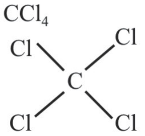
(i) BeF_2

F—Be—F

(ii) BF_3



(iii) CCl_4



683. Arrange the following in the decreasing order of their covalent character?

(a) LiCl (b) NaCl
(c) KCl (d) CsCl

Choose the most appropriate answer from the options given below:

(a) (A) > (C) > (B) > (D)
(b) (B) > (A) > (C) > (D)
(c) (A) > (B) > (C) > (D)
(d) (A) > (B) > (D) > (C)

JEE Main-29.06.2022, Shift-I

Ans. (c) : On moving down the group from top to bottom the covalent character decrease. Hence, the decreasing order of covalent character is-
LiCl > NaCl > KCl > CsCl.

684. The dipole-dipole interaction energy between rotating polar molecules is proportional to____ where 'r' is the distance between polar molecules.

(a) $\frac{1}{r^4}$ (b) $\frac{1}{r^9}$
(c) $\frac{1}{r^3}$ (d) $\frac{1}{r^2}$
(e) $\frac{1}{r^6}$

Kerala CEE -03.07.2022

Ans. (e) : Dipole – dipole interactions result when two dipolar molecules interact with each other through space.
dipole – dipole interaction energy between rotating polar molecules $\propto \frac{1}{r^6}$
dipole – dipole interaction energy between stationary polar molecules $\propto \frac{1}{r^3}$
So, the correct option is (e)

685. Dipole moment of HCl = 1.03 D, HI = 1.6 Å. The ratio of fraction of electric charge δ, existing on each atom in HCl and HI is

(a) 12: 1 (b) 2.7: 1
(c) 3.3: 1 (d) 1: 3.3

AP EAMCET (Engg.)-2009
VITEEE- 2009

Ans. (c): Dipole moment of HCl = 1.03D
Bond length of HCl = 1.3 Å
Dipole moment of HI = 0,38 Å
Bond length of HI = 1.6 Å

@apna_pdf

Dipole moment (μ) = Electric charge (δ) × Bond length (*l*)

$$\text{Electric charge }(\delta)=\frac{\text{Dipole moment}}{\text{Bond length}}$$

$$\frac{\delta_{HCl}}{\delta_{HI}}=\frac{\mu_{HCl}}{l_{HCl}}\times\frac{l_{HI}}{\mu_{HI}}$$

$$\frac{\delta_{HCl}}{\delta_{HI}}=\frac{1.03}{0.38}\times\frac{1.6}{1.3}=\frac{3.33}{1}$$

$\delta_{HCl} : \delta_{HI} = 3.3 : 1$

686. The dipole moment of HBr is 2.60×10^{-30}cm and the interatomic spacing is 1.41Å. What is the percent ionic character of HBr?

(a) 50% (b) 11.5%

(c) 4.01% (d) 1.19%

BCECE-2015, 2013

Ans. (b) : Given that, $\mu_{obs.} = 2.60 \times 10^{-30}$ cm

$d = 1.41Å = 1.41 \times 10^{-10}$ m

$q = 1.6 \times 10^{-19}$ C

$\therefore \quad \mu_{cal} = q \times d$

$= 1.6 \times 10^{-19} \times 1.41 \times 10^{-10}$

$= 2.256 \times 10^{-29}$ cm

$$\%\text{ Ionic Character } = \frac{\mu_{obs}}{\mu_{cal.}}\times100$$

$$=\frac{2.60\times10^{-30}}{2.25\times10^{-29}}\times100 \quad = 11.5\%$$

687. Which of the following molecules will exhibit zero dipole moment?

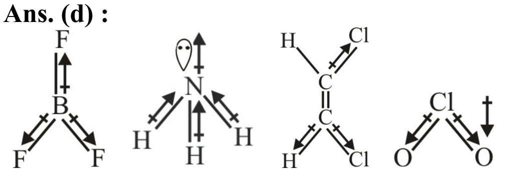
(a) CH_2Cl_2 (b) ClO_2

(c) NH_3 (d) BF_3

J & K CET-(2014)

AMU-2008

Ans. (d) :



μ=0 μ=1.47D μ≠0 μ≠0

BF_3 NH_3 cis-$C_2H_2Cl_2$ ClO_2

688. If a molecule MX_3 has zero dipole moment, the sigma bonding orbital used by M (At. no. 13) are

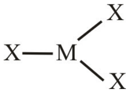
(a) pure p (b) sp- hybridised

(c) sp^2-hybridised (d) sp^3- bybridised

CG PET-2005

J & K CET-(1999)

Ans. (c) : MX_3 molecule has zero dipole moment when M is sp^2 hybridesed, the molecule has trigonal planar geometry and has zero dipole moment as the bond dipoles cancel.



689. Among the following the molecule possessing highest dipole moment is

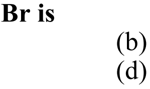
(a) CO_2 (b) BF_3

(c) SO_2 (d) Trans-2-butene

JIPMER-2014

J & K CET-2009

Ans. (c) : CO_2, BF_3 and trans-2-butene molecules having net dipole moment zero. Only SO_2 molecule possessing some net dipole moment so SO_2 molecule having highest dipole moment.



μ ≠ 0

690. The most polar bond is

(a) O–F (b) N–Cl

(c) N–F (d) N–N

UP CPMT-2002

NEET-1992

Ans. (c) : Polarity of bond depend on the difference between the electronegativity of two bonded atom. Electro negativity difference increases, polarity also increases.

O – F = 3.5 – 4.0 = –0.5

N – Cl = 3.0 – 3.0 = 0

N – N = 0

N – F = 3 – 4 = –1

So, N–F bond will be more polar.

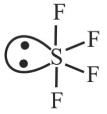
691. Which of the following is a polar molecule?

(a) SiF_4 (b) XeF_4

(c) BF_3 (d) SF_4

NEET-2013, 2005

Ans. (d) : SF_4 molecules having some resultant dipole moment due to their distorted geometry. Therefore SF_4 is polar molecule. But in SiF_4, XeF_4 and BF_3 molecule net dipole moment is zero. So, it is non-polar molecules.



μ ≠ 0

692. The dipole moment of HBr is 1.6×10^{-30} cm and inter atomic spacing is 1 Å. The % ionic character of HBr is

(a) 7 (b) 10

(c) 25 (d) 27

UPTU/UPSEE-2013

JCECE-2008

Ans. (b) : $\mu_{obs} = 1.6 \times 10^{-30}$ cm

Bond length (d) = 1 Å = 1×10^{-10}m

Charge (q) = 1.6×10^{-19} C

$\mu_{cal.} = q \times d = 1.6 \times 10^{-19} \times 1 \times 10^{-10}$ cm

$= 1.6 \times 10^{-29}$ cm

$$\%\text{ Ionic character } = \frac{\mu_{obs}}{\mu_{cal}}\times100$$

$$=\frac{1.6\times10^{-30}}{1.6\times10^{-29}}\times100$$

= 10 %

693. A covalent molecule X - Y is found to have a dipole moment of 1.5×10^{-29} C.m and a bond length of 150 pm. the percent ionic character of the bond will be________

(a) 50% (b) 62.5%

(c) 75% (d) 80%

AP EAPCET 20.08.2021 Shift-II

@apna_pdf

Ans. (b): Given that

$$\mu_{obs} = 1.5\times10^{-29}\ \text{C.m}$$
$$d = 150 \times 10^{-12}\ \text{m}$$
$$q = 1.6 \times 10^{-9}\text{c}$$
$$\therefore\ \mu_{cal.} = q \times d$$
$$= 1.6 \times 10^{-9} \times 150 \times 10^{-12}$$
$$= 1.6 \times 10^{-9} \times 10^{-29}$$
$$= 2.4 \times 10^{-29}\ \text{c.m}$$

$$\%\ \text{Ionic character} = \frac{\mu_{obs.}}{\mu_{cal.}}\times100$$
$$= \frac{1\cdot5\times10^{-29}}{2.4\times10^{-29}}\times100$$
$$= \frac{1\cdot5\times100}{2.4}$$
$$= 62.5\%$$

694. Match the following

List-I **Molecule**	**List-II** **Dipole moment (D)**	
(A) HBr	**(I)**	**1.04**
(B) H_2S	**(II)**	**0**
(C) NH_3	**(III)**	**0.79**
(D) $CHCl_3$	**(IV)**	**0.95**
	(V)	**1.47**

The correct match is

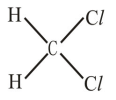
	A	B	C	D
(a)	I	V	IV	III
(b)	III	IV	V	I
(c)	I	V	II	IV
(d)	IV	V	I	III

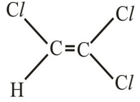
TS-EAMCET (Engg.), 07.08.2021 Shift-II

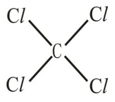
Ans. (b) :

Molecule	**Dipole moment (D)**
HBr	0.79
H_2S	0.95
NH_3	1.47
$CHCl_3$	1.04

695. Which compound among the following will have a permanent dipole moment?


(i)


(ii)

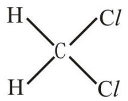

(iii)

$Br-C\equiv C-Br$
(iv)

(a) (i) only
(b) (ii) only
(c) (iii) only
(d) (iv) only

AP-EAPCET-20.08.2021,Shift-I

Ans. (a) :



It has permanent dipole moment due to two chlorine atom has attached to the carbon position.

696. Which of the following molecule has the maximum dipole moment?

(a) NH_3
(b) CS_2
(c) C_2H_6
(d) NCl_3

AP-EAPCET-20.08.2021,Shift-I

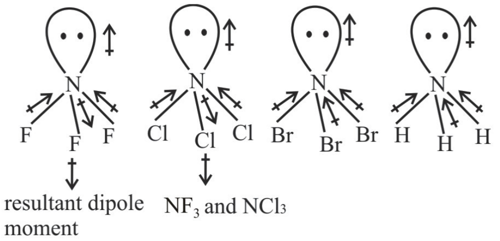
Ans. (a) : CS_2 and C_2H_6 has zero dipole moment and NH_3 is 1.06D and NCl_3 is 0.6D In NCl_3 three lone pair on chlorine atom will reduce.

697. Which of the following will have maximum dipole moment?

(a) NF_3
(b) NCl_3
(c) NBr_3
(d) NH_3

AP-EAPCET-19.08.2021, Shift-I

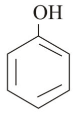
Ans. (b) :

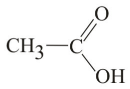


Have less dipole moment because the resultant in opposite direction. But in the case of NBr_3 and NH_3 molecule, NH_3 have more dipole moment as compare to the NBr_3 because the N–Br bond are less polar as in the N–H bond. So the NH_3 molecule have more dipole moment.

698. The compound with maximum vapour pressure at a given temperature is

(a) $CH_3-CH_2-CH_2-CH_2OH$

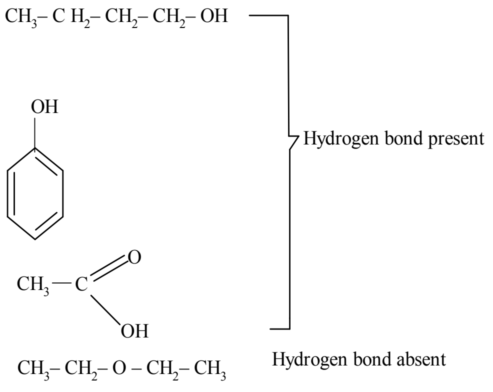
(b)


(c)


(d) $CH_3-CH_2-O-CH_2-CH_3$

TS-EAMCET-09.08.2021, Shift-I

Ans. (d) :



Due to absence of hydrogen bond (Ethoxy ethane) $CH_3–CH_2–O–CH_2–CH_3$ gives maximum vapour pressure at a given temperature.

699. The dipole-dipole interaction energy stationary polar molecules and rotating polar molecules, respectively is proportional to r is the distance between the polar molecules

@apna_pdf

(a) $r^3, \frac{1}{r^2}$ (b) $\frac{1}{r^3}, \frac{1}{r^6}$

(c) $\frac{1}{r^2}, r^2$ (d) $\frac{1}{r^2}, \frac{1}{r^4}$

TS EAMCET 05.08.2021, Shift-I

Ans. (b) : Dipole-dipole interaction energy between polar molecules in solids depends on the distance between them as per following relation.

Dipole-dipole interaction energy $\propto \frac{1}{r^3}$

and that between rotating polar molecules $\propto \frac{1}{r^6}$.

Where r is the distance between polar molecules.

700. One Debye is equal to how many coulomb meter?

(a) 3.33×10^{-30} (b) 2.22×10^{-20}

(c) 1.11×10^{-10} (d) 4.44×10^{-24}

TS EAMCET 05.08.2021, Shift-I

Ans. (a) : Debye was defined as the dipole moment resulting from two charges of opposite sign but an equal magnitude.

1 debye = 3.33×10^{-30} Coulomb meter.

1 debye = 10^{-18} esu-cm.

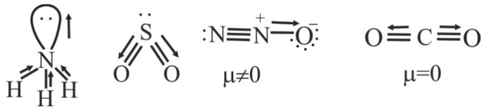
701. Which compound among the following has the highest dipole moment?

(a) NH_3 (b) SO_2

(c) N_2O (d) CO_2

AP-EAPCET-19.08.2021, Shift-II

Ans. (b) :



Two oxygen are more electronegative than a single nitrogen and also S–O bond is longer than N–H bond, through the dipole moment of S–O is more than N–H despite the lone pair on S.

702. The dipole moments of CCl_4, $CHCl_3$ and CH_4 are in the order

(a) $CCl_4 < CH_4 < CHCl_3$

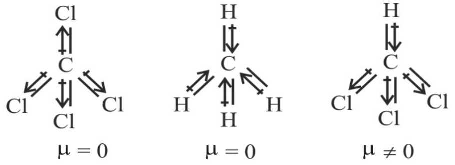
(b) $CH_4 < CCl_4 < CHCl_3$

(c) $CH_4 = CCl_4 < CHCl_3$

(d) $CHCl_3 < CH_4 = CCl_4$

(JEE Main 2020, 7 Jan. Shift-I)

Ans. (c) : All the three compounds possess a tetrahedral geometry. But in case of CCl_4 and CH_4, identical atoms are present around carbon. Therefore, CCl_4 and CH_4 having zero dipole moment.



In case of $CHCl_3$ different atoms are present around carbon and the sum of dipole moment is greater than zero. So, the correct order is

$CH_4 = CCl_4 < CHCl_3$

703. Which of the following set of molecules will have zero dipole moment?

(a) Ammonia beryllium difluoride, water, 1, 4-dischlorobenzene

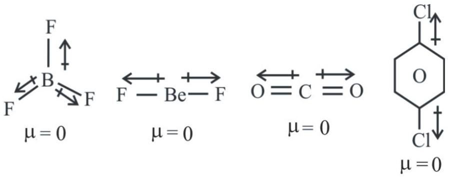
(b) Boom trifluoride, hydrogen fluoride carbon dioxide, 1, 3-dichlorobenzene

(c) Nitrogen trifluoride, beryllium difluoride, water, 1, 3-dichlorobenzene

(d) Boron trifluoride, beryllium difluoride, carbon dioxide, 1, 4-dichlorobenzene

NEET-2020

Ans. (d) : Boron trifluoride (BF_3), Beryllium difluoride (BeF_2), carbon dioxide (CO_2), 1, 4-dichlorobenzene molecules having symmetric geometry Therefore, its resultant dipole moment is zero,



704. Assertion: 1- Butene has less dipole moment than 1-butyne.

Reason: 1-Butyne has more s-character.

(a) If both Assertion and Reason are correct and Reason is the correct explanation of Assertion.

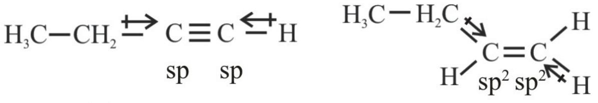
(b) If both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.

(c) If Assertion is correct but Reason is incorrect.

(d) If both the Assertion and Reason are incorrect.

AIIMS 25 May 2019 (Evening)

Ans. (a):



1- Butyne 1-Butene

1-butyne has sp hybridized and more electronegative than double bonded carbon (sp^2) in 1-butene. So, 1-butyne has 50% s-character which is greater than 1-butene having 33% s-character. Therefore, 1-butyne has more dipole moment than 1-butene because 1-butyne has more % s-character.

705. The dipole moment of which of the following molecule is greater than zero?

(a) CCl_4 (b) BF_3

(c) CO_2 (d) NH_3

Assam CEE-2018

Ans. (d) : In NH_3, the net dipole moment is non zero because of Pyramidal shape.

Option (a), (b) & (c) is having not dipole moment zero.

706. Among the following the molecule with the highest dipole moment is–

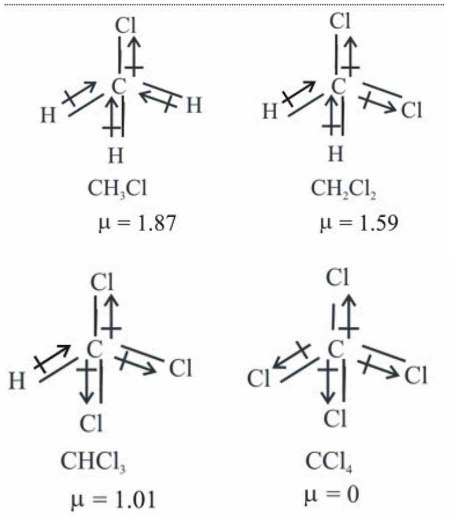
(a) CH_3Cl (b) CH_2Cl_2

(c) $CHCl_3$ (d) CCl_4

BCECE-2018

@apna_pdf

Ans. (a) : CH_3Cl molecule has highest dipole moment because the resultant in same direction.



707. In terms of polar character which one of the following orders is correct?

(a) $H_2S < NH_3 < H_2O < HF$
(b) $H_2O < NH_3 < H_2S < HF$
(c) $HF < H_2O < NH_3 < H_2S$
(d) $NH_3 < H_2O < HF < H_2S$

UPTU/UPSEE-2017

Ans. (a) : As we know that more be the electro negativity difference, more be the polar character, thus correct order is– $H_2S < NH_3 < H_2O < HF$

708. Among the following, the molecule that will have the highest dipole moment is

(a) H_2 (b) HI
(c) HBr (d) HCl
(e) HF

Kerala-CEE-2017

Ans. (e) : Dipole moment is a measure of bond polarity which is turn affected by the electronegativity of atoms in the chemical bond. Greater the electronegativity of atom higher will be the dipole moment.

H – F molecule having highest dipole moment due to high bond polarity in H – F bond.

709. Dipole-dipole interaction energy between polar molecules in solids depends on the radius of the molecule (r) and it is directly proportional to

(a) $(1/r^2)$ (b) $(1/r^6)$
(c) $(1/r)$ (d) $(1/r^5)$
(e) $(1/r^3)$

Kerala-CEE-2016

Ans. (e) : Dipole - dipole interaction energy between polar molecules in solid is directly proportional to $1/r^3$

710. Which of the following compounds has zero dipole moment?

(a) CH_2Cl_2 (b) NH_3
(c) CH_4 (d) PH_3

Manipal-2016

Ans. (c) : Molecules with regular geometry having zero dipole moment therefore, CH_4 molecule has regular tetrahedral geometry and having zero net dipole moment.

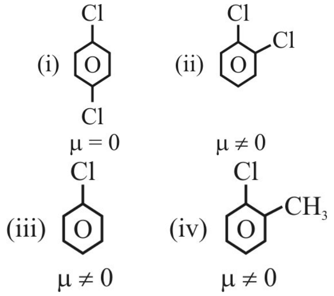
But in case of CH_2Cl_2, NH_3 and PH_3 molecules their geometries are distorted therefore, it have same dipole moment.

711. Which of the following compounds has zero dipole moment?

(a) 1, 4-dichlorobenzene
(b) 1, 2-dichlorobenzene
(c) 1, 3-dichlorobenzene
(d) 1-chloro-2-methyl benzene

AP-EAMCET (Engg.) 2015

Ans. (a) : Dipole moment is defined as the measure of polarity of a chemical bond between two atoms in a molecules i.e. separation of two opposite electrical charges.



712. Pick up the incorrect statement.

(a) Dipole moment of ammonia is due to orbital dipole and resultant dipole in orbital dipole and resultant dipole in the same direction.
(b) In BF_3 bond dipoles are higher but dipole moment is zero.
(c) Dipole moment is a vector quantity.
(d) O_2, H_2 show bond dipole due to polarisation.

COMEDK-2014

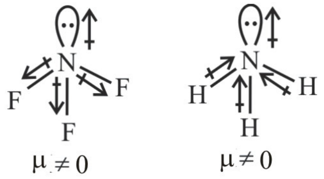
Ans. (d) : O_2, H_2 do not show bond dipole as they are homoatomic molecules hence, are non-polar.

713. Which of the following molecules has the maximum dipole moment?

(a) CO_2 (b) CH_4
(c) NH_3 (d) NF_3

NEET-2014

Ans. (c) : CO_2 and CH_4 molecules have zero net dipole moment. NH_3 and NF_3 have some net dipole moment. But in case of NF_3 molecule having less dipole moment because the resultant in opposite direction, while NH_3 have more dipole moment because the resultant in same direction. So, NH_3 molecule has maximum dipole moment.



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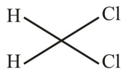
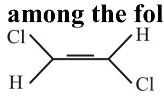
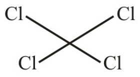
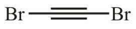
714. The compound that will have a permanent dipole moment among the following is


I


II

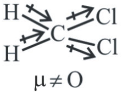

III

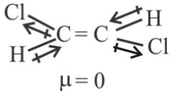

IV

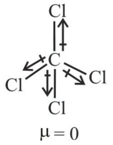
(a) I (b) II
(c) III (d) IV

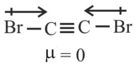
WB-JEE-2014

Ans. (a) : Compounds with asymmetry geometries having some resultant dipole moment. Therefore, CH_2Cl_2 molecule possess some permanent dipole moment.









715. Which of the following will have maximum dipole moment?

(a) NF_3 (b) NH_3
(c) CH_4 (d) PCl_3

J & K CET-2013

Ans. (b) : NH_3 molecule will have maximum dipole moment because in case of NH_3, H is less electronegative than N and hence dipole moment of each N–H bond is towards N and create high net dipole moment. But in NF_3 and PCl_3 molecule resultant dipole moment opposes. So both molecule having less dipole moment.

716. The dipole moment of diatomic molecules AB and CD are 10.41 and 10.27 Debye respectively while there bond distances are 2.82Å and 2.67Å respectively then

(a) bonding is nearly covalent in both the molecules
(b) bonding is 100% ionic in both the molecules
(c) AB has more ionic character than CD
(d) AB has lesser ionic bond character than CD

UP CPMT-2013

Ans. (d) : Dipole moment (μ) = q × d

or $q = \frac{\mu}{d}$

$\therefore$ Magnitude of charge on AB (q_{AB}) $= \frac{\mu_{AB}}{d_{AB}}$

$$= \frac{10.41}{2.82} = 3.69\,\text{esu}$$

and magnitude of charge on CD (q_{CD}) $= \frac{\mu_{CD}}{d_{CD}}$

$$= \frac{10.21}{2.67} = 3.84\,\text{esu}$$

As magnitude of charge is more on CD molecule than that of AB molecule, thus it has more ionic than AB.

717. Which bond would be expected to have the positive end of the bond dipole on the nitrogen atom ?

(a) N–H (b) C–N
(c) Al–N (d) N–O

SCRA-2012

Ans. (d) : The given species are N–H, C–N, Al–N, and N–O are–

$$\begin{array}{cccc} \delta^- \leftarrow +\delta^+ & \delta^+ + \rightarrow \delta^- & \delta^+ + \rightarrow \delta^- & \delta^+ + \rightarrow \delta^- \\ N - H & C - N & Al - N & N - O \end{array}$$

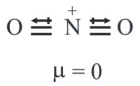
In the N–O species, the polarity of bond towards the oxygen atom and the nitrogen get positive charge.

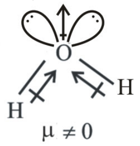
718. which one of the following molecules has zero dipole moment?

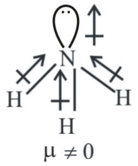
(a) NO_2^+ (b) H_2O
(c) NH_3 (d) CO

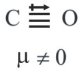
CG PET- 2011

Ans. (a) : NO_2^+ molecule having zero dipole moment because it have symmetric geometry.







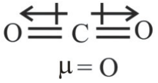


719. Among the following which one is a linear molecule having zero dipole moment?

(a) H_2O (b) HCl
(c) CO_2 (d) H_2S

J & K CET-2011

Ans. (c) : CO_2 is a linear molecule having zero dipole moment. CO_2 is sp - hybridesed so, it has linear geometry. Net resultant dipole moment is zero because CO_2 is symmetric molecule.

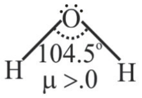


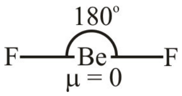
720. H_2O is dipolar whereas, BeF_2 is not. It is because

(a) The electronegativity of F is greater than that of O
(b) H_2O involves hydrogen bonding whereas BeF_2 is a discrete molecule
(c) H_2O is linear and BeF_2 is angular
(d) H_2O is angular and BeF_2 is linear

UP CPMT-2011

Ans. (d) : The structure of H_2O is angular of V-shape as it is sp^3-hybridised with bond angle 105°. Its dipole moment is positive or more than zero. But in BeF_2 structure is linear due to sp-hybridisation (μ = 0). Hence, due to μ > 0, H_2O is dipolar and due to μ = 0, BeF_2 is non-polar.





@apna_pdf

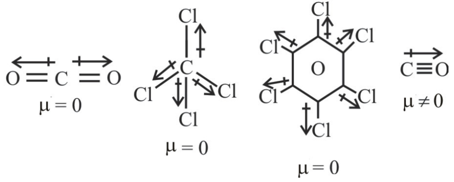
721. Consider(i) CO_2, (ii) CCl_4, (iii) C_6Cl_6 and (iv) CO and tell which of the following statements is correct?

(a) (i), (ii) and (iii) only have zero dipole moment
(b) (i), (ii) and (iv) only have zero dipole moment
(c) only (iv) has zero dipole moment
(d) All have zero dipole moment

UPTU/UPSEE-2011

Ans. (a) : CO_2, CCl_4 and $C_6 Cl_6$ molecules have regular geometry. Therefore, these molecule have zero dipole moment.

But in case of CO molecule, oxygen is more electronegative than carbon due to this bond polarity generate in C – O bond and CO molecule having non-zero dipole moment.



722. Consider the following compounds:
1. $CHCl_3$
2. CH_3Cl
3. NH_3
What is the correct order of the dipole moment of the above compounds?

(a) 1 > 3 > 2
(b) 2 > 1 > 3
(c) 2 > 3 > 1
(d) 3 > 2 > 1

SCRA-2010

Ans. (d) : In $CHCl_3$, CH_3Cl and NH_3, has higher dipole moment because all the vectors are added up to give large dipole moment. In case of $CHCl_3$ and CH_3Cl has higher dipole moment. So, order will be

$NH_3 > CH_3Cl > CHCl_3$

723. Which one of the following molecules has zero dipole moment?

(a) NO_2^+
(b) H_2O
(c) NH_3
(d) CO

SCRA-2010

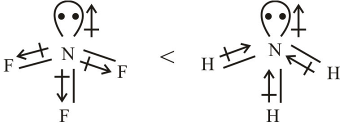
Ans. (a) : All the three molecules CO, H_2O and NH_3 have dipole moment due to individual bond dipoles doesn't cancel each other. But in the case of NO_2^+ as the individual bond dipole cancel each other which results in zero net dipole moment.

724. Which of the following molecule has highest dipole moment?

(a) B_2H_6
(b) NF_3
(c) NH_3
(d) BF_3

AIIMS-2010

Ans. (c): In case of BF_3 and B_2H_6 molecule have zero dipole moment due to their symmetric geometry. NF_3 molecule has less dipole moment than NH_3 because the resultant in opposite direction.



(dipole moment)

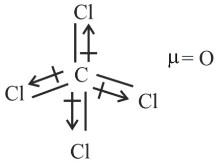
So, NH_3 has highest dipole moment.

725. Identify the molecule that has Zero dipole moment.

(a) CH_3Cl
(b) $CHCl_3$
(c) CH_2Cl_2
(d) CCl_4

J & K CET-2010

Ans. (d) : CCl_4 molecule has zero dipole moment due to the symmetric geometry i.e., all chlorine atoms around carbon are identical.



726. The molecule which has zero dipole moment is

(a) CH_3Cl
(b) NF_3
(c) BF_3
(d) ClO_2

JCECE-2010

Ans. (c) : The molecules having distorted geometry have dipole moment and those having regular geometry have zero dipole moment.

∵ NH_3, CH_3Cl and ClO_2 have distorted geometry.

∴ They have dipole moment.

∵ BF_3 has regular triangular planar geometry.

The dipole moment of BF_3 is zero.

727. The bond length of HCl bond is 2.29×10^{-10}m. The percentage ionic character of HCl, if measured dipole moment is 6.226×10^{-30}C-m, is

(a) 8%
(b) 20%
(c) 17%
(d) 50%

JIPMER-2010

Ans. (c): Given that, $\mu_{obs} = 6.226 \times 10^{-30}$ C-m
Bond length (d) = 2.29×10^{-10} m
Electric charge (q) = 1.6×10^{-19} C

$$\therefore \mu_{cal.} = q \times d$$
$$= 1.6 \times 10^{-19} \times 2.29 \times 10^{-10} \text{ C-m}$$
$$= 3.664 \times 10^{-29} \text{ C-m}$$

$$\% \text{ Ionic character} = \frac{\mu_{obs}}{\mu_{cal}} \times 100$$

$$= \frac{6.226\times10^{-30}}{3.664\times10^{-29}} \times 100$$

$$= 16.99\% \approx 17\%$$

728. A netural molecule XF_3 has a zero dipole moment. The element X is most likely

(a) chlorine
(b) boron
(c) nitrogen
(d) carbon
(e) bromine

Kerala-CEE-2010

Ans. (b) : The element X is most likely be Boron in XF_3 neutral molecule. The molecule BF_3 has regular triangular planar geometry therefore, its dipole moment is zero.

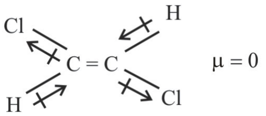
729. Which of the following has zero dipole moment?

(a) 1, 1-dichloromethane
(b) cis-1, 2-dichloroethene
(c) trans-1, 2-dichloroethene
(d) 1-chloroethane

[BITSAT- 2009]

@apna_pdf

Ans. (c) : Trans - 1, 2 - dichloro ethene has zero dipole moment because the resultant dipole moment opposes each other.



730. If H–X bond length is 2.00 Å and H–X bond has dipole moment 5.12×10^{-30} C-m, the percentage of ionic character in the molecule will be

(a) 10% (b) 16%
(c) 18% (d) 20%

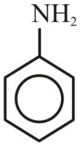
CG PET-2009

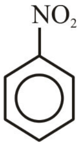
Ans. (b) : Given that, Dipole moment $=5.12\times10^{-30}$ cm
Bond length (ℓ) = 2.00 Å = 2×10^{-10} m
Change (q) = 1.6×10^{-19} C

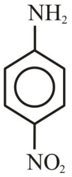
$$\mu_{cal.} = q\times\ell = 1.6\times10^{-19}\times2\times10^{-10}\text{ C-m}$$
$$= 3.2\times10^{-29}\text{ C-m}$$

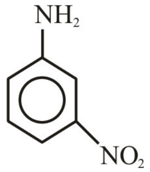
$$\%\text{ Ionic character} = \frac{\mu_{obs}}{\mu_{cal}}\times100$$
$$= \frac{5.12\times10^{-30}}{3.2\times10^{-29}}\times100$$
$$= 16\%$$

731. Which of the following will have large dipole moment?

(a)


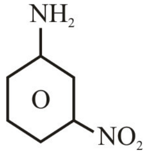
(b)


(c)


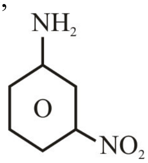
(d)


UPTU/UPSEE-2009

Ans. (d) :



is unsymmetric molecule. usually unsymmetrical molecules have higher dipole moment than symmetrical molecules. Therefore,



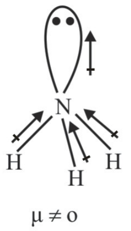
molecule have large dipole moment.

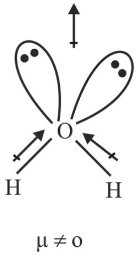
732. The correct order of dipole moment for NH_3, H_2O and CO_2 molecules is

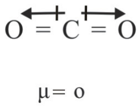
(a) $NH_3 > H_2O > CO_2$ (b) $CO_2 > NH_3 > H_2O$
(c) $H_2O > CO_2 > NH_3$ (d) $H_2O > NH_3 > CO_2$

AP-EAMCET (Medical), 2008

Ans. (d) : The given species are the NH_3, H_2O and CO_2







As we know that oxygen has more electronegative power than nitrogen due to which more polarity present in O-H bond. Oxygen has two lone pair of oxygen is also increase the overall polarity. Thus H_2O has more dipole moment than NH_3.

733. Which one of the following is a non polar molecule?

(a) CCl_4 (b) $CHCl_3$
(c) CH_2Cl_2 (d) CH_3Cl

J & K CET-2008

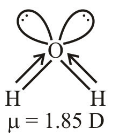
Ans. (a) : CCl_4 is a non-polar molecule because net dipole moment is zero. This is due to the symmetric geometry of CCl_4 molecule.

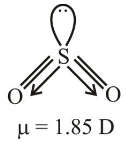
734. In which of the following pairs, both molecules possess dipole moment?

(a) CO_2, SO_2 (b) BCl_3, PCl_3
(c) H_2O, SO_2 (d) CO_2, CS_2

UP CPMT-2008

Ans. (c): H_2O and SO_2 both possess dipole moment due to bent structure.





735. The molecule having zero dipole moment is

(a) CH_2Cl_2 (b) BF_3
(c) NF_3 (d) ClF_3

UPTU/UPSEE-2008

Ans. (b) : Molecules having distorted geometry have dipole moment and those having regular geometry have zero dipole moment.

NF_3, CH_2Cl_2 and ClF_3 have distorted geometry So, they have dipole moment.

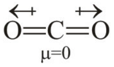
But BF_3 has regular triangular planar geometry. Therefore, it having zero dipole moment.

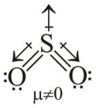
736. In which of the following pairs, both molecules possess dipole moment ?

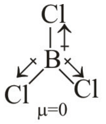
(a) CO_2, SO_2 (b) BCl_3, PCl_3
(c) H_2O, SO_2 (d) CO_2, CS_2

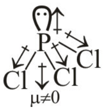
AP-EAMCET (Medical) - 2007

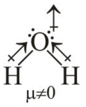
Ans. (c) : The species are given as : CO_2, SO_2, BCl_3, PCl_3, H_2O











Hence, the pair of SO_2 and H_2O having the dipole moment.

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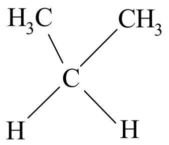
737. Which of the following hydrocarbons has the lowest dipole moment?

(a) 

(b) $CH_3C\equiv CCH_3$

(c) $CH_3CH_2C\equiv CH$

(d) $CH_2=CH-C\equiv CH$

BITSAT-2007

Ans. (b) : $H_3C-C\equiv C-CH_3$ symmetrical and linear. Hence, dipole moment = 0.

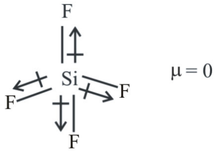
738. Which of the following has zero dipole moment?

(a) ClF (b) PCl_3

(c) SiF_4 (d) $CFCl_3$

CG PET-2006

Ans. (c) : : SiF_4 molecule has zero dipole moment due to its regular tetrahedral geometry and symmetric So, dipole moment get cancelled.



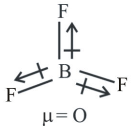
739. Zero dipole moment is possessed by

(a) PCl_3 (b) BF_3

(c) ClF_3 (d) NH_3

J & K CET-2006

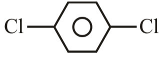
Ans. (b) : BF_3 molecule has zero dipole moment because in BF_3 resultant dipole moment opposes and cancelled out.



740. Consider the following halogen containing compounds:

(A) $CHCl_3$ **(B) CCl_4**

(C) CH_2Cl_2 **(D) CH_3Cl**

(E) 

The compounds with a net zero dipole moment are:

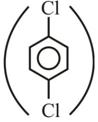
(a) B and E only (b) C only

(c) C and D only (d) A and D only

(e) A and D only

Kerala-CEE-2006

Ans. (a) : CCl_4 and 1, 4 dichlorobenzene



have symmetrical geometry so, its net dipole moment is zero. But is case of $CHCl_3$, CH_3Cl and CH_2Cl_2 molecule having non-zero dipole moment due to their distorted geometry.

741. The molecule which does not exhibit dipole moment is:

(a) NH_3 (b) $CHCl_3$

(c) H_2O (d) CCl_4

UPTU/UPSEE-2006

Ans. (d) : CCl_4 molecule does not exhibit dipole moment due to symmetric tetrahedral geometry. While NH_3, $CHCl_3$ and H_2O molecules have distorted geometry therefore they possess some dipole moment.

742. Assertion (A) : The spin only magnetic moment of Sc^{3+} is 1.73 BM.

Reason (R) : The spin only magnetic moment (in BM) of an ion is equal to $\sqrt{n(n+2)}$, where n is the number of unpaired electrons present in the ion.

The correct answer is:

(a) both (A) and (R) are true and (R) is the correct explanation of (A)

(b) both (A) and (R) are true and (R) is not the correct explanation of

(c) (A) is true but (R) is not true

(d) (A) is not true but (R) is true

AP-EAMCET (Engg.)-2005

Ans. (d) : The given metal is Sc^{3+}.

Electronic configuration of Sc = [Ar], $3d^1$, $4s^2$

For Sc^{3+} = [Ar], 3d°, 4s°

Number of unpaired electron = 0

$$\therefore \quad \mu_s=\sqrt{n(n+2)}$$

$$\mu_s=\sqrt{0(0+2)}$$

$$\mu_s=0$$

The formula for spin only magnetic moment is $\sqrt{n(n+2)}$, where n is the number of unpaired electron.

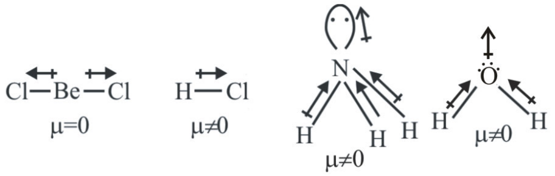
743. Which of the following molecules has zero dipole moment?

(a) $BeCl_2$ (b) HCl

(c) NH_3 (d) H_2O

AP-EAMCET (Engg.)-2005

Ans. (a) : The species are given as : $BeCl_2$, HCl, NH_3 and H_2O.



Hence, $BeCl_2$ has zero dipole moment.

744. If the molecule of HCl were totally polar, the expected value of dipole moment is 6.12D (debye), but the experimental value of dipole moment was 1.03D. Calculate the percentage ionic character:

(a) 17 (b) 83

(c) 50 (d) zero

(d) 90

Kerala-CEE-2005

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Ans. (a) : % Ionic character = $\frac{\mu_{\text{experimental}}}{\mu_{\text{ expected}}} \times 100$

% Ionic character = $\frac{1.03}{6.12} \times 100$

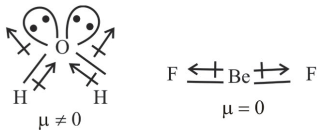
= 16.83% ≈17%

745. H_2O is dipolar, whereas BeF_2 is not. It is because

(a) the electronegativity of F is greater than that of O
(b) H_2O involves hydrogen bonding whereas BeF_2 is a discrete molecule
(c) H_2O is linear and BeF_2 is angular
(d) H_2O is angular and BeF_2 is linear

NEET-2004

Ans. (d) :



H_2O has angular shape therefore its resultant dipole moment is greater than zero. H_2O is dipolar molecule, but BeF_2 molecule has linear shape therefore, its resultant dipole moment zero. So BeF_2 is non-polar molecule.

746. Which of the following are arranged in the decreasing order of dipole moment?

(a) CH_3C1,CH_3Br,CH_3F
(b) CH_3C1,CH_3F,CH_3Br
(c) CH_3Br,CH_3C1,CH_3F
(d) CH_3 Br, CH_3F,CH_3C1

AIIMS-2003

Ans. (b): : Dipole moment = Charge × Bond length

$\xrightarrow{\text{C–F} \qquad \text{C–Cl} \qquad \text{C–Br}}$

On moving left to right bond length increases while charge density decreases. Therefore, decreasing order of dipole moment.

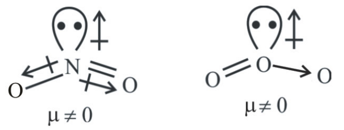
$CH_3Cl > CH_3F > CH_3Br$

747. Which one of the following pairs of molecules will have permanent dipole moments for both members?

(a) SiF_4 and NO_2
(b) NO_2 and CO_2
(c) NO_2 and O_3
(d) SiF_4 and CO_2

AIEEE-2003

Ans. (c) : NO_2 and O_3 molecule will have permanent dipole moment because both the molecule having some resultant non-zero dipole moment.

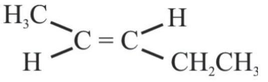


748. The only molecule having dipole moment is

(a) 2,2-dimethylpropane
(b) trans-2-pentene
(c) trans-3-hexene
(d) 2,2,3,3-tetramethylbutane

J & K CET-2003

Ans. (b) : 2, 2 - dimethylpropane, trans-3-hexene and 2, 2,3,3 - tetramethylbutane molecules having zero dipole moment because of their symmetric geometry but trans - 2 - pentene is non symmetric geometry and having some net dipole moment.



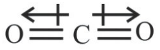
μ ≠ 0

749. In which of the following, the dipole moment is zero?

(a) H_2O_2
(b) CO_2
(c) SO_2
(d) NH_3

JCECE-2003

Ans. (b): CO_2 molecule has zero dipole moment because both oxygen atom symmetrically present around carbon atom and form linear geometry.



μ = O

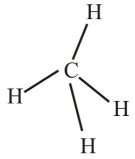
But in case of H_2O_2, SO_2 and NH_3 molecule have some dipole moment.

750. The molecule having largest dipole moment among the following is

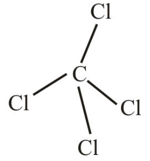
(a) CHI_3
(b) CH_4
(c) $CHCl_3$
(d) CCl_4

UP CPMT-2003

Ans. (c) : Dipole moment is a vector quantity.
Dipole moment = charge on any one atom × bond length
∵ The compounds having regular geometry and having bonds of same type have zero dipole moment.
∴ CH_4 and CCl_4 have zero dipole moment



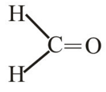
CH_4

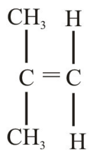


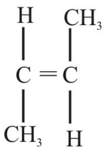
CCl_4

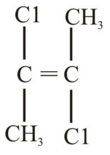
Between CHI_3 and $CHCl_3$, $CHCl_3$ will have larger dipole moment because the electro negativity difference between carbon and chlorine is more as compared to between carbon and iodine
∴$CHCl_3$ will have highest dipole moment.

751. Which of the following has the highest dipole moment?

(a)


(b)


(c)


(d)


AIIMS-2002

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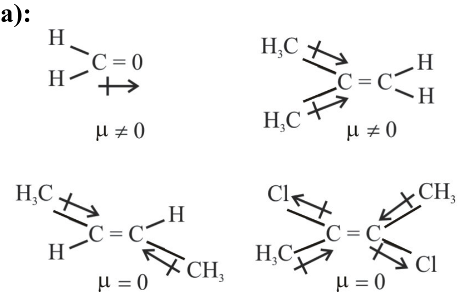
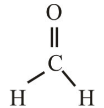
Ans. (a):



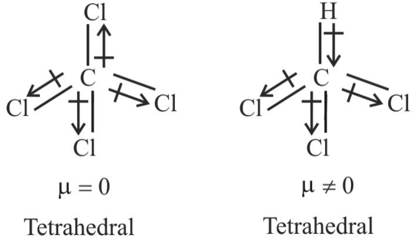
In  molecule, oxygen has more electronegative and therefore molecule having highest dipole moment.

752. CHCl$_3$ is a polar solvent while CCl$_4$ is a non-polar solvent because CCl$_4$ has

(a) linear structure
(b) symmetrical structure
(c) unsymmetrical structure
(d) square planar structure.

J & K CET-(2019)

Ans. (b) : CCl$_4$ is a non-polar solvent because CCl$_4$ has symmetrical structure, i.e., all chlorine atoms around carbon atoms are identical. But in CHCl$_3$ molecules atoms around the carbon atom is non - identical. So, CHCl$_3$ is a polar solvent.



753. Dipole-dipole interaction energy between stationary polar molecule separated by a distance 'r' is proportional to

(a) 1/r	(b) $1/r^2$
(c) $1/r^3$	(d) $1/r^6$

Assam CEE-2019

Ans. (c) : Dipole-dipole interaction energy between polar molecules in solids depends on the distance between them as per following = $\frac{1}{r^3}$

(r= radius on the molecule under consideration)

754. Which of the following possess net dipole moment?

(a) SO$_2$	(b) BF$_3$
(c) BeCl$_2$	(d) CO$_2$

Karnataka-CET-2019

Ans. (a) : Molecules having regular geometry have zero dipole moment and those having distorted geometry having dipole moment.

BF$_3$, BeCl$_2$ and CO$_2$ have regular geometry therefore having zero dipole moment.

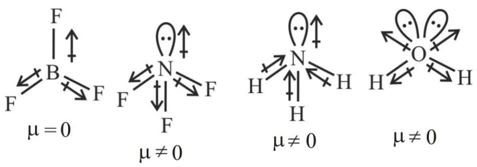
But SO$_2$ has distorted geometry therefore it possess net dipole moment.

755. Which of the following is the correct order of dipole moment?

(a) $NH_3 > BF_3 < NF_3 < H_2O$
(b) $BF_3 < NF_3 < NH_3 < H_2O$
(c) $BF_3 > NH_3 < NF_3 < H_2O$
(d) $H_2O > NF_3 < NH_3 < BF_3$

NEET-Odisha-2019

Ans. (b) : The given species are NH$_3$, NF$_3$, H$_2$O, BF$_3$



As we know that oxygen has more electronegativity than nitrogen due to which more polarity present in O – H bond. Oxygen has two lone pair also increase the overall polarity. Thus H$_2$O has more polar than NH$_3$ and NF$_3$ molecules.

In case of NH$_3$ and NF$_3$ molecules, NH$_3$ has more polar than NF$_3$ because in NH$_3$ resultant dipole moment in same direction BF$_3$ has regular triangular planar geometry. So, it has zero dipole moment. Then the correct orders of dipole moment is :-

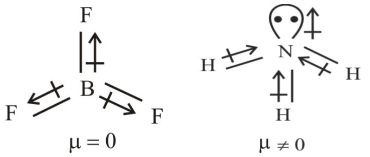
$BF_3 < NF_3 < NH_3 < H_2O$

756. Which have correct order of dipole moment:

(a) $SO_2 > H_2O$	(b) $NF_3 > NH_3$
(c) $BF_3 < NH_3$	(d) $SO_2 < SO_3$

AIIMS-27.05.2018 (M)

Ans. (c):



In case of BF$_3$ atoms around the 'B' atom are similar so BF$_3$ molecule has zero dipole moment but in NH$_3$ molecule, atoms around 'N' atom is non-identical and has highest dipole moment than BF$_3$.

757. Which bond is most polar?

(a) F—F	(b) I—F
(c) Cl—F	(d) Br—F

AMU-2002

Ans. (b) : I–F has more polar bond due to the more electro negativity difference between them.

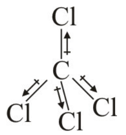
2.5 4.0
I — F
$\Delta X_{I-F} = 1.5$

758. The molecule having zero dipole moment is :

(a) CHCl$_3$	(b) H$_2$O
(c) CCl$_4$	(d) HCl

AP-EAMCET-1999

Ans. (c): Symmetric molecules having with similar electronegative are non polar i.e. have zero dipole moment whereas, CHCl$_3$, H$_2$O and HCl are polar molecule.



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759. Which of the following molecules has the highest dipole moment?
(a) CO_2 (b) NF_3
(c) BCl_3 (d) CCl_4

AP-EAMCET-1995

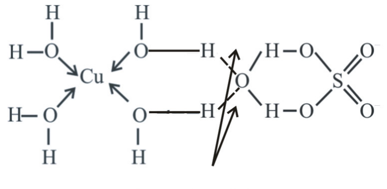
Ans. (b): In CO_2, BCl_3, CCl_4 all the molecule have zero dipole moment due to their symmetric geometry but NF_3 is non symmetric geometry and highest dipole moment.

7. Hydrogen Bonding

760. How many hydrogen bonded water molecules are present in $CuSO_4 \cdot 5H_2O$?
(a) 5 (b) 4
(c) 1 (d) 0

TS EAMCET 05.08.2021, Shift-I
NEET-Odisha 2019
SCRA-2015
AMU-2014
JIPMER-2013

Ans. (c): In $CuSO_4.5H_2O$ four water molecule are co-ordinated to Cu^{2+} and one is hydrogen bonded with SO_4^{2-}



Hydrogen bonded

761. Which of the following hydrogen bond is the strongest?
(a) $O-H\cdots N$ (b) $F-H\cdots F$
(c) $O-H\cdots O$ (d) $O-H\cdots F$

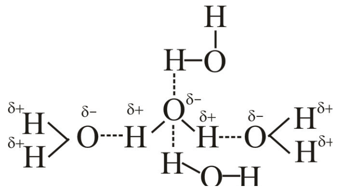
WB-JEE-2018, JCECE - 2009
AIIMS-1997

Ans. (b) : Strength of hydrogen bonding depends upon the electronegativity of elements. Therefore, F–H ---F show strongest hydrogen bond because fluorine is most electronegative atom.

762. The maximum number of hydrogen bonds that a molecule of water can have is
(a) 1 (b) 2
(c) 3 (d) 4

AP EAMCET (Engg.) 21.09.2020, Shift-I
Karnataka-CET, 2008
JCECE - 2006

Ans. (d) : One water molecule is joined to four water molecules – two with H-atoms and other two with O-atoms. Thus, the maximum number of hydrogen bonds that a molecule of water can have is four as shown below:



763. Strongest hydrogen bond is shown by
(a) water (b) ammonia
(c) hydrogen fluoride (d) hydrogen sulphide

NEET-1992, 1990

Ans. (c) : Strength of hydrogen bonding is depends on the electronegativity of atom. Higher the electro negativity , stronger the hydrogen bonding.
Since, fluorine is more electronegative atom and it forms stronger hydrogen bond.

764. The high boiling point of water is due to which reason?
(a) Coordinate bonding
(b) Covalent bond
(c) Electrostatic force of attraction
(d) Hydrogen bonding

UP CPMT-2003, AIIMS-1996

Ans. (d) : High boiling point of water is due to hydrogen bonding.
The compounds having oxygen or fluorine or nitrogen along with hydrogen forms hydrogen bond. Since they have strong forces of attraction, more heat is required to break them while we boil these liquids. So, they have high boiling point.

765. The dominant intermolecular force that must be overcome to convert liquid methanol to its vapour is__________.
(a) Covalent Bonds
(b) Dipole-Dipole Interactions
(c) Hydrogen Bonds
(d) Co-ordinate Bonds

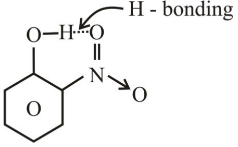
AP-EAMCET 25-08-2021 Shift-I
NEET-2009

Ans. (c) : In CH_3OH (methanol), intermolecular hydrogen bonding are found. Thus, H-bonding play an role overcome in converting liquid methanol to vapour.

766. Intra-molecular hydrogen bonding is found in
(a) o-nitrophenol (b) m-nitrophenol
(c) p-nitrophenol (d) phenol

AMU-2015, Kerala-CEE-2011

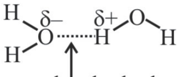
Ans. (a) : Intra-molecular hydrogen bonding is found in o-nitro phenol. For intra-molecular hydrogen bonding the two groups are close enough to each other and for five or six membered rings.



767. Inter-molecular hydrogen bonding exists in
(a) o-nitrophenol (b) o-chlorophenol
(c) water (d) ammonium chloride

UPTU/UPSEE-2015
J & K CET-(2007)

Ans. (c) : Intermolecular hydrogen-bonding takes place between H atom and electronegative element present in the different molecules of some substance.



intermolecular hydrogen bonding in water

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768. Given below are two statements: one is labelled as Assertion A and the other is labelled as Reason R.

Assertion A: Dipole-dipole interactions are the only non-covalent interactions, resulting in hydrogen bond formation.

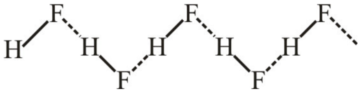
Reason R: Fluorine is the most electronegative element and hydrogen bonds in HF are symmetrical.

In the light of the above statements, choose the most appropriate answer from the options given below:

(a) Both A and R are true and R is the correct explanation of A
(b) Both A and R are true but R is NOT the correct explanation of A
(c) A is true but R is false
(d) A is false but R is true

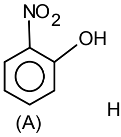
JEE Main 26.02.2021, Shift-I

Ans. (d) : In hydrogen bonding, Dipole-dipole interactions are non covalent but ion-dipole interaction can also result in H-bond formation. F is most electro negative element & structure is

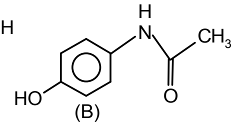


Symmetrical H-bonds are Present
Hence, Assertion is false and reason is true.

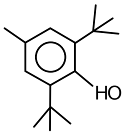
769. The compound/s which will show significant intermolecular H-bonding is/are



(A)



(B)

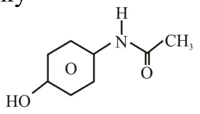


(C)

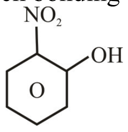
(a) (B) only (b) (C) only
(c) (A) and (B) (d) (A), (B) and (C)

(JEE Main 2021, 27 Aug. Shift-II)

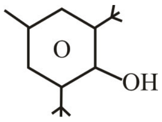
Ans. (a) : Only



will show intermolecular hydrogen bonding while



compound will show intramolecular hydrogen bonding and compound



does not show hydrogen bonding because of steric hindrance due to presence of bulkier group.

770. Which of the following is an incorrect statement?

(a) Hydrogen bonding is stronger than dispersion forces
(b) Sigma bonds are stronger than π-bonds
(c) Ionic bonding is non-directional
(d) σ-electrons are referred to as mobile electrons

Kerala-CEE-29.08.2021

Ans. (d) : (A) Hydrogen bonds are powerful force in determining the structure and properties of many compounds.

(B) Sigma bonds are formed by the head to head overlapping between two orbital whereas pi-bonds are formed by the lateral overlapping due to which sigma bond is stronger bond than pi-bond. Hence, the statement is true.

(C) This statement is true because ionic bonds are formed by the transfer of electron between two atom. Thus, transfer of electron are not depends upon the direction. Hence, we can say that ionic bond are non directional.

(D) This statement is false because π-electrons are referred to as mobile electrons.

771. Hydrogen bonding is not present in

(a) glycerine (b) water
(c) hydrogen sulphide (d) hydrogen fluoride.

J & K CET-(2017)

Ans. (c) : Sulphur is less electronegative than fluorine and oxygen atoms due to which hydrogen sulphide will not shows hydrogen bonding while water, hydrogen fluoride and glycerine will shows hydrogen bonding.

772. Which of the following compounds show hydrogen bonding?

(a) HCl (b) C_2H_6
(c) RCH_2CHO (d) RCH_2NHCH_3

Manipal-2016

Ans. (d) :RCH_2NHCH_3 compound will show hydrogen bonding because hydrogen is directly attached with more electronegative atom i.e. nitrogen.

773. Which one of the following compounds shows the presence of intramolecular hydrogen bond?

(a) H_2O_2
(b) HCN
(c) Cellulose
(d) Concentrated acetic acid

NEET-II, 2016

Ans. (c) : H_2O_2, HCN and concentrated CH_3COOH form intermolecular hydrogen bonding while cellulose has intra-molecular hydrogen bonding this is due to the fact that the glucose monomers form straight chains and thus its polymeric structure crowd together showing intra-molecular hydrogen bonding.

774. The molecular interactions responsible for hydrogen bonding in HF

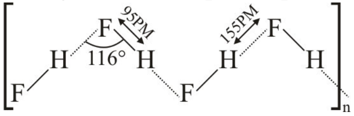
(a) ion-induced dipole (b) dipole-dipole
(c) dipole-induced dipole (d) ion-dipole

AP-EAMCET (Engg.) - 2014

Ans. (b) : A hydrogen bond is formed by a dipole-dipole force between an electronegative atom and a hydrogen atom that attaches covalently with another electronegative atom of the same molecule or of a different molecule. Only nitrogen, oxygen, and fluorine atoms can with hydrogen to form hydrogen bond.

@apna_pdf

Hence, the molecular interaction responsible for hydrogen bonding in HF are dipole-dipole interaction.

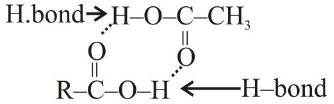


775. The pair of molecules forming strongest hydrogen bonds are

(a) HCOOH and CH_3COOH
(b) CH_3COCH_3 and $CHCl_3$
(c) H_2O and H_2
(d) SiF_6 and SiH_4

UPTU/UPSEE-2014

Ans. (a) : Formic acid (HCOOH) and acetic acid (CH_3COOH) forms strongest hydrogen bonding because they form two hydrogen bonds and having high polarity.



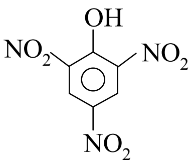
776. The polypeptides are obtained by assembling the peptide units by

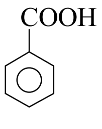
(a) ionic bond
(b) covalent bond
(c) intermolecular H-bonding
(d) covalent and H-bonding

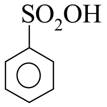
UPTU/UPSEE-2013

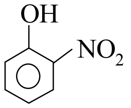
Ans. (c) : More than one polypeptide chains when assemble as a result of intermolecular hydrogen bonding between them, the polypeptide assume the secondary structure of proteins.

777. Which of the following is not soluble in sodium carbonate solution?

(a)


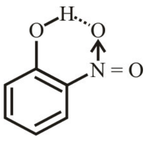
(b)


(c)


(d)


UP CPMT-2013

Ans. (d) : Picric acid (2,4,6-trinitro phenol), benzene sulphonic acid and benzoic acid are strong acids in nature and react with alkali sodium carbonate to form their salts, whereas in o-nitrophenol, —NO_2 and —OH groups are located exactly right for the formation of intramolecular hydrogen bond, therefore o-nitrophenol doesn't remove its —H atom and doesn't react with sodium carbonate solution.



Intra-molecular H-bond in o-nitrophenol

778. The hydrogen bonds are encountered in HF, H_2O, NH_3 and HF_2^-. The relative order of energies of hydrogen bonds is

(a) HF > H_2O > H_3N > HF_2^-
(b) H_2O > HF_2^- > HF > NH_3
(c) HF > HF_2^- > H_2O > NH_3
(d) HF_2^- > HF > H_2O > NH_3

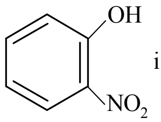
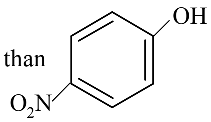
AMU-2012

Ans. (d) : The strength or energy of hydrogen bonding depends upon the electronegativity of atoms.

Order of electronegativity:- F^- > F > O > N

Order of energies of hydrogen bonds is :- HF_2^- > HF > H_2O > NH_3

779. The vapour pressure of

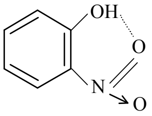
 is higher than 

due to

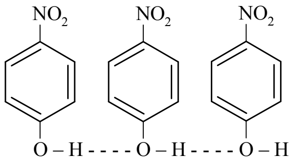
(a) Dipole moment
(b) Dipole-dipole interaction
(c) H-bonding
(d) Lattice structure

BITSAT-2012

Ans. (c) : Ortho-nitrophenol has intramolecular H-bonding



and para-nitrophenol has intermolecular H-bonding.



Hence former is more volatile than latter.

780. Hydrogen molecule differs from chlorine molecule in the following respect.

(a) Hydrogen molecule is non - polar but chlorine molecule is polar
(b) Hydrogen molecule is polar while chlorine molecule is non-polar
(c) Hydrogen molecule can form intermolecular hydrogen bond but chlorine molecule does not
(d) Hydrogen molecule cannot participate in coordinate bond formation but chlorine molecule can

JIPMER-2012

Ans. (d) : Chlorine has a lone pair of electron and vacant d-orbitals, thus they can take part in coordinate bond but hydrogen molecule does not have a lone pair of electrons so, it will not take part in the coordinate bond.

@apna_pdf

781. Among water molecules, the type of bond present between H and O is

(a) hydrogen bond (b) electrovalent bond
(c) coordinate bond (d) covalent bond

UP CPMT-2012

Ans. (a) : Oxygen atom of each H_2O molecule is covalent linked with two H-atoms of its own molecule and with another H-atom of adjacent H_2O molecules by H-bonding.

782. Intermolecular hydrogen bonding is strongest in

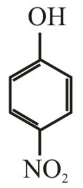
(a) HCHO (b) CH_3OH
(c) C_6H_5OH (d) CH_3NH_2

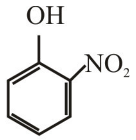
UPTU/UPSEE-2012

Ans. (b) : Hydrogen bond is found in a compound in which hydrogen bond is directly attached to a highly electronegative elements such as fluorine, oxygen and nitrogen. In HCHO the hydrogen atom is not directly attached to an oxygen atom. Thus, will show very less hydrogen bonding, while in case of CH_3NH_2, CH_3OH and C_6H_5OH, CH_3OH will show strongest hydrogen bonding because hydrogen is directly attached with more electronegative oxygen atom.

In C_6H_5OH compound strength of hydrogen bonding reduces due to the presence of bulky phenyl ($–C_6H_5$) group.

783. Out of the given two compounds, the vapour pressure of B at a particular temperature is

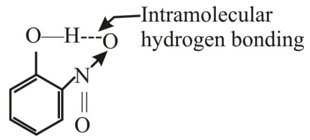

(A)


(B)

(a) higher than that of A
(b) lower than that of A
(c) higher or lower than A depending on the size of the vessel
(d) same as that of A

Karnataka-CET-2011

Ans. (a) : Vapour pressure of o-nitrophenol is more than vapour pressure of p-nitrophenol due to the intramolecular hydrogen bonding. As a results, it is more volatile.



o-nitrophenol

784. The low density of ice compared to water is due to

(a) induced dipole-induced dipole interactions
(b) dipole-induced dipole interactions
(c) hydrogen bonding interactions
(d) dipole-dipole interactions

JCECE-2010

Ans. (c) : Hydrogen bonding interactions are responsible for the low density of ice as compared to water.

785. Two ice cubes are pressed over each other until they unite to form one block. Which one of the following forces dominates for holding them together?

(a) Dipole-dipole interaction
(b) Van der waals' forces
(c) Hydrogen bond formation
(d) Covalent attraction

BITSAT-2008

Ans. (c) : Two ice cubes are pressed over each other until they unite to form one block. It is due to H-bonding.

786. Unusually high b.p. of water is result of

(a) Intermolecular hydrogen bonding
(b) Intramolecular hydrogen bonding
(c) both intra & intermolecular hydrogen bonding
(d) High specific heat

WB-JEE-2008

Ans. (a) : High boiling point of water is due to formation of four intermolecular hydrogen bonding, since they have strong force of attraction, more heat is required to break them while boiling these liquids. So, it has high boiling point.

787. H-bond is not present in :

(a) water (b) glycerol
(c) hydrogen fluoride (d) hydrogen sulphide

BCECE-2005

Ans. (d) : Sulphur is less electronegativity than fluorine and oxygen due to which H_2S do not show the hydrogen bonding while H_2O, HF and glycerol shows hydrogen bonding.

788. Which of the following does not have the hydrogen bond?

(a) Phenol (b) Liquid NH_3
(c) Water (d) Liquid HCl

CG PET-2005

Ans. (d) : Chlorine is less electronegativity than fluorine, oxygen and nitrogen due to which liquid HCl not show hydrogen bonding. H_2O, phenol and liquid NH_3 show hydrogen bonding.

789. H-bond is strongest in

(a) C_2H_5OH (b) $H – F$
(c) H_2O (d) CH_3COCH_3

JIPMER-2005

Ans. (b) : Strength of hydrogen bonding will depends upon the electronegativity of atom. Greater the electronegative atom, greater the hydrogen bonding strength. Therefore, fluorine has highest electronic activity and form strongest hydrogen bond in HF molecule.

790. Which of the following compounds in liquid state does not have hydrogen bonding?

(a) H_2O (b) HF
(c) NH_3 (d) C_6H_6

CG PET-2004

Ans. (d) : In benzene molecule, electronegativity difference between C–H bond is less therefore molecule behaves as non-polar and does not show hydrogen bonding. But H_2O, HF and NH_3 shows hydrogen bonding because F, O and N atom are highly electronegative.

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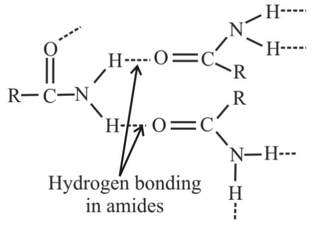
791. Assertion: Boiling and melting points of amides are higher than corresponding acids.
Reason: It is due to strong intermolecular hydrogen bonding in their molecules.

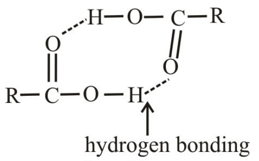
(a) If both Assertion and Reason are correct and the Reason is correct explanation of the Assertion.
(b) If both Assertion and Reason are correct but Reason is not a correct explanation of the Assertion.
(c) If the Assertion is correct but Reason is incorrect.
(d) If both the Assertion and Reason are incorrect.
(e) If the Assertion is incorrect but the Reason is correct.

AIIMS-2002

Ans. (a): In case of amide 2 N – H bonds are present. So, amides are doing more intermolecular H-bonding due to this force of attraction between the molecules, increases and that's why boiling and melting point increase. While in case of acids only 1 O – H bond is present. So, less intermolecular hydrogen bonding is formed due to this boiling and melting points of acids decreases.



Hydrogen bonding in amides



hydrogen bonding in acids

792. In which of the following substances, hydrogen bonding is absent?

(a) HF (b) H_2O
(c) CCl_4 (d) Salicylaldehyde

AP-EAMCET (Medical), 2001

Ans. (c) : Chlorine has less electronegativity value than fluorine due to which they do not show the hydrogen bonding.

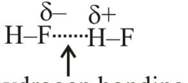
- HF, H_2O and salicylaldehyde shows hydrogen bonding.

793. The predominant intermolecular forces in HF is due to

(a) dipole-induced dipole interaction
(b) hydrogen bond formation
(c) dispersion interaction
(d) dipole-dipole interaction

J & K CET-(2000)

Ans. (b) : Intermolecular forces in HF is due to formation of hydrogen bonding.



hydrogen bonding in HF.

794. Which one of the following values could be used to estimate the strength of a hydrogen bond in water?

(a) strength of an O – H bond in H_2O
(b) heat evolved when one mole of H_2O is formed from its elements
(c) enthalpy change of vapourisation of water
(d) the melting point of ice

J & K CET-(1998)

Ans. (c) : Water forms a hydrogen bonding in its molecule. Due to hydrogen bonding, the electrostatic force of attraction in the molecules become large. Hence, its boiling point is high because large energy is required to separate these molecules. Hence enthalpy changed value of vapourisation of water could be used to estimate the strength of a hydrogen bonding in water.

795. Assertion: Ionic compounds tend to be non-volatile.
Reason: The inter-molecular forces in these compounds are weak.

(a) If both Assertion and Reason are true and the Reason is a correct explanation of the Assertion.
(b) If both Assertion and Reason are true but Reason is not a correct explanation of the Assertion.
(c) If Assertion is true but the Reason is false
(d) If both Assertion and Reason are false

AIIMS-1994

Ans. (c): Intermolecular forces (i.e., electrostatic forces) in ionic compounds are strong thus they form big crystal lattices and are non-volatile. Thus, only assertion is true but reason is false.

796. Methanol and ethanol are miscible in water due to

(a) covalent character
(b) hydrogen bonding character
(c) oxygen bonding character
(d) none of the above

JIPMER-2008
JCECE - 2007

Ans. (b) : Methanol and ethanol contain polar covalent O–H bond. Hence, they form hydrogen bonding with water due to this they are miscible in water.

797. H_2O is liquid while H_2S is a gas due to

(a) covalent bonding
(b) molecular attraction
(c) H-bonding
(d) both H-bonding and molecular attraction

UPTU/UPSEE-2008
JIPMER-2005

Ans. (c) : H_2O contains intermolecular hydrogen bond, due to this it exist as liquid while H_2S does not containing intermolecular hydrogen bond, it contains weak van der Waal forces. So it exist as gas.

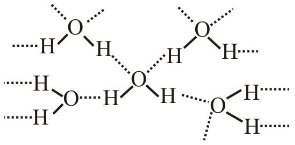
@apna_pdf

798. The boiling point of the water is higher than liquid HF. The reason is that

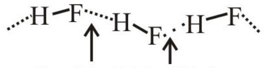
(a) Hydrogen bonds are stronger in water
(b) Hydrogen bonds are stronger in HF
(c) Hydrogen bonds are larger in number in HF
(d) Hydrogen bonds are larger in number in water

WB-JEE-30.04.2022

Ans. (d) : One water molecule forms four intermolecular hydrogen bonds while one hydrogen fluoride forms two intermolecular hydrogen bonds, Thats why, boiling point of the water is higher than liquid HF.



One H_2O molecule will form four H-bonds.



One liquide HF will form two H-bonds

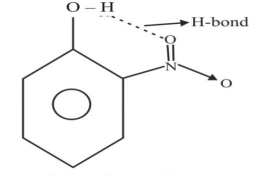
799. The correct option among the following about hydrogen bonding is

a) Hydrogen bond strength increases with the decrease of electronegativity of the atom connected to hydrogen
b) Hydrogen bonding involves more than two atoms
c) In general, intramolecular hydrogen bonding forms through five or six membered rings
d) Hydrogen bonding is an electrostatic force

(a) A and B (b) B and C
(c) A and C (d) C and D

TS EAMCET 10.08.2021, Shift-II

Ans. (d) : (a) Hydrogen bond strength increases with the increase of electronegative of the atom connected to hydrogen.
(b) As a result of hydrogen bonding, a hydrogen atoms links the two electronegative atoms simultaneously.
(c) In intramolecular species, H – bonding forms through five or six membered rings.



(o-nitro phenol)

(d) Hydrogen bonding is an electrostatic force. Hence, the statement is true.

800. Match the following

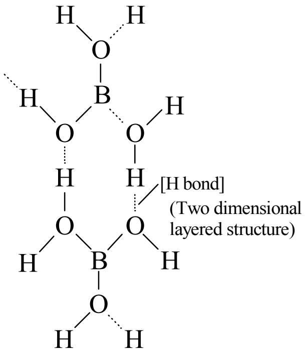
List-I Compound	List-II Physical/Chemical property/name/structure
A. H_3BO_3	**I. Dimeric form**
B. $AlCl_3$	**II. Back bonding**
C. $B_3N_3H_6$	**III. Hydrogen bonding**
D. BF_3	**IV. Inorganic benzene**

The correct match is

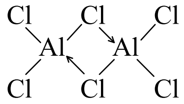
	A	B	C	D
(a)	I	II	III	IV
(b)	III	II	IV	I
(c)	III	I	II	IV
(d)	III	I	IV	II

TS-EAMCET (Engg.), 06.08.2021

Ans. (d):
Compound-Physical/Chemical property/name/structure
(a) H_3BO_3 - Hydrogen bonding

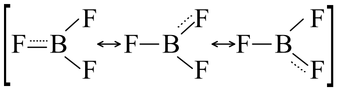


(b) $AlCl_3$ - Dimeric form



(Al_2Cl_6)

(c) $B_3N_3H_6$ - Inorganic benzene
(d) BF_3 - Back bonding



801. When hydrogen bond is formed between two molecules, it is called:

(a) intra-molecular H-bond
(b) intermolecular H-bond
(c) directional H-bond
(d) Both (b) and (c)

AP-EAMCET-1993

Ans. (b): Intermolecular hydrogen bond is formed between two molecules while intramolecular hydrogen bond is formed within the same molecule. The example of intermolecular H-bonding is H_2O whereas o-nitro phenol has intramolecular H-bonding.

802. In which of the following compounds is hydrogen bonding strongest in liquid phase?

(a) HF (b) CH_4
(c) HI (d) PH_3

AP-EAMCET-1993

Ans. (a): HF molecule has highest dipole character. Hence, the HF has strongest hydrogen bonding in liquid phase.

803. Water has a higher boiling point than corresponding hydrides H_2S, H_2Se and H_2Te. This is because of:

@apna_pdf

(a) angular structure of water
(b) presence of lone pair of electrons in H_2O
(c) presence of intra-molecular H-bonding in water
(d) presence of intermolecular H-bonding in water

AP-EAMCET-1991

Ans. (d): Water has a higher boiling point than corresponding hydrides i.e. H_2S, H_2Se, H_2Te. This is because of presence of intermolecular H-bonding in water.

804. Which of the following hydrogen bonds are strongest in vapour phase?

(a) HF…………HF	(b) HF…………HCl
(c) HCl…………HCl	(d) HF…………HI

AIEEE 2007

Ans.(a): The hydrogen bond in HF is strongest because fluorine is the most electronegative element hence form strongest hydrogen bond.

805. Which of the following can form H–bond?

(a) NH_3	(b) R–CN
(c) R–O–R	(d) R–Br

VITEEE 2003

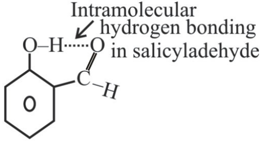
Ans. (a) : Only NH_3 molecule will show hydrogen bonding because it is polar in nature and having high electro negativity difference. But in case of R–CN, R–O–R and R–Br and non-polar or less polar and also having low electronegativity difference.

806. Intra-molecular hydrogen bonding is formed in

(a) H_2O_2	(b) salicyladehyde
(c) NH_3	(d) benzophenone

KCET 2013

Ans. (b) : Intramolecular hydrogen bond is formed within the same molecule when two groups are enough close to each other and form five or six member ring after hydrogen bonding. Therefore, only salicylaldehyde shows intermolecular hydrogen bonding.



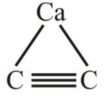
8. Ionic, Covalent and Coordinate Bonding

807. The number and type of bonds between two carbon atoms in CaC_2 are

(a) One σ bond and one π bond
(b) One σ bond and two π bonds
(c) One σ bond only
(d) One σ and one δ bond

WB JEE-2016, SCRA - 2014, AIEEE-2011

Ans. (b) : The molecular formula of calcium carbide is CaC_2. The Structure of CaC_2 is:



Triple bond are formed between two carbon atom. Hence, one sigma and two pi-bonds are present.

808. Which of the following is not correct regarding the properties of ionic compounds?

(a) Ionic compounds have high melting and boiling points
(b) Their reaction velocity in aqueous medium is very high
(c) Ionic compounds in their molten and aqueous solutions do not conduct electricity
(d) They are highly soluble in polar solvents

UPTU/UPSEE-2010
CG PET -2008
AP-EAMCET-2004

Ans. (c): Ionic compounds in their molten and aqueous solution are a good conductor of electricity. However, they are bad conductor in solid state.

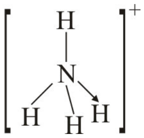
- Ionic compound has high melting and boiling point due to strong bond length.
- The mobility of ions is very fast in aqueous solution.
- The ionic compounds are very soluble in polar solvent due to electrostatic attraction between two opposite charge of the aqueous solution and salts.

809. Which of the following contains a coordinate covalent bond?

(a) H_2O	(b) NH_3
(c) NH_4^+	(d) C_2H_4

COMEDK-2011
AP-EAMCET-1993

Ans. (c): Co-ordinate bond is also a type of covalent bond in which sharing of electron given by only one atom. In NH_4^+, N is the donor atom whereas H atom is the acceptor atom. Thus, NH_4^+ has a coordinate covalent bond.

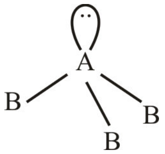


810. A covalent molecule AB_3 has pyramidal structure. The number of lone pair and bond pair electrons in the molecule are respectively

(a) 0 and 4	(b) 3 and 1
(c) 1 and 3	(d) 2 and 2

COMEDK-2018
Karnataka-CET, 2009

Ans. (c) : In general, a compound with formula AB_3 is sp^2 hybridised with triangular planar geometry. However, the given compound has pyramidal structure which is possible only when it has a lone pair of electrons. Thus, AB_3 has 3 bond pairs and one lone pair. The hybridisation of AB_3 molecule with one lone pair is sp^3.



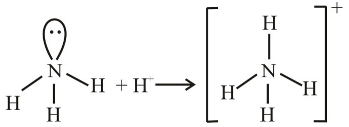
811. Which one of the following has a coordinate bond?

(a) NH_4Cl	(b) $AlCl_3$
(c) NaCl	(d) Cl_2

JIPMER-2012
Karnataka-CET, 2009

@apna_pdf

Ans. (a) : NH_4Cl forms coordinate bond.



$$NH_4^+ + Cl^- \rightarrow NH_4Cl$$

Lone pair of nitrogen is donated to H^+ ion and formed coordinate bond.

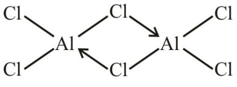
812. The sum of the number of dative bonds present in all the given species are

Al_2Cl_6, $Al(H_2O)_6$, CO, NH_4^+

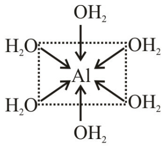
(a) 5 (b) 7
(c) 8 (d) 10

TS EAMCET 10.08.2021, Shift-II

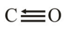
Ans. (d) : A co-ordinate covalent or dative bond is a covalent bond that forms when both electrons come from the same atom. The given species are Al_2Cl_6, $[Al(H_2O)_6]^{3+}$, CO and NH_4^+.



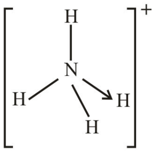
2- dative bond



6- dative bond



1- dative bond



1- dative bond

There are 10 dative bond present in given species.

813. A hard substance melts at high temperature and is an insulator in both solid and in molten state. This solid is most likely to be a/an

(a) ionic solid (b) molecular solid
(c) metallic solid (d) covalent solid

(JEE Main 2021, 18 March Shift-II)

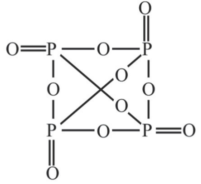
Ans. (d) : Covalent solids having high melting points and act as insulator in both solid and in molten state due to absence of free electrons in covalent solid.

814. Number of different bonds present in P_4O_{10} is ....

(a) 8 P–O bonds and 4 P = O bonds
(b) 12 P–O bonds and 3 P = O bonds
(c) 12 P–O bonds and 4 P = O bonds
(d) 8 P–O bonds and 3 P = O bonds

AP EAMCET (Engg.) 18.09.2020, Shift-I

Ans. (c) : Phosphorus pentaoxide is a chemical compound with molecular formula P_4O_{10}. This white crystalline solid is the anhydride of phosphoric acid. It is a powerful desiccant and dehydrating agent. The structure of P_4O_{10} is given as –



Number of
P—O bonds = 12
P = O bonds = 4

815. Which bond in a molecule of ethyl magnesium bromide is ionic in nature?

(a) C — C bond (b) C — Mg bond
(c) Mg — Br bond (d) C — H bond

MHT CET-03.05.2019, Shift-I

Ans. (c) : In ethyl magnesium bromide, the nature of Mg–Br bond is ionic because of the higher eletronegative difference between them. In other words, magnesium is metal and bromine is non-metal and the combination of these two gives rise to an ionic compound named magnesium bromide.

816. Which of the following compounds contain (s) no covalent bond (s) ?

KCl, PH_3, O_2, B_2H_6, H_2SO_4

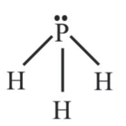
(a) KCl, B_2H_6, PH_3 (b) KCl, H_2SO_4
(c) KCl (d) KCl, B_2H_6

JEE Main-2018

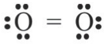
Ans. (c) :

$$K \xrightarrow{\text{losses } e^-} K^+ \qquad Cl \xrightarrow{\text{gains } e^-} Cl^-$$

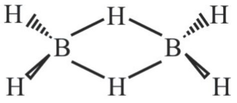
So, KCl forms ionic bond not covalent bond.



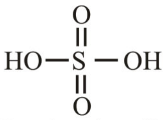
Covalent bonding in PH_3



Covalent bonding in O_2



Covalent bonding in B_2H_6



Covalent bonding in H_2SO_4

817. Which of the following is not a conductor of electricity?

(a) Solid NaCl (b) Cu
(c) Fused NaCl (d) Brine solution

Karnataka-CET-2018

Ans. (a) : In solid state, no unpaired electrons are present in molecule. So they does not conduct electricity. Therefore , solid NaCl does not having unpaired electron which helps in conduction of electricity. So solid NaCl is not a conductor of electricity.

818. Maximum number of covalent bonds formed by N and P are

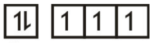
(a) 3, 5 (b) 3, 6
(c) 3, 4, 5 (d) 3, 4, 6
(e) None of these

Kerala-CEE-2018

Ans. (a) : N and P belongs to the same group of elements of periodic table. It contains the five valence electron on valence shell

$${}_7N = 1s^2, 2s^2, 2p^3$$

Ground state



2s

Hence, nitrogen can form three bonds in ground state.

$${}_{15}P = [Ne]3s^2, 3p^3, 3d^0$$

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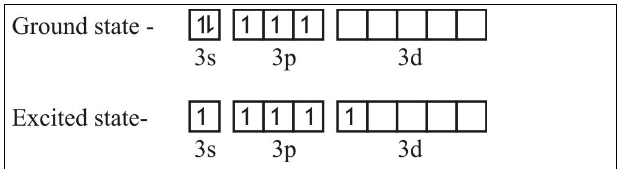


Here, P can form five bond in excited state. Hence, the correct option is (a).

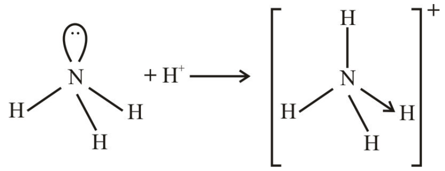
819. **NH$_3$ molecule attract H$^+$ ion towards itself to form ammonium ion (NH$_4^+$) through**

(a) electrovalent bond (b) metallic bond

(c) co-ordinate bond (d) hydrogen bonding

BCECE-2017

Ans. (c) : NH$_3$ molecules forms NH$_4^+$ ion by forming coordinate bond with H$^+$ ion.



820. **Select the most appropriate statement in BF$_3$**

(a) All the bonds are completely ionic

(b) The B-F bond is partially ionic.

(c) B-F bond has partial double bond character.

(d) Bond energy and bond length data indicates single bond character of the B-F bond.

(e) All the bonds are covalent.

Kerala-CEE-2017

Ans. (e) : BF$_3$ has three B–F bond in own structure. The hybridisation of boron in BF$_3$ is sp^2. Boron contains the three valence electron which is share with the fluorine atom and the covalent bond formed. Boron completes its octet by back -bonding making B–F bond partial double bond.

821. **Which of the following is covalent?**

(a) NaCl (b) KCl

(c) BeCl$_2$ (d) MgCl$_2$

(e) CaCl$_2$

Kerala-CEE-2017

Ans. (c) : BeCl$_2$ has covalent character because the electronegativity difference between Be & Cl is very less whereas NaCl, MgCl$_2$, KCl and CaCl$_2$ are the salt of alkali and alkaline earth metal.

822. **An ionic compound is**

(a) SnCl$_2$ (b) CCl$_4$

(c) GeCl$_4$ (d) SiCl$_4$

JCECE-2016

Ans. (a) : In p-block members, as we move down the group, lower positive oxidation state (+2) is more stable and ionic character increases due to inert pair effect. Hence, SnCl$_2$, i.e. (Sn = +2), is ionic in nature.

823. **Anhydrous mixture of KF and HF contain which types of ions?**

(a) K$^+$, H$^+$, F$^-$ (b) {KF$^+$, (HF$^-$)}

(c) KH$^+$, F$^-$ (d) K$^+$, HF$_2^-$

JIPMER-2016

Ans. (d) : KF and HF forms K$^+$[HF$_2$]$^-$ compound in anhydrous mixture. This is due to presence of hydrogen bonding between fluorine atom of KF and hydrogen atom of HF molecules.

$$KF+HF \rightarrow K^+[F^- \text{---} HF] \rightarrow K^+[HF_2]^-$$

Hydrogen
bonding

824. **HCl gas is covalent and NaCl is an ionic compound. This is because**

(a) sodium is highly electropositive

(b) hydrogen is a non-metal

(c) HCl is a gas

(d) electronegativity difference between H and Cl is less than 2.1

Karnataka-CET-2016

Ans. (d) : In HCl molecule the electronegativity difference between H and Cl atom is less so they act as covalent compound while in NaCl molecule the electronegativity difference in Na and Cl atom is high. Therefore, NaCl act as ionic compound.

825. **Which compound has electrovalent bond ?**

(a) H$_2$O$_2$ (b) CCl$_4$

(c) NaBr (d) CHCl$_3$

MPPET-2013

Ans. (c) : Electrovalent bond formed by transfer of e$^-$ and gain of e$^-$. After dissociation of electrovalent bond, opposite ion (cation and anion) are formed mostly. It is formed between non metal and metal.

$$Na-Br \longrightarrow Na^+ + Br^-$$

- H$_2$O$_2$, CCl$_4$ and CHCl$_3$ have the covalent bond because these bonds formed due to sharing of electron.

826. **Which one of the following statements about C$_2$ molecule is wrong?**

(a) The bond order of C$_2$ is 2

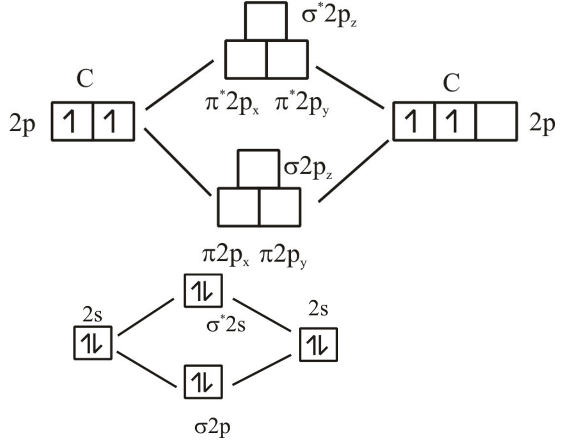
(b) In vapour phase, C$_2$ molecule is diamagnetic

(c) Double bond in C$_2$ molecule consists of both π-bonds because of the presence of 4e$^-$ in two π-molecular orbitals.

(d) Double bond in C$_2$ molecule consists to one σ-bond and one π bond

JIPMER-2013

Ans. (d) : According to MOT diagram of C$_2$ molecule double bond in C$_2$ molecule consist of both π–bonds no σ–bond is present.



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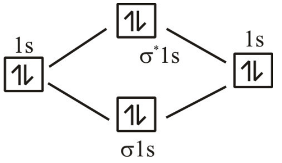


• Bond order $= \frac{1}{2}\left[e^-_B - e^-_{AB}\right]$

$$= \frac{1}{2}[4-0]$$

$$= 2$$

• All $4e^-$ are present in two π–molecular orbital so, it show the diamagnetic character.

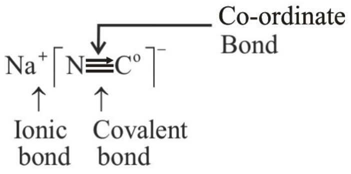
827. Which one of the following contains ionic, covalent and coordinate bonds?

(a) NaCl (b) NaCN

(c) NaNC (d) NaOH

Karnataka-CET-2012

Ans. (c) : NaNC contains ionic, covalent and coordinate type of bonding.



NaCN only shows ionic and covalent bonding.
NaCl and NaOH shows ionic bonding.

828. Which of the following is not a characteristic of a covalent compound?

(a) No definite geometry

(b) Insoluble in polar solvent

(c) Small difference in electronegativity between the combining atoms

(d) Low melting point

Karnataka-CET-2012

Ans. (a) : The covalent compound have some properties which is given below.
(i) The geometry of the covalent compound is definite.
(ii) Covalent compounds are in soluble in polar solvents.
(iii) The covalent bond formed in between two atom of covalent compound due to small difference of electronegativity.
(iv) The covalent compounds have low melting point rather than ionic compounds.

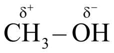
829. Which of the following dissolves in ionic solvents?

(a) C_6H_6 (b) CH_3OH

(c) CCl_4 (d) C_5H_{12}

MHT CET-2012

Ans. (b) : CH_3OH is the polar molecule which is dissolve in the polar solvent (ionic solvent).



$$\overset{\delta^+}{CH_3}-\overset{\delta^-}{OH}$$

C_6H_6, CCl_4 and C_5H_{12} are the non-polar molecule due to which they can not be dissolved in the polar solvent (e.g. H_2O).

830. CO is practically non-polar since

(a) the σ-electron drift from C to O is almost nullified by the π-electron drift from O to C

(b) the σ-electron drift from O to C is almost nullified by the π-electron drift from C to O

(c) the bond moment is low

(d) there is a triple bond between C and O

WB-JEE-2012

Ans. (a) : CO is the heterodiatomic molecule. It has the σ bond (sigma electron) and π-bond (π-electron). The polarity of this molecule is destroyed by the σ-electron drift from C to O and π-electron drift from O to C.

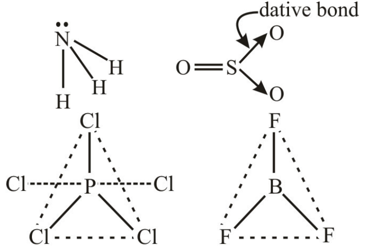
831. The dative bond is present in

(a) NH_3 (b) SO_3

(c) PCl_5 (d) BF_3

JCECE-2011

Ans. (b) : The structures of the given molecules are as-



Hence, SO_3 molecules contains co-ordinate or dative bonds.

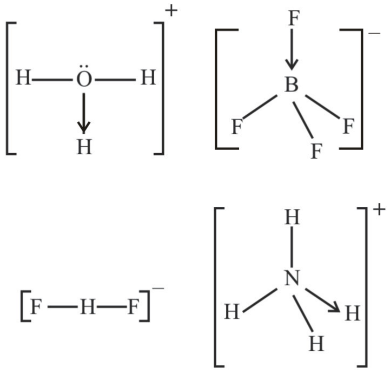
832. Which of the following does not contain any coordinate bond?

(a) H_3O^+ (b) BF_4^-

(c) HF_2^- (d) NH_4^+

MHT CET-2011

Ans. (c) :



Hence, HF_2^- does not contain the any type of Co-ordinate bond.

833. The compound which contains both ionic and covalent bond

(a) KCl (b) KCN

(c) CH_4 (d) H_2

BCECE-2010

Ans. (b) : KCN contains both ionic and covalent bond.

$$K^+C\equiv N^-$$

K^+ and CN^- forms ionic bond and C–N bond is covalent.

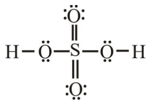
@apna_pdf

834. In the electronic structure of H_2SO_4, the total number of unshared electrons is

(a) 20 (b) 16
(c) 12 (d) 8

JIPMER-2010

Ans. (a)



No. of lone pair = 10

∴ No. of unshared e^- = 10×2 = 20 e^-

835. Which combination of atoms can form a polar covalent bond?

(a) H and H (b) H and Br
(c) N and N (d) Na and Br

UPTU/UPSEE-2009

Ans. (b) : The condition for a polar covalent bond is that the combining atom must have the low electronegativity difference not zero. Here, H–Br fulfills the condition and form the polar covalent bond.

$$H \leftrightarrows Br$$

- H and H & N and N forms the non-polar covalent bond because the electronegativity difference is zero.
- Na and Br forms the ionic bond.

836. The nature of the bond in diamond is

(a) ionic (b) covalent
(c) metallic (d) coordinate covalent

J & K CET-2008

Ans. (b) : Diamond forms covalent bond. In diamond only carbon atoms are present. Each carbon atom attached by 4 other carbon atoms through covalent bonds.

837. The number of covalent bonds in fluorine molecules is

(a) 2 (b) 3
(c) 1 (d) 5

J & K CET-2007

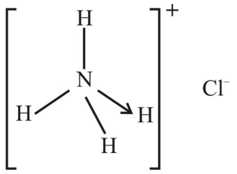
Ans. (c) : Fluorine molecules form one F–F covalent bond. Electronic configuration of F → $1s^2\ 2s^2\ 2p^5$
This show fluorine requires one more electron to complete it's octate. So, it forms only one covalent bond.

838. Which of the following contains both covalent and ionic bond ?

(a) CCl_4 (b) $CaCl_2$
(c) NH_4Cl (d) H_2O

MHT CET-2007

Ans. (c) : Ammonium chloride has ionic as well as covalent bond. Ionic bond formed between $[NH_4]^+$ and Cl^- whereas covalent co-ordinate bond formed between N→H.



- CCl_4 and H_2O are form the covalent bond whereas $CaCl_2$ has only ionic bond between own ion.

839. Which of the following combination will form an electrovalent bond?

(a) P and Cl (b) $NH_3$and BF_3
(c) H and Ca (d) H and S

UPTU/UPSEE-2005

Ans. (c) : The ionic bond formed between such type of element in which more electronegative difference present in between them. Here, Ca and H has the maximum electronegative difference. Hence it forms the electrovalent bond.

840. Ionic bonds are usually formed by combination of elements with

(a) high ionisation potential and low electron affinity
(b) low ionisation potential and high electron affinity
(c) high ionisation potential and high electron affinity
(d) low ionisation potential and low electron affinity

CG PET -2005

Ans. (b) : Ionic bonds are usually formed by combination of element which easily loose electrons i.e. low ionisation energy and element which easily takes electron i.e. having high electron affinity.

841. An example of a polar covalent compounds is:

(a) KCl (b) NaCl
(c) CCl_4 (d) HCl

JCECE-2005

Ans. (d) : KCl and NaCl are ionic compound because bond formed due to transfer of electron whereas CCl_4 and HCl are both covalent compound but one is polar and other one is non-polar. CCl_4 is the non-polar covalent compound because it's magnitude of polarity cancel to each other. Hence, HCl is the polar covalent compound.

842. When electric current is passed through an ionic hydride in molten state:

(a) hydrogen is liberated at anode
(b) hydrogen is liberated at cathode
(c) no change takes place
(d) hydride for migrates towards cathode
(e) hydride ion remains in solution

Kerala-CEE-2005

Ans. (a) : When electric current is passed through an ionic hydride in molten state then hydrogen gas liberated at anode.

$$M^+H^- \longrightarrow M^+ + \underset{\text{Hydride ion}}{H^-}$$

$$H^- \longrightarrow \frac{1}{2}H_2 + e^-\,(\text{At anode})$$

843. A covalent bond between two atoms is formed by which of the following?

(a) Electron nuclear attraction
(b) Electron sharing
(c) Electron transfer
(d) Electrostatic attraction

CG PET -2004

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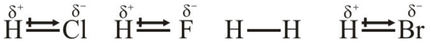
Ans. (b) : Covalent bond is a chemical bond that involves the sharing of electron pairs between atoms. These electron pairs, and the stable balance of attractive and repulsive forces between atoms, when they share electrons, is known as covalent bonding.

844. Identify the non-polar molecule in the set of compounds given:
HC*l*, HF, H_2, HBr

(a) H_2 (b) HC*l*
(c) HF, HBr (d) HBr

UPTU/UPSEE-2004

Ans. (a) : The species are given below-



H_2 is the non-polar molecule because the electronegative difference between H–H is zero. Hence, H_2 non-polar molecule.

845. Assertion: The O–O bond length in H_2O_2 is shorter than that of O_2F_2.
Reason: H_2O_2 is an ionic compound.

(a) If both Assertion and Reason are correct and the Reason is correct explanation of the Assertion.
(b) If both Assertion and Reason are correct but Reason is not a correct explanation of the Assertion.
(c) If the Assertion is correct but Reason is incorrect.
(d) If both the Assertion and Reason are incorrect.
(e) If the Assertion is incorrect but the Reason is correct.

AIIMS-2003

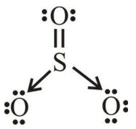
Ans. (d) : O – O bond length in O_2F_2 is less than H_2O_2 because in O_2F_2, highly electronegative fluorine atom attracts lone pair of oxygen that's why lone pair-lone pair repulsion in O–O bond decreases and O–O bond length is also decreases.

846. The number of S – S bonds in sulphur trioxide is

(a) Three (b) two
(c) one (d) zero

J & K CET-2003

Ans. (d) : There is zero S – S bond in sulphur trioxide (SO_3).

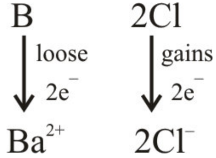


847. In which of the following ionic bond is present?

(a) BF_3 (b) CCl_4
(c) HCl (d) $BaCl_2$

JCECE-2003

Ans. (d) : In $BaCl_2$ compound, the electronegativity difference between Barium and Chlorine atom is high therefore only $BaCl_2$ forms ionic bond.

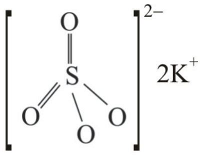


848. Which one of the following molecules contains both ionic and covalent bonds?

(a) CH_2Cl_2 (b) K_2SO_4
(c) $BeCl_2$ (d) SO_2

AP-EAMCET-2002

Ans. (b): K_2SO_4 molecule contains both ionic and covalent bonds.



849. Which of the following is the weakest bond?

(a) hydrogen bond (b) metallic bond
(c) ionic bond (d) covalent bond

J & K CET-2001

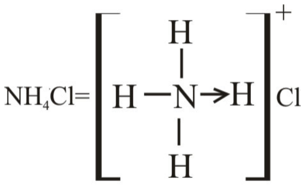
Ans. (a) : Hydrogen bonding is the weakest bond because it only formed by attraction between dipoles not formed a real bond.

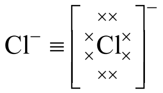
850. Which of the following molecule/ion has all the three types of bonds electrovalent, covalent and co-ordinate :

(a) HCl (b) NH_4Cl
(c) Cl^- (d) H_2O_2

BITSAT-2015

Ans. (b) : Bond structure of molecules are :
HCl = H – Cl





$H_2O_2 \equiv H – O – O – H$
Hence, from above structure it is clear that NH_4Cl molecule contains all three types bonds.

851. Consider the following with regard to water molecule :

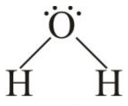
1. Non-polar covalent **2. Polar covalent**
3. σ bond **4. sp^3 hybridization**

Which of the above describe the bonding in water molecule?

(a) 2 and only (b) 1 and 4
(c) 2 and 3 only (d) 2, 3 and 4

SCRA-2014

Ans. (d) : Water molecule contains the two bond pair and two lone pair. H_2O is polar in nature because O–H bond are polar in nature. The hybridization of H_2O molecule is sp^3. There are two σ bond present.



(H_2O molecule)

@apna_pdf

852. **Assertion: LiCl is predominantly a covalent compound.**
Reason: Electronegativity difference between Li and Cl is too small.

(a) If both Assertion and Reason are correct and the Reason is the correct explanation of Assertion
(b) If both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.
(c) If Assertion is correct but Reason is incorrect
(d) If both the Assertion and Reason are incorrect

AIIMS-2014

Ans. (c) : LiCl is covalent compound because the size of Li^+ is smaller and Cl^- is larger. Therefore, Li^+, has high polarizing power according to Fajan's rule, then LiCl is covalent in nature. Electronegativity difference between Li and Cl is high.

853. **The correct statement for the molecule CsI_3 is**

(a) It is a covalent molecule
(b) It contains Cs^+ and I_3^-
(c) It contains Cs^{3+} and I^- ions
(d) It contains Cs^+, I^- and lattice I_2 molecule

JEE Main-2014

Ans. (b) : CsI_3 is an ionic compound.

$$CsI_3 \longrightarrow Cs^+ + I_3^-$$

Cs belongs to alkali metal groups therefore Cs^{3+} is not possible because alkali metals only shows +1 oxidation state, i.e. Cs^+. I_2 molecules is not present in lattice because its size is too large.

854. **The attractive force which holds various constituents together in different chemical species is called**

(a) valence bond
(b) chemical bond
(c) atomic bond
(d) electrovalent bond.

J & K CET-2014

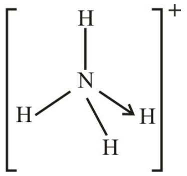
Ans. (b) : Only chemical bonds forms attractive force because it is formed by sharing of electrons between atoms. Electrovalent bonds are ionic bonds and formed by donation of electron so it is not formed by attractive forces.

855. **Which one of the following statements is true for ammonium ion?**

(a) All bonds are ionic
(b) All bonds are co-ordinate covalent
(c) H- atoms are situated at the corners of a square
(d) H-atoms are situated at the corners of tetrahedron.

AP – EAMCET - (Medical)-1997

Ans. (d) : In ammonium ion NH_4^+, three N–H bonds are covalent and one N–H bond is co-ordinate covalent. Hydrogen atoms are situated at the corners of a tetrahedron as N atom is sp^3 hybridised.



856. **Assertion:** The atoms in a covalent molecule are said to share electrons, yet some covalent molecules are polar.
Reason: In a polar covalent molecule, the shared electrons spend more time than the average near one of the atoms.

(a) If both Assertion and Reason are true and the Reason is a correct explanation of the Assertion
(b) If both Assertion and Reason are true but Reason is not a correct explanation of the Assertion
(c) If Assertion is true but the Reason is false
(d) If both Assertion and Reason are false

AIIMS-1996

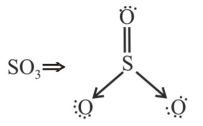
Ans. (a) : Covalent bonds are formed by the sharing of electrons between atoms if there is difference in electronegativity between atoms then shared electron spent more time near more electronegativity atom but if electronegativity difference is less then shared electron exist in centre.

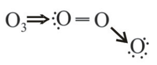
857. **The compound containing co-ordinate bond is**

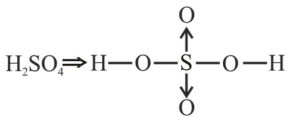
(a) SO_3
(b) O_3
(c) H_2SO_4
(d) all of these

AIIMS-1994

Ans. (d) :







Hence, all species contains the co-ordinate bond.

858. **Heterolytic fission of an organic covalent bond gives only**

(a) anion
(b) free radicals
(c) cation
(d) both (a) and (c)

AIIMS-1994

Ans. (d) : There are two types of fission take place in an organic covalent bond i.e. (i) Homolytic and heterolytic fission. On the heterolytic fission, cation and anion are formed.

$$C{-}X \xrightarrow[\text{Cleavage}]{\text{Heterolytic}} C^+ + X^-$$

@apna_pdf

9. Molecular Orbital Theory

859. Which of the following molecules/ions do not contain unpaired electrons?

(a) O_2^{2-} (b) B_2

(c) N_2^+ (d) O_2

(JEE Main 2021, 31 Aug. Shift-II)
Karnataka-CET-2012
UP CPMT-2011

Ans. (a) : O_2^{2-} (number of electrons = 18) does not contain unpaired electrons.

$O_2^{2-}: \sigma 1s^2, \sigma^* 1s^2, \sigma 2s^2, \sigma^* 2s^2, \sigma 2p_z^2, \pi 2p_x^2$
$\approx \pi 2p_y^2, \pi^* 2p_x^2 \approx \pi^* 2p_y^2$

860. Which of the following show pπ – dπ bonding?

(a) NO_3^- (b) SO_3^{2-}

(c) BO_3^{3-} (d) CO_3^{2-}

BCECE-2016, 2012

Ans. (b) : NO_3^-, BO_3^{3-} and CO_3^{2-} contains the second period elements (central atom and surrounding atom) and there is no availability of d– orbital in second period element due to which they cannot acquire the pπ– dπ bonding.
In SO_3^{2-}, sulphur belongs to the third period of the periodic table and it has the d–orbital due to which they can form pπ–dπ bonding.

861. Which of the following elements forms pπ – pπ bond with itself?

(a) P (b) Se
(c) N (d) Te

Karnataka-CET-2017
MHT CET-2017

Ans. (c) : The condition for forming the pπ-pπ bond is that, the molecule having the small size with high electronegativity. In the given options, only nitrogen has fulfill the condition for pπ-pπ bond. N has more electronegativity than P, Se and Te.

862. The number of antibonding electron pairs in O_2^{2-} molecular ion on the basis of molecular orbital theory is (Atomic number of O is 18)

(a) 5 (b) 4
(c) 3 (d) 2

Karnataka-CET-2007
NEET-1998

Ans. (b) : The electronic configuration of O_2^{2-} ion is-

$$O_2^-\left(18e^-\right) = \sigma 1s^2, \sigma^* 1s^2, \sigma 2s^2, \sigma^* 2s^2, 2p_z^2,$$
$$\pi 2p_x^2 = \pi 2p_y^2, \sigma 2p_z^2, \pi^* 2p_y^2 = \pi^* 2p^2$$

Hence, number of antibonding electron pairs in O_2^{2-} molecular ion are four.

863. AX is a covalent diatomic molecule, where A and X are second row elements of periodic table. Based on molecular orbital theory, the bond order of AX is 2.5. The total number of electrons in AX is ....
(Round off to the nearest integer).

(JEE Main 2021, 18 March Shift-I)

Ans. (15) : It is given that the bond order of AX is 2.5. The compound AX will be NO because the total number of electron of NO is 15 Total number of electrons equal to 13 will also have the 2.5 bond order. But in this case neutral diatomic molecule will not be possible.

864. Arrange the following species in the correct order of their stabilities.

$N_2^-, C_2, Ne_2, O_2^{2-}$

(a) $Ne_2 < O_2^{2-} < C_2 < N_2^-$

(b) $Ne_2 < C_2 < O_2^{2-} < N_2^-$

(c) $Ne_2 < N_2^- < O_2^{2-} < C_2$

(d) $Ne_2 < O_2^{2-} < N_2^- < C_2$

AP EAPCET 25.08.2021, Shift-II

Ans. (a) : According molecular orbital theory–

For N ≤ $14e^-$	**For N > 14 e^-**
$\sigma^* 2p_z$	$\sigma^* 2p_z$
$\pi^* 2p_x = \pi^* 2p_y$ (bonding)	$\pi^* 2p_x = \pi^* 2p_y$
$\sigma 2p_z$	$\pi 2p_x = \pi 2p_y$
$\pi 2p_x = \pi 2p_y$ (bonding)	$\sigma 2p_z$
$\sigma^* 2s$	$\sigma^* 2s$
$\sigma 2s$ (bonding)	$\sigma 2s$
$\sigma^* 1s$ (antibonding orbital)	$\sigma^* 1s$
$\sigma 1s$ (bonding orbital)	$\sigma 1s$

$$\therefore \text{B.O.} = \frac{\text{No. of bonding } e^- - \text{No. of antibonding } e^-}{2}$$

So, bond order is increase so stability is increase. Bond order of $N_2^- = 5/2$, $C_2 = 2$, $O_2^{2-} = 1$ and $Ne_2 = 0$.

865. Addition of an electron to an antibonding molecular orbital _____

(a) increase bond - order
(b) decreases bond - order
(c) stabilizes the system
(d) decreases the inter-nuclear distance

AP-EAPCET-24.08.2021, Shift-I

Ans. (b) : The formula of bond order is –
Bond order

$$= \frac{\text{no. of bonding } e^- - \text{no. of of anti bonding } e^-}{2}$$

If the no. of electron in antibonding increases the bond order decreases. Hence the second option is correct.

866. According to molecular orbital theory, the species among the following that does not exist is :

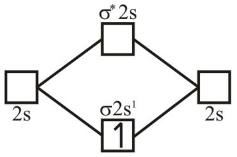
(a) He_2^- (b) He_2^+

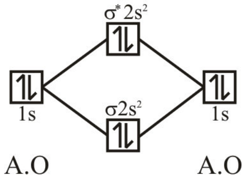
(c) O_2^{2-} (d) Be_2

JEE Main 25-02-2021, Shift-I

@apna_pdf

Ans. (d) : (i) $He_2^-(5)$: $\sigma 1s^2 \sigma^* 1s^2\, \sigma 2s^1$





$$\text{Bond Order} = \frac{1}{2}[N_b - N_a]$$

$$= \frac{1}{2}[3-2] = \frac{1}{2} = 0.5$$

(ii) $He_2^+(3)$: $\sigma 1s^2\, \sigma^* 1s^1$

$$\text{Bond Order} = \frac{1}{2}[N_b - N_a]$$

$$= \frac{1}{2}[2-1] = 0.5$$

(iii) $O_2^{2-}(18)$: $\sigma 1s^2, \sigma^* 1s^2, \sigma 2s^2, \sigma^* 2s^2, \sigma 2p_z^2$

$$\pi 2p_x^2 = \pi 2p_y^2, \pi^* 2p_x^2 = \pi^* 2p_y^2$$

$$\text{Bond Order} = \frac{1}{2}[N_b - N_a]$$

$$= \frac{1}{2}[10-8] = 1$$

(iv) $Be_2 = 4 + 4 = 8$

$= \sigma\, 1s^2, \sigma^* 1s^2, \sigma 2s^2, \sigma^* 2s^2$

$$\text{Bond Order} = \frac{1}{2}[N_b - N_a]$$

$$= \frac{1}{2}[2-2] = 0$$

Bond Order of Be_2 is zero so, it does not exist.

867. The total number of electrons in all bonding molecular orbitals of O_2^{2-} is ....
(Round of to the nearest integer)

(JEE Main 2021, 27 July Shift-II)

Ans. 10 : The species is O_2^{2-}. The total no. of e^- in O_2^{2-} is 18.

MO configuration $= (\sigma 1s)^2 (\sigma^* 1s)^2 (\sigma 2s)^2 (\sigma^* 2s)^2$

$(\sigma 2p_z)^2 (\pi 2p^2{}_x = \pi 2p^2{}_y)\ (\pi^* 2p^2{}_x = \pi^* 2p^2{}_y)$

The bonding molecular orbital contains the 10 electron.

868. The bond stability of N_2, N_2^- and N_2^{2-} varies as

(a) $N_2 < N_2^- < N_2^{2-}$ (b) $N_2^- < N_2 < N_2^{2-}$
(c) $N_2^{2-} < N_2^- < N_2$ (d) $N_2^- < N_2^{2-} < N_2$

AP EAMCET (Engg.) 21.09.2020, Shift-I

Ans. (c) : Stability of a molecule is related with bond order as:

Stability ∝ Bond order

Bond order of N_2, N_2^- and N_2^{-2} are 3, 2.5 and 2 respectively. Therefore, the bond stability order is $N_2^{-2} < N_2^- < N_2$.

Hence, the correct option is (c).

869. During the change of O_2 to O_2^-, the incoming electron goes to the orbital.

(a) $\pi 2p_x$ (b) $\pi^* 2p_x$
(c) $\pi 2p_y$ (d) $\pi^* 2p_z$

AIIMS 25 May 2019 (Morning)

Ans. (b) : : The total number of electron in O_2 molecule is 16. The molecular orbital configuration of O_2 is $(\sigma 1s)^2 (\sigma^* 1s)^2 (\sigma 2s)^2 (\sigma^* 2s)^2$ $(\sigma 2p_z)^2 (\pi 2p^2 x = \pi 2p^2{}_y)\ (\pi^* 2p^1{}_x = \pi^* 2p^1{}_y)$

Similarly, for O_2^-, total $e^- = 17$

MO electronic configuration

$= (\sigma 1s)^2 (\sigma^* 1s)^2 (\sigma 2s)^2 (\sigma^* 2s)^2\ (\sigma 2p_z)^2$

$(\pi 2p^2{}_x = \pi 2p^2{}_y)\ (\pi^* 2p^2{}_x = \pi^* 2p^1{}_y)$

In O_2 to O_2^-, the incoming electron goes to the $\pi^* 2p_x$ orbital.

870. Which of the following species cannot exist on the basis of Molecular Orbital Theory?

(a) O^{2+} (b) He_2^+
(c) H_2^+ (d) He_2

J & K CET-2019
CG PET-2004

Ans. (d) : The molecule which have bonding electron equal to the Antibonding electron then the molecule cannot exist. He_2 has the 4 electron.

MO configuration of $He_2 = (\sigma 1s^2)\ (\sigma^* 1s)^2$

Hence, no of bonding electron is equal to the no. of antibonding. Hence, the He_2 molecule cannot exist.

871. In the process, $O_2^+ \rightarrow O_2^{2+} + e^-$ the electron lost is from :

(a) bonding π-orbital
(b) antibonding π-orbital
(c) $2p_z$ orbital
(d) $2p_x$ orbital

Manipal-2019

Ans. (b) : $O_2^- \rightarrow O_2^{2+} + e^-$

O_2^+ Total $e^- = 15 = \sigma 1s^2, \sigma^* 1s^2, \sigma 2s^2, \sigma^* 2s^2, \sigma 2p_z^2$

$\pi 2\,p_x^2 = \pi 2\,p_y^2, \pi^* 2p_x^1$

The removal of electron takes place from $\pi^* P_x$ orbital which is π- antibonding orbital.

872. Which of the following diatomic molecular species has only π bonds according to molecular orbital theory?

(a) Be_2 (b) O_2
(c) N_2 (d) C_2

NEET-2019

Ans. (d) : The total number of electrons in C_2 molecule is 12. The molecular orbital electronic configuration of C_2 is $(\sigma 1s)^2\ (\sigma^* 1s)^2\ (\sigma 2s)^2\ (\sigma^* 2s)^2\ \ (\pi 2p_x^2 = \pi 2p_y^2)$.

Thus, C_2 has only π bonds according to MOT.

@apna_pdf

873. Assertion: NH_2^- has a square planar shape.

Reason: Species which involve dsp^2 hybridization have square pyramidal structure.

(a) If both Assertion and Reason are correct and the Reason is the correct explanation of Assertion

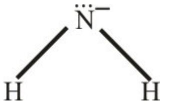
(b) If both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.

(c) If Assertion is correct but Reason is incorrect

(d) If both the Assertion and Reason are incorrect

AIIMS-26 May,2018 (M)

Ans. (d): The hybridization of NH_2^- is sp^3 with two lone pair The structure of NH_2^- is given below –



V– Shaped or Bent shape

Species which involve dsp^2 hybridization have square planer geometry whereas the molecules having the sp^3d^2 hybridization with one lone pair has the square pyramidal structure.

874. According to molecular orbital theory which of the following statement about the magnetic character and bond order is correct regarding O_2^+

(a) Paramagnetic and Bond order < O_2

(b) Paramagnetic and Bond order > O_2

(c) Diamagnetic and Bond order < O_2

(d) Diamagnetic and Bond order > O_2

BITSAT-2018

Ans. (b) : $O_2 : \sigma 1s^2, \sigma^* 1s^2, \sigma 2s^2, \sigma^* 2s^2, \sigma 2p_z^2$

$\pi 2p_x^2 = \pi 2p_y^2, \pi^* 2p_x^1 = \pi^* 2p_y^1$

Bond order $= \dfrac{10-6}{2} = 2$

(two unpaired electrons in antibonding molecular orbital)

$O_2^+ : \sigma 1s^2, \sigma^* 1s^2, \sigma 2s^2, \sigma^* 2s^2, \sigma 2p_z^2$

$\pi 2p_x^2 = \pi 2p_y^2 \pi^* 2p_x^1 \pi^* 2p_y^0$

Bond order $= \dfrac{10-5}{2} = 2.5$

(One unpaired electron in antibonding molecular orbital)

Hence O_2 as well as O_2^+ both are paramagnetic, and bond order of O_2^+ is greater than that of O_2.

875. According to MOT, O_2 is paramagnetic in nature, what is the number of electrons in antibonding molecular orbitals?

(a) 8 (b) 7

(c) 9 (d) 6

AMU-2017

Ans. (d) : The given species is O_2. The total number of electron in O_2 is 16. The molecular orbital configuration is $(\sigma 1s)^2$ $(\sigma^* 1s)^2$ $(\sigma 2s)^2$ $(\sigma^* 2s)^2$ $(\sigma 2p_z)^2$ $(\pi 2p_x^2 = \pi 2p_y^2)$ $(\pi^* 2p_x^1 = \pi^* 2p_y^1)$. Hence, antibonding molecular orbital contains the 6 electron.

876. The molecule (ion) having one unpaired electron is :

(a) NO (b) CO

(c) CN^- (d) O_2

Manipal-2017

Ans. (a) : NO (total e^- = 7 +8 + = 15) = $\sigma 1s^2$, $\sigma^* 1s^2$, $\sigma 2s^2$, $\sigma^* 2s^2$, $\sigma 2p_z^2$, $\pi 2p_x^2 = \pi 2p_y^2$, $\pi^* 2p_x^1$

Unpaired electron = 1

(b) CO (total e^- = 14) = $\sigma 1s^2$, $\sigma^* 1s^2$, $\sigma 2s^2$, $\sigma^* 2s^2$

$\pi 2p_x^2 = \pi 2p_y^2$, $\sigma 2p_z^2$

Unpaired electron = 0

(c) CN (Total e^- =14) =is isoelectronic with CO.

Hence, it has 0 unpaired electron

(d) O_2 (Total e^- = 16) $\sigma 1s^2$, $\sigma^* 1s^2$, $\sigma 2s^2$, $\sigma^* 2s^2$

$\sigma 2p_z^2$, $\pi 2p_x^2 = \pi 2p_y^2$, $\pi^* 2p_x^1 = \pi^* 2p_y^1$

Unpaired e^- = 2

877. Which one of the molecular species has unpaired electrons?

(a) N_2 (b) N_2^{2+}

(c) N_2^{2-} (d) O_2^{2-}

COMEDK-2016

Ans. (c) : $N_2(\text{total } e^- = 14) : \sigma 1s^2, \sigma^* 1s^2, \sigma 2s^2, \sigma^* 2s^2,$

$\left(\pi 2p_x^2 = \pi 2p_y^2\right), \sigma 2p_z^2$

$N_2^{2+}(\text{total } e^- = 12) : \sigma 1s^2, \sigma^* 1s^2, \sigma 2s^2, \sigma^* 2s^2 \left(\pi 2p_x^2 = \pi 2p_y^2\right)$

$N_2^{2-}(\text{total } e^- = 16) : \sigma 1s^2, \sigma^* 1s^2, \sigma 2s^2, \sigma^* 2s^2, \left(\pi 2p_x^2 = \pi 2p_y^2\right), \sigma 2p_z^2,$

$\left(\pi^* 2p_x^1 = \pi^* 2p_y^1\right)$

$O_2^{2-}(\text{total } e^- = 18) : \sigma 1s^2, \sigma^* 1s^2, \sigma 2s^2, \sigma^* 2s^2, \sigma 2p_z^2, \left(\pi 2p_x^2 = \pi 2p_y^2\right)$

$\left(\pi^* 2p_x^2 = \pi^* 2p_y^2\right)$

Here, N_2^{2-} contains the two unpaired electron.

878. The total number of antibonding electrons in N_2 and O_2 molecules respectively is

(a) 4, 6 (b) 6, 8

(c) 5, 8 (d) 4, 8

AP EAMCET (Medical) - 2013

Ans. (a) : The species are N_2 and O_2.

Total electron in N_2 = 14

Molecular electronic configuration of N_2 =

$\sigma 1s^2, \sigma^* 1s^2, \sigma 2s^2, \sigma^* 2s^2, \pi 2p_x^2 = \pi 2p_y^2, \sigma 2p_z^2$

∴ Antibonding electron = 4

Total electron in O_2 = 16

Molecular electronic configuration of O_2 =

$\sigma 1s^2, \sigma^* 1s^2, \sigma 2s^2, \sigma^* 2s^2, \sigma 2p_z^2, \pi 2p_x^2 = \pi 2p_y^2, \pi^* 2p_x^1 = \pi^* 2p_y^1$

∴ Antibonding electron = 6

@apna_pdf

879. Using MOT, which of the following pairs denote paramagnetic species?

(a) B_2 and C_2 (b) B_2 and O_2

(c) N_2 and C_2 (d) O_2 and O_2^{2-}

BITSAT-2013

Ans. (b) : B_2 and O_2 are paramagnetic due to presence of unpaired electron. MO configuration of B_2 is :

$\sigma 1s^2 \sigma^* 1s^2 \sigma 2s^2 \sigma^* 2s^2 \pi 2p_x^1 = \pi 2p_y^1$

MO configuration of O_2 is :

$\sigma 1s^2 \sigma^* 1s^2 \sigma 2s^2 \sigma^* 2s^2 \sigma 2p_z^2 \pi 2p_x^2$

$= \pi 2p_y^2 \pi^* 2p_x^1 = \pi^* 2p_y^1$

880. The ground state electronic configuration of CO molecule is

(a) $1\sigma^2 2\sigma^2 1\pi^4 3\sigma^2$ (b) $1\sigma^2 2\sigma^2 3\sigma^2 1\pi^2 2\pi^2$

(c) $1\sigma^2 2\sigma^2 1\pi^2 3\sigma^2 2\pi^2$ (d) $1\sigma^2 1\pi^2 2\sigma^2 2\sigma^2$

WB-JEE-2013

Ans. (a) : CO molecule contains the 14 electron in ground state. The molecular orbital configuration of CO is $(\sigma 1s)^2 (\sigma^* 1s)^2 (\sigma 2s)^2 (\sigma^* 2s)^2$ $(\pi 2p_x^2 = \pi 2p_y^2)$ $(\sigma 2p_z)^2$.

881. The number of molecular orbitals obtained by mixing two atomic orbitals from each of the atoms is:

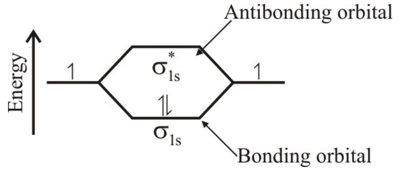
(a) 2 (b) 3

(c) 4 (d) 6

MPPET-2012

Ans. (a) : Due to hybridized orbitals of atoms, if 'n' number of orbitals are combined, then the number of orbitals formed would also be equal to 'n'.

• One bonding orbital & one anti-bonding orbital, when two '1s' orbitals combine –



882. The molecule having one unpaired electron is:

(a) CO (b) O_2

(c) N_2 (d) NO

MPPET-2012

Ans. (d) : (i) $:C \overset{\leftarrow}{\equiv} O:$ (ii) $\underset{\cdot\cdot}{\ddot{O}} = \underset{\cdot\cdot}{\ddot{O}}$

(iii) $\ddot{N} \equiv \ddot{N}$ (iv) $\underset{\cdot}{\ddot{N}} = \underset{\cdot\cdot}{\ddot{O}}$ (one unpaired e^-)

883. According to molecular orbital theory, the total number of bonding electron pairs in O_2 is

(a) 2 (b) 3

(c) 5 (d) 4

AP EAMCET (Engg.)-2012

Ans. (c) : According to molecular orbital theory molecular orbital configuration of O_2 is –

$O_2(16e^-) = \sigma 1s^2, \sigma^* 1s^2, \sigma 2s^2, \sigma^* 2s^2, 2p_z^2$,

$\pi 2p_x^2 = \pi 2p_y^2$ $, \sigma 2p_z^2$ $, \pi^* 2p_y^1 = \pi^* 2p^1$

∴ Number of bonding electrons = 10

and number of bonding electron pairs = 5

and Number of antibonding electrons = 6

884. Molecular orbital theory was proposed by

(a) Lewis (b) Mulliken

(c) Slater (d) Pauling

AP- EAMCET(Medical) -2010

Ans. (b): Molecular Orbital Theory (MOT) was developed by F. Hund and R.S. Mulliken in 1932.

- Lewis was best known for his discovery of the covalent bond and his concept of electron pairs. His Lewis dot structure and other contributions to valence bond theory have shaped **modern theories of chemical bonding**.
- **Slater's rules** provide numerical values for the effective nuclear charge in a many electron atom.
- **Pauling** was the scientist who gave scale of electroelectronegativity.

885. Which is false statement about LCAO?

(a) Addition of atomic orbitals result in molecular orbitals.

(b) Atomic orbitals of nearly same energy combine to form molecular orbitals.

(c) Bonding molecular orbitals occupy higher energy than atomic orbitals.

(d) Each molecular orbital accommodates maximum no of two electrons.

J & K CET-2010

Ans. (c) : The linear combination of atomic orbital's to form molecular orbital's takes place only if the following conditions are satisfied-

(i) Two or more than two atomic orbital combination to form molecular orbital's

(ii) The combining atomic orbitals must have the same or nearly the same energy.

(iii) Bonding molecular orbital's occupy less energy than atomic orbital's

(iv) Each molecular orbital fits in with maximum no. of two electrons.

886. Which one of the following is paramagnetic

(a) O_2 (b) N_2

(c) He (d) NH_3

MPPET-2009

Ans. (a) : Paramagnetism is due to the presence of unpaired electrons in the material.

According to molecular orbital theory–

$\sigma 1s^2, \sigma^* 1s^2, \sigma 2s^2, \sigma^* 2s^2, \sigma 2p_z^2, \pi 2p_x^2 = \pi 2p_y^2,$

$\pi^* 2p_x^1 = \pi^* 2p_y^1$

O_2 is paramagnetic because antibonding molecular orbital has 2 unpaired electron.

887. The correct statement with regard to H_2^+ and H_2^- is:

(a) both H_2^+ and H_2^- are equally stable

(b) both H_2^+ and H_2^- do not exist

(c) H_2^- is more table than H_2^+

(d) H_2^+ is more stable than H_2^-

Karnataka-CET, 2009

Ans. (d) : $H_2^+ : \sigma 1s^1, \overset{*}{\sigma} s^0$ Bond order $= \frac{1}{2}$

$H_2^+ : \sigma 1s^2, \overset{*}{\sigma} s^1$ Bond order $= \frac{2-1}{2} = \frac{1}{2}$

@apna_pdf

The bond order of H_2^+ and H_2^- are same but H_2^+ is more stable than H_2^-. It is due to the presence of one electron in the antibonding molecular orbital in H_2^-.

888. Which of the following is correct based on Molecular orbital theory for peroxide ion?

(a) Its bond order is two and it is diamagnetic
(b) Its bond order is one and it is paramagnetic
(c) Its bond order is two and it is paramagnetic
(d) Its bond order is one and it is diamagnetic

GUJCET-2007

Ans. (d) : The chemical formula of peroxide ion is O_2^{2-}

Total electron = 16+2 = 18

Molecular electronic configuration of

$$O_2^{2-} = \sigma 1s^2, \sigma^* 1s^2, \sigma 2s^2, \sigma^* 2s^2, \sigma 2p^2$$

$$\pi 2p_x^2 = \pi 2p_y^2, \sigma 2p_z^2, \pi^* 2p_y^2 = \pi^* 2p^2$$

$$\text{Bond order} = \frac{\text{no. of bonding electron} - \text{no. of antibonding electron}}{2}$$

$$\text{Bond order} = \frac{10-8}{2} = 1$$

So, its bond order is one and it is diamagnetic in nature.

889. One of the following examples exhibit transient existence

(a) H
(b) H_2^+
(c) H^+
(d) He

J & K CET-2007

Ans. (c) : H^+ has the zero bond order due to which we can say that H^+ is not stable or exhibit transient existence and H_2^+ has the positive value of bond order. Hence, it is stable.

890. Molecular orbital electronic configuration of X anion is
$KK(\sigma 2s)^2 (\sigma^* 2s)^2 (\pi 2p_x)^2 (\pi 2p_y)^2 (\sigma 2p_z)^2 (\pi^* 2p_x)^1$
Then anion X is –

(a) N_2^-
(b) O_2^-
(c) N_2^{2-}
(d) O_2^{2-}

AMU-2005

Ans. (a) : The given molecular orbital electronic configuration of X anion is K K- $\sigma 2s^2$, $\sigma^* 2s^2$, $\pi 2p_x^2$, $\pi 2p_y^2$, $\sigma 2p_z^2$, $\pi^* 2p_x^1$,. The anion contains the 15 electron on molecule orbital configuration.

(a) N_2^- ⇒ (total e^-) = 14 + 1 = 15
(b) O_2^- ⇒ (total e^-)= 16 + 1 = 17
(c) N_2^- ⇒ (total e^-) = 14 + 2 = 16
(d) O_2^{2-} ⇒ Total e^- = 16 + 2 = 18

Hence, anion X is N_2^-.

891. Paramagnetism of oxygen is explained on the basis of its electronic configuration of:

(a) $(2\pi_x^*)(2\pi_y)^1$
(b) $(\pi^* 2p_x)^1 (\pi^* 2p_y)^1$
(c) $(2\sigma_s^*)^1 (2\pi_y)^1$
(d) $(2\sigma_s^*)^1 (2\pi_y)^1$

JCECE-2005

Ans. (b) : The chemical formula of oxygen is O_2. The total number of electron in oxygen is 16.

The molecular orbital configuration of O_2 is

$\sigma 1s^2, \sigma^* 1s^2, \sigma 2s^2, \sigma^* 2s^2, \sigma 2p_z^2, \pi 2p_x^2 = \pi 2p_y^2$

$\pi^* 2p_x^1 = \pi^* 2p_y^1$

From the above configuration it is clear that the last electron goes to the $\pi^* 2P_x = \pi^* 2P_y$ which has two unpaired electron and shows the paramagnetic character.

892. Number of unpaired eletronis in O_2 molecule is:

(a) zero
(b) one
(c) two
(d) four

UP CPMT-2005

Ans. (c) : Write the electronic configuration of O_2 according to molecular orbital theory to find the number of unpaired electrons in it.

O_2 = (total e^- = 8+8 =16)

$= \sigma 1s^2, \sigma^* 1s^2, \sigma 2s^2, \sigma^* 2s^2, \sigma 2p_z^2, \pi 2p_x^2 = \pi 2p_y^2,$

$\pi^* 2p_x^1 = \pi^* 2p_y^1$ ∴ number of unpaired electrons =2

893. Which of the following molecules have unpaired electrons in antibonding molecular orbitals?

(a) O_2
(b) N_2
(c) C_2
(d) B_2

J & K CET-2002

Ans. (a) : O_2(Total e^- =16) = $(\sigma 1s^2)$ $(\sigma^* 1s^2)$ $(\sigma 2s^2)$ $(\sigma^* 2s^2)$ $(\sigma 2p_z^2)$ $(\pi 2p_x^2 = \pi 2p_y^2)$ $(\pi^* 2p_y^1 = \pi^* 2p_y^2)$

Unpaired e^- in ABMO = 2

(b) (N_2 Total e^- 14) = $(\sigma 1s^2)$ $(\sigma^* 1s^2)$ $(\sigma 2s^2)$ $(\sigma^* 2s^2)$ $(\pi 2p_x^2 = \pi 2p_y^2)$ $(\sigma 2p_z^2)$

Unpaired e^- in ABMO = 0

(c) C_2 (Total e^- =12) = $(\sigma 1s^2)$ $(\sigma^* 1s^2)$ $(\sigma 2s^2)$ $(\sigma^* 2s^2)$ $(\pi 2p_x^2 = \pi 2p_y^2)$

Unpaired e^- = in ABMO = 0

(d) B_2 (total e^- =10) = $(\sigma 1s^2)$ $(\sigma^* 1s^2)$ $(\sigma 2s^2)$ $(\sigma^* 2s^2)$ $(\pi 2p_x^1 = \pi 2p_y^1)$

Unpaired e^- in ABMO = 0

Here, O_2 has tow unpaired electron in antibonding molecular orbital ABMO

894. Which of the following is paramagnetic?

(a) N_2O_4
(b) NO
(c) N_2O_3
(d) N_2

AP EAMCET- 1995

Ans. (b) : From the Molecular orbital theory–

$$\text{NO}(\text{total } e^- = 15) = \sigma 1s^2, \sigma^* 1s^2, \sigma 2s^2, \sigma^* 2s^2, \sigma 2p_z^2, \pi 2p_x^2 =$$

$$\pi 2p_y^2, \pi^* 2p_x^1 = \pi^* 2p_y$$

Hence, last e^- goes to in anti bonding as an unpaired e^-. So, NO is paramagnetic in nature.

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895. The ground state electronic configuration of valence shell electrons in nitrogen molecule (N_2) is written as KK, $\sigma 2s^2$, $\sigma^* 2s^2$, $\pi 2p_x^2 = \pi 2p_y^2$. $\sigma 2p_z^2$. Hence the bond order in nitrogen molecule is

(a) 2 (b) 3

(c) 0 (d) 1

NEET-1995

Ans. (b) : Bond order = $= \dfrac{N_b - N_a}{2}$

Where- N_b = no. of bonding electron

N_a = no. of antibonding electron

$\therefore$ Bond order of $N_2 = \dfrac{10-4}{2} = 3$

Hence, the bond order of N_2 is 3

896. Using MO theory, predict which of the following species has the shortest bond length?

(a) O_2^{2+} (b) O_2^{+}

(c) O_2 (d) O_2^{2}

AIEEE 2009

Ans. (a) : The bond length of molecule is inversely proportional to the bond order. First of all we calculate the bond order of given species–

(a) $O_2^{2+}(\text{total } e^- 16-2=14)$

$= (\sigma 1s)^2(\sigma^* 1s)^2(\sigma 2s)^2(\sigma^* 2s)^2\ (\pi 2p^2_x = \pi 2p^2_y)$

$(\sigma 2p_z)^2$

B.O. = $\dfrac{10-4}{2} = 3$

(b) $O_2^{+}(\text{total } e^- = 16-1=15)$

$= (\sigma 1s)^2(\sigma^* 1s)^2(\sigma 2s)^2(\sigma^* 2s)^2\ (\sigma 2p_z)^2(\pi 2p^2_x = \pi 2p^2_y)$

$(\pi^* 2p^1_x)$

B.O. = $\dfrac{10-5}{2} = 2.5$

(c) $O_2^{-}(\text{total } e^- = 16+1=17)$

$= (\sigma 1s)^2(\sigma^* 1s)^2(\sigma 2s)^2(\sigma^* 2s)^2\ (2p_z)^2\ (\pi 2p^2_x = \pi 2p^2_y)$

$(\pi^* 2p^2_x = \pi^* 2p^1_y)$

B.O. = $\dfrac{10-7}{2} = 1.5$

(d) $O_2^{2-}(\text{total } e^- = 18) = (\sigma 1s)^2\ (\sigma^* 1s)^2\ (\sigma 2s)^2(\sigma^* 2s)^2$

$(\sigma 2p_z)^2\ (\pi 2p^2_x = \pi 2p^2_y)\ (\pi^* 2p^2_x = \pi^* 2p^2_y)$

B.O. = $\dfrac{10-8}{2} = 1$

The molecule which has the maximum bond order, having the shortest bond length. O_2^{2+} has the shortest bond length.

897. Oxygen molecule is paramagnetic because

(a) Bonding electrons are more than anti-bonding electrons

(b) It contains two unpaired electrons

(c) Anti-bonding electrons are more than bonding electrons

(d) Bonding electrons are equal to anti bonding electrons

SCRA-2015

Ans. (b): Oxygen molecule is paramagnetic because it contains two unpaired electrons in the anti bonding state. The molecular orbital configuration of O_2 is–

$\sigma 1s^2, \sigma^* 1s^2, \sigma 2s^2, \sigma^* 2s^2, \sigma 2p_z^2, \pi 2p_x^2 = \pi 2p_y^2, \pi^* 2p_x^1 = \pi^* 2p_y^1$

Here, O_2 has the two unpaired electron.

898. In He_2, the electrons in bonding and antibonding orbitals are

(a) 2, 2 (b) 4, 2

(c) 4, 0 (d) 2, 4

J & K CET-2015

Ans. (a) : The total number of electron in He_2 is 4. The molecular orbital configuration of He_2 is $(\sigma 1s)^2\ (\sigma^* 1s)^2$ He_2 contains the two electrons in bonding as well as antibonding orbital.

899. Using MOT, compare O_2^+ and O_2^- species and choose the incorrect option

(a) O_2^+ have higher bond order than O_2^-

(b) O_2^- is less stable

(c) O_2^+ is diamagnetic while O_2^- is paramagnetic

(d) Both O_2^+ and O_2^- are paramagenetic

Karnataka-CET-2015

Ans. (c) : The species are O_2^+ and O_2

(i) O_2^+ (Total e^- = 15)

MO configuration = $\sigma 1s^2$, $\sigma^* 1s^2$, $\sigma 2s^2$, $\sigma^* 2s^2$, $\sigma 2p_z^2$, $\pi 2\ p_x^2 = \pi 2\ p_y^2$, $\pi^* 2\ p_y^1$

Bond order = $\dfrac{N_b - N_a}{2} = \dfrac{10-5}{2} = 2.5$

Unpaired electron = 1 (paramagnetic)

(ii) O_2^- (Total e^- = 16+1=17)

MO configuration = $\sigma 1s^2$, $\sigma^* 1s^2$, $\sigma 2s^2$, $\sigma^* 2s^2$, $\sigma 2p_z^2$

$\pi 2\ p_x^2 = \pi 2\ p_y^2$, $\pi^* 2\ p_x^2 = \pi^* 2\ p_y^1$

Bond order = $\dfrac{10-7}{2} = 1.5$

Unpaired electron = 1 (paramagnetic)

The incorrect option is (c) because both species are paramagnetic in nature.

900. KO_2 exhibits paramagnetic behaviour. This is due to the paramagnetic nature of

(a) KO^- (b) K^+

(c) O_2 (d) O_2^-

AP-EAMCET (Engg.) - 2014

Ans. (d) : KO_2 exhibits paramagnetic behaviour because oxygen exists as O_2^- ions.

$$O_2^- = \sigma 1s^2, \sigma^* 1s^2, \sigma 2s^2, \sigma^* 2s^2, \sigma 2p_z^2,$$
$$\pi 2p_x^2 = \pi 2p_y^2,\ \pi^* 2p_x^2 = \pi^* 2p_y^1$$

Due to the presence of 1 unpaired electron in anti-bonding molecular orbital, it is paramagnetic in behaviour.

901. In case of hetero nuclear diatomics of the type AB, where A is more electronegative than B. bonding molecular orbital resembles the character of A more than that of B. The statement

@apna_pdf

(a) is false
(b) is true
(c) cannot be evaluated since data is not sufficient
(d) is true only for certain systems

WB-JEE-2014

Ans. (b) : Electronegativity is the tendency of an element to attract a shared pair of electrons towards itself. Heteronuclear diatomic molecules have atoms with different electronegativities and hence tend to become polarized. In a heteronuclear diatomic molecule AB, where A is more electronegative then B. Since the electrons shift more towards A due to its more electronegative character hence bonding molecular orbital resembles the character of A more than that of B.

902. According to molecular orbital theory, which of the following will not be a viable molecule?

(a) He_2^{2+} (b) He_2^+
(c) H_2^- (d) H_2^{2-}

JEE Main 2018

Ans. (d) : A positive bond order (i.e. $N_b > N_a$) means a stable molecule while negative (i.e. $N_b < N_a$) or zero (i.e. $N_b = N_a$) bond order means an unstable molecule.

(a) $He_2^{2+}(\text{total } e^- = 2) = (\sigma 1s)^2$

$$\text{Bond order} = \frac{N_b - N_a}{2} = \frac{2-0}{2} = 1$$

(b) $He_2^+(\text{total } e^- = 3) = (\sigma 1s)^2(\sigma^* 1s)^1$

$$\text{Bond order} = \frac{2-1}{2} = 0.5$$

(c) $H_2^-(\text{total } e^- = 3) = (\sigma 1s)^2(\sigma^* 1s)^1$

$$\text{Bond order} = \frac{2-1}{2} = 0.5$$

(d) $H_2^{2-}(\text{total } e^- = 4) = (\sigma 1s)^2(\sigma^* 1s)^2$

$$\text{Bond order} = \frac{N_b - N_a}{2} = \frac{2-2}{2} = 0$$

H_2^{2-} has the zero bond order. It will not be a viable molecule.

903. According to molecular orbital theory, which of the following is true with respect to Li_2^+ and Li_2 ?

(a) Both are unstable
(b) Li_2^+ is unstable and Li_2 is stable
(c) Both are stable
(d) Li_2^+ is stable and Li_2 is unstable

JEE Main 2019

Ans. (d) : The stability of molecule is depend upon the mathematical value of bond order.

$$N_b > N_a \longrightarrow \text{Stable molecule}$$

$$N_b = N_a \longrightarrow \text{Unstable molecule}$$

$Li_2^+(\text{total } e^- = 5) = (\sigma 1s)^2(\sigma^* 1s)^2(\sigma 2s)^1$.

$$\text{Bond order} = \frac{N_b - N_a}{2} = \frac{3-2}{2} = 0.5$$

$Li_2^-(\text{total } e^- = 7) = (\sigma 1s)^2(\sigma^* 1s)^2(\sigma 2s)^2(\sigma^* 2s)^1$

$$\text{Bond order} = \frac{4-3}{2} = 0.5$$

Here, Li_2^+ has two electron in antibonding molecular orbital whereas Li_2^+ has 3 electron in ABMO. The species which have less electron in ABMO are more stable. Li_2^- is least stable than Li_2^-.

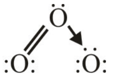
10. Formal Charge

904. The formal charge on the central oxygen atom in O_3 molecule is

(a) 0 (b) +1
(c) –1 (d) –2

COMEDK-2016

Ans. (b) : The Lewis dot structure of O_3 is



Formal charge on central oxygen atom

Formal charge = (Total no. of valence electron in free atom) – (lone pair) – $\frac{1}{2}$(total no. of bonding electrons)

$$\text{F.C} = 6 - \frac{1}{2} \times 6 - 2 = +1$$

905. The formal charges of $N_{(1)}$, $N_{(2)}$ and O atoms in $:\underset{1}{\ddot{N}} = \underset{2}{N} = \ddot{O}:$ are respectively

(a) +1,–1, 0 (b) –1,+1,0
(c) +1,+1,0 (d) –1,–1,0

BCECE-2014

Ans. (b) : The formal charge of $N_{(1)}$, $N_{(2)}$ and O atom in $N_{(1)} = N_{(2)} = O$ are–

Formal charge = (Total no. of valence electron in free atom) – (lone pair) – $\frac{1}{2}$(total no. of bonding electrons)

In N atom marked 1,

$$\text{Formal charge } (N_1) = 5 - 4 - \frac{1}{2}\ (4)$$
$$= 5 - 4 - 2$$
$$= -1$$

$$\text{Formal charge } (N_2) = 5 - 0 - \frac{1}{2}\ (8)$$
$$= 5 - 4$$
$$= +1$$

$$\text{Formal charge of O atom} = 6 - 4 - \frac{1}{2}\ (4)$$
$$= 6 - 4 - 2$$
$$= 0$$

Thus, the formal charge of $N_{(1)}$, $N_{(2)}$, O atoms are –1, +1, 0 respectively.

906. The formal charges of C and O atoms in $CO_2(:\ddot{O} = C = \ddot{O}:)$ are, respectively

(a) 1, –1 (b) –1, 1
(c) 2, –2 (d) 0, 0

AP EAMCET (Engg.) - 2012

@apna_pdf

Ans. (d)
Formal charge = (total no. of valance e$^-$ present in atom) – (total no. of non bonding e$^-$ present in atom) – $\frac{1}{2}$(total no. of Bonding e$^-$ present in atom)

Formal charge on C in CO_2 -
total no. of valance e$^-$ = 4
total no. of non- Bonding e$^-$ = 0
Total no of Bonding e$^-$ = 8

$$F.C = 4 - 0 - \frac{1}{2} \times 8$$
$$= 4 - 4 = 0$$

F.C = 0
Formal charge on C is 0.
Formal charge on O in CO_2 -
total no. of valance e$^-$ = 6
total no. of non- Bonding e$^-$ = 4
Total no of Bonding e$^-$ = 4

$$F.C.\ of\ O = 6 - 4 - \frac{1}{2} \times 4$$
$$= 6 - 6 = 0$$

Formal charge on O is 0 (zero)

907. The formal charges of $N_{(1)}, N_{(2)}$ and O atoms in $:\underset{(1)}{\ddot{N}}=\underset{(2)}{N}=\ddot{O}:$ are respectively

(a) $+1, -1, 0$
(b) $-1, +1, 0$
(c) $+1, +1, 0$
(d) $-1, -1, 0$

AP-EAMCET- (Engg.)-2011

Ans. (b) : Formal charge (FC) = Valence electron– Lonepair $-\frac{1}{2}$ bond pair

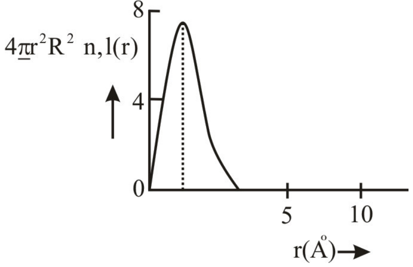
For $:\underset{(1)}{\ddot{N}}=\underset{(2)}{N}=\ddot{O}:$

$$\text{For } N_{(1)} = 5 - 4 - \frac{1}{2} \times 4 = -1$$
$$\text{For } N_{(2)} = 5 - 0 - \frac{1}{2}(8) = +1$$
$$\text{For } O = 6 - 4 - \frac{1}{2}(4) = 0$$

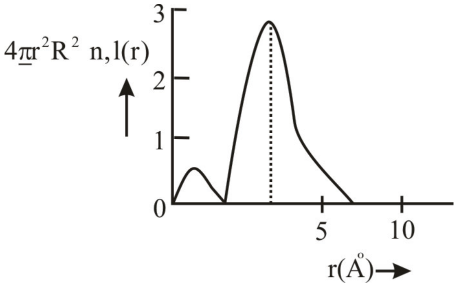
11. Valence Bond Theory

908. The plots of radial distribution functions for various orbitals of hydrogen atom against 'r' are given below :

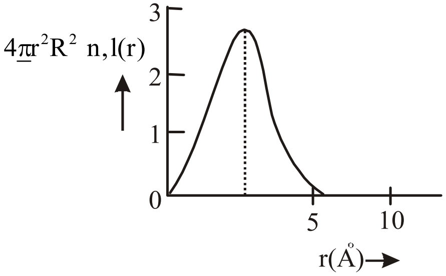
(A)



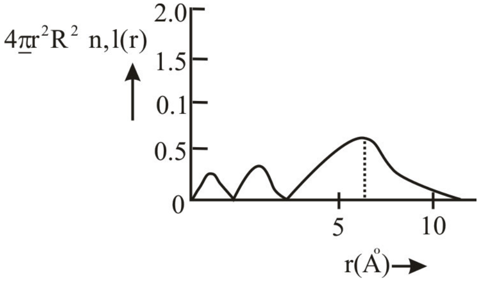
(B)



(C)



(D)



The correct plot for 3s orbital is :
(a) A (b) B
(c) C (d) D

JEE Main 25-02-2021, Shift-I

Ans. (d) : For 3s orbital-
No. of radial nodes = n – λ –1
∵ n = 3 and λ = 0 (for s – subshell)
∴ No. of radial nodes = 3 – 0 – 1= 2
Which is correctly matched by option (d).

909. Valence bond theory of L. Pauling and J.C. Slater accounts for .... characteristics of covalent bond.

(a) directional (b) non-directional
(c) sharing (d) None of these

AP-EAMCET-1993

Ans. (a): Valence Bond Theory (VBT) of L. Pauling and J.C. Slater accounts for directional characteristics of covalent bond.

- The covalent bond formed between two atom by the sharing of electron.
- The ionic bond are non-directional in nature.

910. In case of nitrogen, NCl_3 is possible but not NCl_5 while case of phosphorus, PCl_3 as well as PCl_5 are possible. It is due to

(a) availability of vacant d orbitals in P but not in N
(b) lower electronegativity of P than N
(c) lower tendency of H-bond formation in P than N
(d) occurrence of P in solid while N in gaseous state at room temperature.

VITEEE-2018

@apna_pdf

Ans. (a) : Phosphorus belongs to the 3rd period which contains the vacant d–orbital but in the case of N, it's not contains the d-orbital because this is belongs to the second period.

${}_7N = 1s^2\ 2s^2\ 2p^3$ ${}_{15}P = 1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^3\ 3d^0$

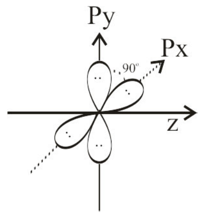
12. Types of Overlapping and Nature of Covalent Bonds

911. Main axis of diatomic molecule is z. The orbitals p_x and p_y overlap to form

(a) π-molecular orbital
(b) σ- molecular orbital
(c) δ- molecular orbital
(d) No bond is formed

Karnataka-CET-2016
NEET-2001

Ans. (d) : The shape of the P-orbital is dumbell.
According to the question-



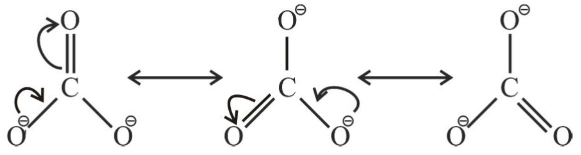
p_x and p_y are perpendicular to each other due to which they cannot overlap and no bond will be form.

912. Identify the species having one π-bond and maximum number of canonical forms from the following

(a) SO_3 (b) O_2
(c) SO_2 (d) CO_3^{2-}

(JEE Main 2021, 25 July Shift-II)

Ans. (d) : The structure of CO_3^{2-} is given below :



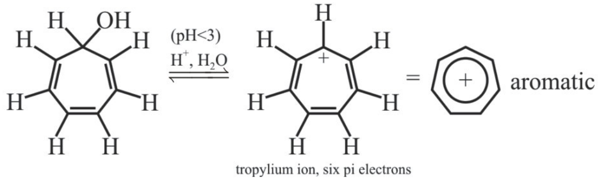
The above structure contains the one π-bond.

913. The total number of overlapping p-orbitals present in cycloheptatrienyl cation is

(a) 4 (b) 5
(c) 6 (d) 7

TS-EAMCET (Engg.), 06.08.2021

Ans. (c):



- The cycloheptatrienyl cation has 6 pi electrons and an empty p orbital.
- The cycloheptatrienyl cation is easily formed by treating the corresponding alcohol with dilute (0.01N) aqueous sulfuric acid.
- The cycloheptatrienyl cation is commonly known as the **tropylium ion**.

914. Which one of the following energy is stored in the links between the atoms ?

(a) Nuclear energy (b) Chemical energy
(c) Potential energy (d) Thermal energy

NDA (I)-2019

Ans : (b) Chemical energy is stored in the links between the atoms.

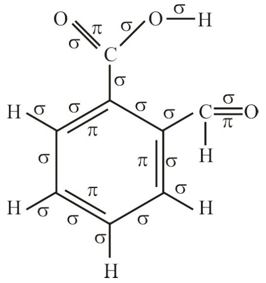
- Potential energy is the energy which possess due to virtue of its position.
- Nuclear energy is stored in the nucleus of an atom.
- Thermal energy is the energy which possess due to movement of the particles within the object or system.

915. The number of σ and π-bonds in 2-formylbenzoic acid are respectively.

(a) 10, 3 (b) 14, 3
(c) 12, 5 (d) 17, 5

MHT CET-02.05.2019, Shift-II

Ans. (d) : The structure of 2-formyl benzoic acid is given below-



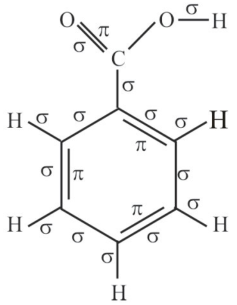
There are 17σ and 5π bonds present in 2-formyl benzoic acid.

916. The number of pi-bonds present in benzoic acid molecule are

(a) 5 (b) 4
(c) 3 (d) 6

MHT CET-03.05.2019, Shift-I

Ans. (b) : The structure of benzoic acid is given below :



There are four pi bond present in above structure.

917. A π-bond is formed by side way overlapping of

(a) s-s orbitals (b) s-p orbitals
(c) p-p orbitals (d) s-p-s orbitals

J & K CET-2019

@apna_pdf

Ans. (c) : In the formation of π–bond the atomic orbitals overlap in such a way that their axes remain parallel to each other and perpendicular to the internuclear axis. The orbitals formed due to sidewise overlapping consists of two saucer type charged clouds above and below the plane of the participating atoms.

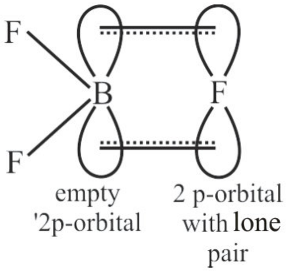
918. Among the following compounds of boron, the species which also forms π-bond in addition to σ-bonds is

(a) BH_3 (b) B_2H_6

(c) BF_3 (d) BF_4^-

UPTU/UPSEE-2017

Ans. (c) : Boron trifluoride has planar structure. Boron has an empty p-orbital, while fluorine has a lone pair of electrons in its p-orbital. As a result, boron is a Lewis acid, while fluorine is a Lewis base. Back bonding is a form of bonding in which fluorine donates a lone pair of electrons to boron atoms.



919. In the formation of π-bond, the atomic orbitals overlap in such a way that

(a) their axes remain parallel to each other and perpendicular to the internuclear axis

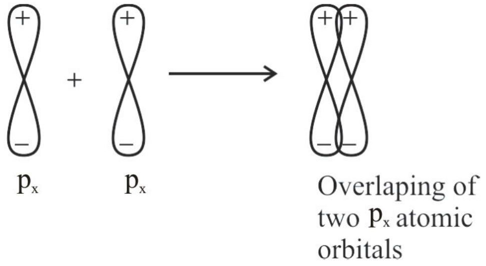
(b) their axes remain parallel to each other and parallel to the internuclear axis

(c) their axes remain perpendicular to each other and parallel to the internuclear axis

(d) their axes remain perpendicular to each other and perpendicular to the internuclear axis.

J & K CET-2014

Ans. (a) : The π bond formed when the atomic orbitals overlap in such a manner that their axes remain parallel to each other and perpendicular to the internuclear axis.



920. Which one of the following has longest covalent bond distance?

(a) C–C (b) C–H

(c) C–N (d) C–O

AP EAMCET (Engg.) -2014

Ans. (a) :

Species	Bond Length (pm)
C – C	154
C – H	107
C – N	143
C – O	143

C – C has the longest covalent bond distance.

921. Which one of the following statements is correct?

(a) Hybrid orbitals do not form σ bonds

(b) Lateral overlap of p-orbitals of p-orbitals and d-orbitals produces π – bonds

(c) The strength of bonds follows the order $\sigma_{p-p} < \sigma_{s-s} < \pi_{p-p}$

(d) s-orbitals do not form σ bonds

AP-EAMCET (Engg.)-2013

Ans. (b) :

(i) Hybrid orbital only head on overlapping to form σ bonds.

(ii) Lateral overlap of p–orbital and d–orbitals produces π – bonds.

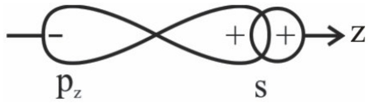
(iii) Head on overlapping is stronger than sideways overlapping. The strength of order is –

$$\pi_{p\text{-}p} < \sigma_{s-s} < \sigma_{p-p}$$

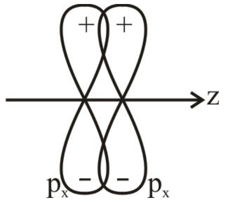
(iv) s-orbitals are spherically and thus show only head on overlapping to form σ bond.

922. Which of the following represents the zero overlap?

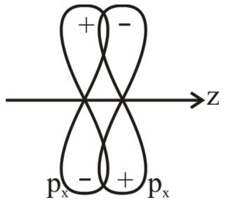
(a)



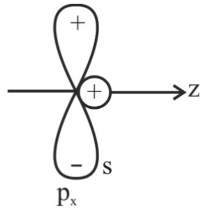
(b)



(c)



(d)



AMU-2013

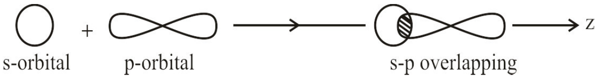
@apna_pdf

Ans. (d) : The covalent bond may be classified into two types depending upon the types of overlapping:

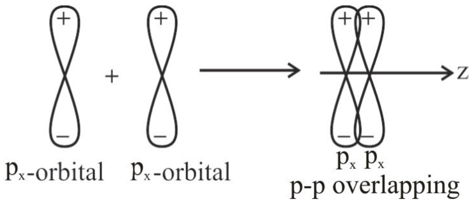
(i) Head on overlap

(ii) Side wise overlapping.

(i)



(ii)



When two atoms came closer to each other, there is overlapping of atomic orbitals. This overlap may be positive, negative or zero depending upon the properties of overlapping of atomic orbitals.

923. Which of the following species contains equal number of a σ and π-bonds>?

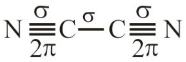
(a) $(CN)_2$ (b) $(CH)_2(CN)_2$

(c) HCO^-_3 (d) XeO_4

NEET-2013

Ans. (d) :

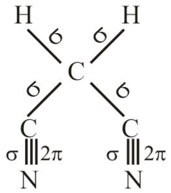
(a)



σ – bond = 3

π – bond = 4

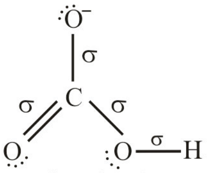
(b)



σ – bond = 6

π – bond = 4

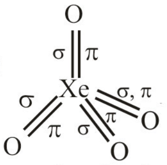
(c)



σ – bond = 4

π – bond = 1

(d)



σ – bond = 4

π – bond = 4

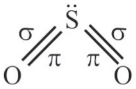
924. Which one of the following molecules contains no π bond?

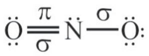
(a) SO_2 (b) NO_2

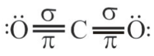
(c) CO_2 (d) H_2O

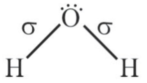
NEET-2013

Ans. (d) : The species are given below:









Here, H_2O has not any π bond.

925. The number of sigma (σ) and pi (π) bonds present in 1, 3, 5, 7-octatetraene respectively are

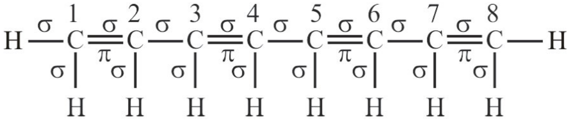
(a) 14 and 3 (b) 17 and 4

(c) 16 and 5 (d) 15 and 4

(e) 16 and 3

Kerala-CEE-2012

Ans. (b) : The structure of 1,3,5,7 octatetraene is given below-



There are 17σ and 4π-bond.

926. The enolic form of acetone contains

(a) 9 sigma bonds, 2 pi bonds and 1 lone pair

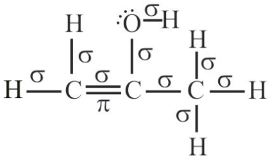
(b) 9 sigma bonds, 1 pi bonds and 2 lone pairs

(c) 8 sigma bonds, 2 pi bonds and 2 lone pairs

(d) 10 sigma bonds, 1 pi bonds and 1 lone pair

AMU-2012

Ans. (b) : The chemical formula of enolic form of acetone is-



(9 σ bonds, 1π bond, two lone pair)

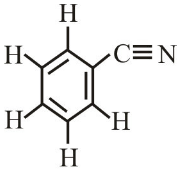
927. The number of sigma (σ) and pi (π) covalent bonds respectively in benzene nitrile are.....

(a) 5, 13 (b) 15, 3

(c) 13, 5 (d) 16, 2

GUJCET-2011

Ans. (c):

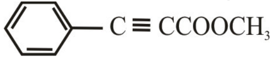


Benzene nitrile

Number of σ bonds = 13

Number of π bonds = 5

928. Consider the following molecule:



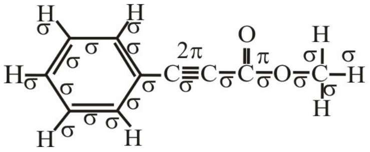
What are the number of sigma and pi bonds present in the above molecule respectively?

(a) 20, 6 (b) 18, 5

(c) 15, 5 (d) 14, 4

SCRA-2010

Ans. (a) :



There are 20 σ and 6π bonds.

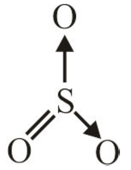
@apna_pdf

929. The type of bonds present in sulphuric anhydride are

(a) 3σ and three pπ – dπ
(b) 3σ one pπ – pπ and two pπ – dπ
(c) 2σ and three pπ – dπ
(d) 2σ and two pπ – dπ

BITSAT-2009
VITEEE- 2009

Ans. (b) : The formula of sulphuric anhydride is SO_3 and its structure is as follows :



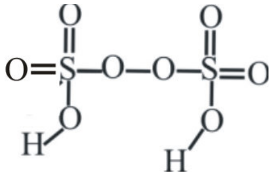
⇒ 3σ, 1pπ-pπ, 2 pπ-dπ bond are present.

930. The number of sigma and pi bonds in peroxodisulphuric acid are, respectively

(a) 9 and 4
(b) 11 and 4
(c) 4 and 8
(d) 4 and 9

AP EAMCET-2008

Ans. (b) : The molecular formula of peroxodisulphuric acid is $H_2S_2O_7$.



In peroxodisulphuric acid, 11σ-bond and 4 π-bond are present.

931. Non-directional orbital is :

(a) 4p
(b) 4d
(c) 4f
(d) 3s

BCECE-2006

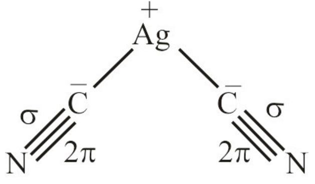
Ans. (d) : Shape of s, p, d orbitals are spherical, dumbell, double dumbell respectively and the shape of f orbital is quite complex. The s-orbitals are spherical in shape and hence non-directional in nature.

932. In $[Ag(CN_2)]^-$, the number of π bonds is:

(a) 2
(b) 3
(c) 4
(d) 6

AIIMS-2006

Ans. (c): The structure of $[Ag(CN)_2]^-$ is given below:



π —bond→4

933. Which one of the following statement is not correct for sigma and pi-bonds formed between two carbon atoms?

(a) Sigma-bond is stronger than a pi-bond
(b) Bond energies of sigma and pi-bonds are of the order of 264 kJ/mol and 347 kJ/mol, respectively
(c) Free rotation of atoms about a sigma-bond is allowed but not in case of a pi-bond.
(d) Sigma-bond determines the direction between carbon atoms but a pi-bond has no primary effect in this regard

NEET-2003

Ans. (b) : Sigma bond is stronger than pi bond because of maximum overlapping extent. Bond energy of sigma and pi bonds are not of the order of 264 kJ/mol and 347 kJ/mol respectively. The bond energy of C – C is 347 kJ/mol and of C = C is 619 kJ/mol.

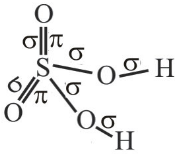
The rotation of σ bond take place in room temperature.

934. What is the number of sigma (σ) and pi (π) bonds present in sulphuric acid molecule?

(a) 6σ, 2π
(b) 6σ, 0π
(c) 2σ, 4π
(d) 2σ, 2π

AP-EAMCET (Medical), 2002

Ans. (a) : The chemical formula of the sulfuric acid is H_2SO_4. The structure is given below –



935. Which statement is not correct?

(a) A sigma bond is weaker than a pi bond
(b) A sigma bond is stronger than a pi bond
(c) A double bond is stronger than a single bond
(d) A double bond is shorter than a single bond

NEET-1990

Ans. (a) : (a) A sigma bond is stronger than the pi bonds.

(b) A sigma bond is stronger than a pi bond because the overlapping of orbitals take place to a larger extent.

(c) The bond length of double and single bond are 1.34A° and 1.54A° respectively. From the data, it is clear that the distance between two atom is small and makes the bond stronger.

(d) The bond length of double bond is 1.34 A° and single bond length is 1.54A°.

936. Which of the following does not apply to metallic bond?

(a) Overlapping valence orbitals
(b) Mobile valence electrons
(c) Delocalized electrons
(d) Highly directed bonds

NEET-1989

Ans. (d) : The metallic bonds are formed when the electron of valence shell of valence orbital overlaps to each other. In metals, there is huge number of mobile electron moving in microscopic level. The electrons are delocalized over a rigid lattice of metal ions in a metallic bond. Metals having free electrons as mobile electrons due to which metallic bond does not have directional property.

@apna_pdf

13. Application of Molecular Orbital Theory

937. In oxygen and carbon molecule the bonding is

(a) $O_2 : 1\sigma, 1\pi; C_2 : 0\sigma, 2\pi$

(b) $O_2 : 0\sigma, 2\pi; C_2 : 2\sigma, 0\pi$

(c) $O_2 : 1\sigma, 1\pi; C_2 : 1\sigma, 1\pi$

(d) $O_2 : 2\sigma, 0\pi; C_2 : 0\sigma, 2\pi$

Karnataka CET-17.06.2022, Shift-II

Ans. (a) : In O_2 the molecular bonding configuration is-

$$O_2 = \sigma 1s^2, \sigma^* 1s^2, \sigma 2s^2, \sigma^* 2s^2, \sigma 2p_z^2,\ \pi 2p_x^2 = \pi 2p_y^2,\ \pi^* 2p_x^1 = \pi^* 2p_y^1$$

$$C_2 = \sigma 1s^2, \sigma^* 1s^2, \sigma 2s^2, \sigma^* 2s^2,\ \pi 2p_x^2 = \pi 2p_y^2$$

Hence, the oxygen and carbon molecule the bonding is $O_2 : 1\sigma, 1\pi$ and $C_2 : O\sigma, 2\pi$

938. Bonding in which of the following diatomic molecule(s) become (s) stronger, on the basis of MO Theory by removal of an electron?

(A) NO (B) N_2 (C) O_2 (D) C_2 (E) B_2

Choose the most appropriate answer from the options given below:

(a) (A), (B), (C) only

(b) (B), (C), (E) only

(c) (A), (C) only

(d) (D) only

JEE Main-25.06.2022, Shift-I

Ans. (c) : (i) For NO = $\sigma 1s^2\ \sigma^* 1s^2\ \sigma 2s^2\ \sigma^* 2s^2$

$$\sigma 2p_z^2,\ \pi 2p_x^2 = \pi 2p_y^2,\ \pi^* 2p_x^1 = \pi 2p_y$$

Bond order = $\frac{10-5}{2} = 2.5$

(ii) $N_2 = \sigma 1s^2, \sigma^* 1s^2, \sigma 2s^2, \sigma^* 2s^2, \pi 2p_x^2 = \pi 2p_y^2, \sigma 2p_z^2$

Bond order = $\frac{10-4}{2} = 3$

(iii) $O_2 = \sigma 1s^2, \sigma^* 1s^2, \sigma 2s^2, \sigma^* 2s^2$

$$\sigma 2p_z^2, \pi 2p_x^2 = \pi 2p_y^2, \pi^* 2p_x^1 = \pi^* 2p_y^1$$

Bond order = $\frac{10-6}{2} = 2$

(iv) $C_2 = \sigma 1s^2, \sigma^* 1s^2, \sigma 2s^2, \sigma^* 2s^2, \pi 2p_x^2 = \pi 2p_y^2$

Bond order = $\frac{8-4}{2} = 2$

(v) $B_2 = \sigma 1s^2, \sigma^* 1s^2, \sigma 2s^2, \sigma^* 2s^2, \pi 2p_x^1 = \pi 2p_y^1$

Bond order = $\frac{6-4}{2} = 1$

Bond strength ∝ Bond order

Hence, $NO \rightarrow NO^+$

Bond order 2.5 3

$O_2 \rightarrow O_2^+$

Bond order 2 2.5

939. Which among the following are having diamagnetic property?

(i) B_2 **(ii) N_2**

(iii) O_2 **(iv) C_2**

(a) ii, iii

(b) i, iv

(c) ii, iv

(d) i, ii

AP-EAMCET-2017

Ans. (c) : According to molecular orbital configuration for,

(i) B_2 = (total electron = 10)

$$= \sigma_{1s^2}, \overset{*}{\sigma}_{1s^2}, \sigma_{2s^2}, \overset{*}{\sigma}_{2s^2}, \pi_{px^1} = \pi_{py^1}$$

Thus, B_2 have two unpaired electron and paramagnetic.

(ii) N_2 = (Total electron = 16)

$$= \sigma_{1s^2}, \overset{*}{\sigma}_{1s^2}, \sigma_{2s^2}, \overset{*}{\sigma}_{2s^2}, \pi_{2px^2} = \pi_{2py^2}, \sigma_{2pz^2}$$

Thus N_2 has no unpaired electron and diamagnetic

(iii) O_2 (Total electron = 16)

$$= \sigma_{1s^2}, \overset{*}{\sigma}_{1s^2}, \sigma_{2s^2}, \overset{*}{\sigma}_{2s^2}, \sigma_{2pz^2}, \pi_{2px^2} = \pi_{2py^2}, \overset{*}{\pi}_{2px^2} = \overset{*}{\pi}_{2py^2}$$

Thus, O_2 has two unpaired electron and paramagnetic

(iv) C_2 = (Total electron = 12)

$$= \sigma_{1s^2}, \overset{*}{\sigma}_{1s^2}, \sigma_{2s^2}, \overset{*}{\sigma}_{2s^2}, \pi_{2px^2} = \pi_{2py^2}$$

Thus, C_2 has no unpaired electron and diamagnetic.

Hence (c) is correct.

940. The molecular orbital configuration of CO is

$$\boldsymbol{\sigma 1s^2, \sigma^* 1s^2, \sigma 2s^2, \sigma^* 2s^2, \pi 2p_x^2 = \pi 2p_y^2, \sigma 2p_z^2}$$

The bond order and magnetic nature of CO molecule are respectively :

(a) 7 and paramagnetic

(b) 5 and paramagnetic

(c) 3 and diamagnetic

(d) 2 and diamagnetic

SCRA-2010

Ans. (c) : The molecular orbital configuration of CO is-

$$\sigma 1s^2, \sigma^* 1s^2, \sigma 2s^2, \sigma^* 2s^2 \left[\begin{matrix} \pi 2p_x^2 \\ \pi 2p_y^2 \end{matrix}\right., \sigma 2p_z^2$$

Bond order = $\frac{1}{2}$ [No. of bonding-No. of anti bonding]

$$= \frac{1}{2}[10-4]$$

$$= \frac{6}{2} = 3$$

941. The electronic configuration

$$\sigma 1s^2 \sigma^* 1s^2 \sigma 2s^2 \sigma^* 2s^2 \sigma 2p_z^2 \pi 2p_x^2 = \pi 2p_y^2 \pi^* 2p_x^1 = \pi^* 2p_y^1$$

can be assigned to

(a) N_2

(b) O_2

(c) F_2

(d) Ne_2

AMU-2006

Ans. (b) : Total number of electrons in bonding and antibonding orbitals = 16. Hence the given electronic configuration represents O_2 molecule.

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05.

States of Matter

1. The Gas Laws

1. A box contains 0.90 g of liquid water in equilibrium with water vapor at 27°C. The equilibrium vapor pressure of water at 27°C is 32.0 Torr. When the volume of the box is increased, some of the liquid water evaporates to maintain be equilibrium pressure. If all the liquid water evaporates. Then the volume of the box must be____ litre. [Nearest integer]
[Given : R= 0.082 L atm K^{-1} mol^{-1}]
(Ignore the volume of the liquid water and assume water vapors behave as an ideal gas.

JEE Main-29.06.2022, Shift-II

Ans. (29) : Given: No. of particle in 0.90 g of liquid water molar mass of H_2O = 18

$T = 27°C = 300K$

$R = 0.0821 \text{ L atm } K^{-1} \text{ Mol}^{-1}$

Vapour pressure of water at 27°C is 32.0 Torr

$\because$ 1 atm = 760 Torr

Form ideal gas equation

$$PV = nRT$$

$$V = \frac{nRT}{P} = \frac{0.90\times0.082\times300\times760}{18\times32}$$

$$= 29.24$$

2. At 300 K, a sample of 3.0 g of gas a occupies the same volume as 0.2 g of hydrogen at 200 K at the same pressure. The molar mass of gas A is_____ g mol^{-1}. (nearest integer) Assume that the behaviour of gases as ideal.
(Given : The molar mass of hydrogen (H_2) gas is 2.0 g mol^{-1}).

JEE Main-24.06.2022, Shift-II

Ans. (45) : From ideal gas equation,

$$PV = nRT$$

Pressure and volume are the same

So, $n_1T_1 = n_2T_2$

$$\frac{m_1}{M_1}T_1 = \frac{m_2}{M_2}T_2$$

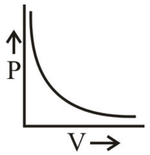
$$\frac{3.0}{M_1}\times300 = \frac{0.2}{2.0}\times200$$

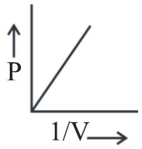
$$900 = 20\times M_1$$

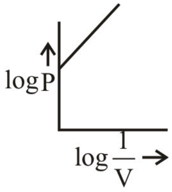
$$M_1 = \frac{900}{200}$$

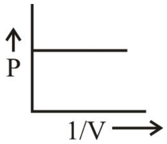
$$M_1 = 45 \text{g mol}^{-1}$$

3. Which of the following plots is not according to Boyle's law?

(a) 

(b) 

(c) 

(d) 

COMEDK 2016

Ans. (d) : $P \propto \frac{1}{V}$, the graph will be a straight line passing through origin

4. A given mass of a gas obeys Boyle's law at certain temperature. Which one of the plots will not given a straight line?

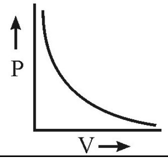
(a) V versus $\frac{1}{P}$ (b) P versus $\frac{1}{V}$
(c) log P versus log V (d) P versus V

A-P EAMCET 1995

Ans. (d) : Boyle's law is a gas law which states that the pressure exerted by a gas (of a given mass, kept at a constant temperature) is inversely proportional to the volume occupied by it.

According to Boyle's law at certain temperature–

$$P \propto \frac{1}{V}$$



5. Which of the following is a representation of Charles' law?

(a) $P_1T_1 = P_2T_2$ (b) $P_1T_2 = P_2T_1$
(c) $P_1V_1 = P_2V_2$ (d) $V_1T_2 = V_2T_1$

A-P EAMCET 1995

Ans. (d) : Charles's law states that the volume of an ideal gas is directly proportional to the absolute temperature at constant pressure.

According to Charles's law, at constant pressure

$$V \propto T$$

or $V_1T_2 = V_2T_1$

6. n moles of an ideal gas at temperature, T (in Kelvin) occupy V L of volume, exerting a pressure of P atmospheres. What is the concentration(in mol/L)?

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(a) $\frac{P}{RT}$ (b) $\frac{PT}{R}$

(c) $\frac{RT}{P}$ (d) $\frac{R}{PT}$

A-P EAMCET 2001

Ans. (a) : For ideal gas equation –

$\therefore$ $PV = nRT$

$$\frac{n}{V} = \frac{P}{RT}$$

or $C = \left(\frac{n}{V}\right) = \frac{P}{RT}$

7. The total pressure of a mixture of 6.4g of O_2 and 5.6 of N_2 present in a 2 L vessel is 1200 mm.

(a) 1200 (b) 600

(c) 900 (d) 200

A-P EAMCET 2000

Ans. (b) : Given that,

Total pressure = 1200 mm

No. of moles of oxygen (m) = $\frac{6.4}{32} = 0.2$ moles

No. of moles of nitrogen (m) = $\frac{5.6}{28} = 0.2$ moles

$\therefore$ Mole fraction of $N_2 = \frac{n_2}{n+n_2} = \frac{0.2}{0.2+0.2} = \frac{1}{2}$

Since, partial pressure = mole fraction of N_2 × total pressure

$= \frac{1}{2} \times 1200 = 600\,\text{mm}$

8. At 27ºC, a closed vessel contains a mixture of equal weights of helium, (mol. wt. = 4), methane (mol. wt. = 16) and sulphur dioxide (mol. wt. = 64). The pressure exerted by the mixture is 210 mm. If the partial pressures of helium, methane and sulphur dioxide are P_1, P_2 and P_3 respectively, which one of the following is correct?

(a) $p_3 > p_2 > p_1$ (b) $p_1 > p_2 > p_3$

(c) $p_1 > p_3 > p_2$ (d) $p_2 > p_3 > p_1$

A-P EAMCET 2002

Ans. (b) : The partial pressure of helium (P_1), methane (P_2) and sulphur dioxide (P_3).

n_1 (He) = 64/4 = 16

n_2 (CH_4) = 64/16 = 4

n_3 (SO_2) = 64/64 = 1

$$\therefore \quad P_1(\text{He}) = X_{\text{He}} \times P = \frac{16}{21} \times 210 = 160\,\text{mm}$$

$$P_2(CH_4) = X_{CH_4} \times P = \frac{4}{21} \times 210 = 40\,\text{mm}$$

$$P_3(SO_2) = X_{SO_2} \times P = \frac{1}{21} \times 210 = 10\,\text{mm}$$

The correct order is –

$P_1 > P_2 > P_3$

9. A and B are ideal gases. The molecular weights of A and B are in the ratio of 1 : 4. The pressure of a gas mixture containing equal weights A and B is p atm. What is the partial pressure (in atm) of B in the mixture?

(a) $\frac{p}{5}$ (b) $\frac{p}{2}$

(c) $\frac{p}{2.5}$ (d) $\frac{3p}{4}$

A-P EAMCET 2005

Ans. (a) : Given that,

Molecular weight ratio of A and B = 1 : 4

Since, mole ratio of A and B if equal weight of A and B are taken = 4 : 1

$\therefore$ Partial pressure of B $= \frac{1}{(1+4)} \times P = \frac{P}{5}$

10. A certain mass of a gas occupies a volume of 2 L at STP. To what temperature the gas must be heated to double its volume, keeping the pressure constant?

(a) 100 K (b) 273 K

(c) 273 ºC (d) 546 ºC

A-P EAMCET 2007

Ans. (c) : Given that, $V_1 = 2L$, $T_1 = 273K$

$V_2 = 4L$, $T_2 = ?$

According to the Charles's law-

$$\frac{V_1}{T_1} = \frac{V_2}{T_2}$$

Putting the value are these, we get –

$$\frac{2}{273} = \frac{4}{T_2}$$

$$T_2 = \frac{4 \times 273}{2} = 546\text{K or } 273^\circ\text{C}$$

11. A person living in Shimla observed that cooking food without using pressure cooker takes more time. The reason is that at high altitude

(a) Temperature decreases

(b) Pressure increases

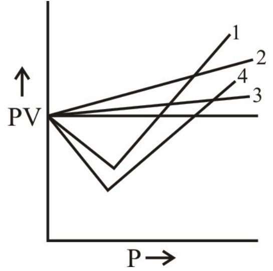
(c) Pressure decreases

(d) Temperature increases

AP EAPCET 23-08-2021 Shift-I

Ans. (c) : A person living in Shimla observed that cooking food without using pressure cooker takes more time. The reason is that at high altitude pressure decreases. Hence, correct option is (c).

12. The figure represents PV vs P relation for CO, CH_4, H_2 and He gases under identical conditions. Which curve, shown in the figure, represents He gas ?



(a) 1 (b) 2

(c) 3 (d) 4

TS-EAMCET (Engg.), 05.08.2021 Shift-II

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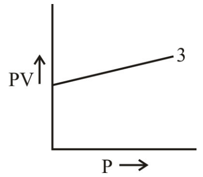
Ans. (c)



This curve represent the He gas in this given figure.

13. 1 L each of gases A and B diffused through a membrane in 15 and 30 minutes, respectively, under identical conditions. What is the ratio of molecular weight of A and B ?

(a) 1 : 2 (b) 2 : 1
(c) 4 : 1 (d) 1 : 4

TS-EAMCET (Engg.), 05.08.2021 Shift-II

Ans. (d) : Using Graham's law of diffusion-

$$\frac{r_1}{r_2} = \sqrt{\frac{m_2}{m_1}}$$

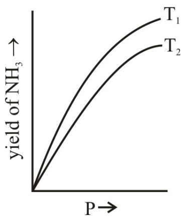
$$\frac{v/15}{v/30} = \sqrt{\frac{m_2}{m_1}}$$

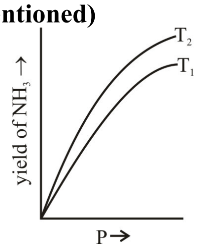
$$\frac{2}{1} = \sqrt{\frac{m_2}{m_1}}$$

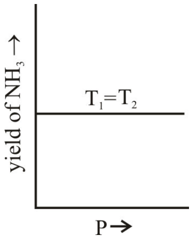
$$\frac{m_2}{m_1} = \frac{4}{1}$$

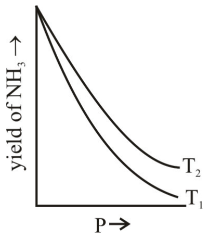
$$\boxed{m_1 : m_2 = 1 : 4}$$

14. For the formation of $NH_3(g)$ from H_2 and N_2, which one of the following graphs represents the yield of ammonia at equilibrium ? (Assume $T_1 < T_2$, unless mentioned)

(a)


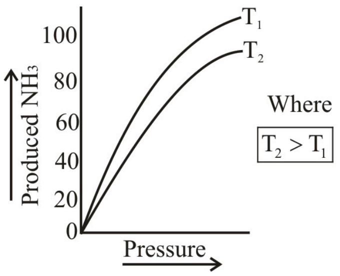
(b)


(c)


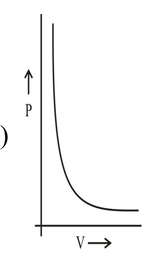
(d)


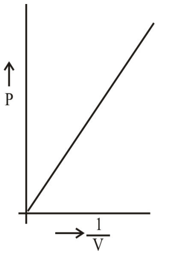
TS-EAMCET (Engg.), 07.08.2021 Shift-II

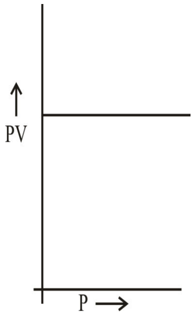
Ans. (a) :

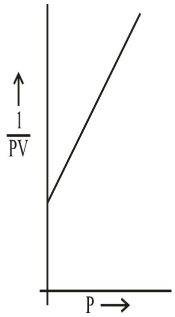


15. Which of the following plots correctly represent Boyle's law?

(a)


(b)


(c)


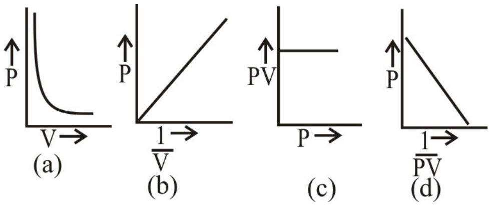
(d)


(a) a, b, d (b) a, c, d
(c) a, b, c, d (d) a, b, c

TS EAMCET 10.08.2021, Shift-I

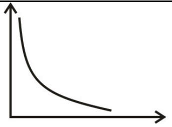
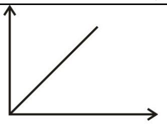
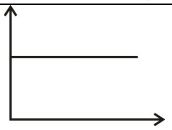
Ans. (d) : Boyle law state that the pressure (p) of a given quantity of gas varies inversely with its volume (v) at constant temperature.

$$\boxed{PV = K}$$



Thus a, b, c is light

16. Match the following graphs of a gas with their corresponding y and x coordinates.

	Graph		y vs x
A.		**1.**	**pV vs V**
B.		**2.**	**P vs V**
C.		**3.**	$p \text{ vs } \frac{1}{V}$

Code:

	A	B	C
(a)	2	3	1
(b)	1	3	2
(c)	2	1	3
(d)	1	2	3

AP EAMCET (Engg.) 18.9.2020 Shift-I

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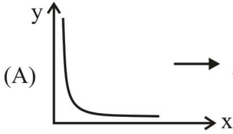
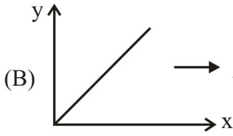
Ans. (a) :

(A)



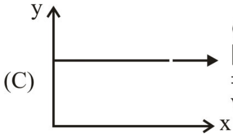
② p vs V (Boyle's law)
[p ∝ 1/V] ⇒ p and V
Vary inversely.

(B)



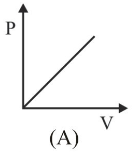
③ p vs V (Boyle's law)
[p ∝ 1/V] ⇒ p and 1/V
Vary directly.

(C)

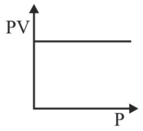


① p vs V (Boyle's law)
[pV = constant]
⇒ pV remains unchanged
with V or p..

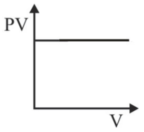
17. Which of the following graphs correctly represents Boyle's Law?



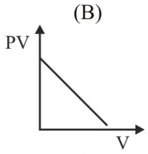
(A)



(B)



(C)



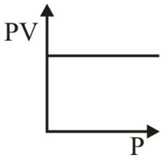
(D)

(a) (A), (B) & (C) only (b) (B) & (C) only
(c) (C) & (D) only (d) (B) & (D) only

AP EAPCET 19-08-2021 Shift-I

Ans. (b) : Boyles law states that –"at constant temperature the pressure of a fixed amount of gas varies inversely with its volume i.e.

$p \alpha \frac{1}{v}$



or pv = K_1 Where K_1 = Proportionality constant it means that at constant temperature product of pressure and volume of a fixed amount of gas is constant.

18. The ratio of rates of diffusion of gases X and Y is 1 : 5 and that of y and Z is 1 : 6. The ratio of rates of diffusion of Z and X is

(a) 1 : 30 (b) 1 : 6
(c) 30 : 1 (d) 6 : 1

AP EAMCET (Engg.) -2014

Ans. (c) : Let assume that the rate of diffusion of X,Y,Z are respectively r_x, r_y, r_z.

Given, $\frac{r_x}{r_y} = \frac{1}{5}$ …..(i)

and $\frac{r_y}{r_z} = \frac{1}{6}$ …..(ii)

Multiplying the equation (i) with (ii) – we get

$$\frac{r_x}{r_y} \times \frac{r_y}{r_z} = \frac{1}{5} \times \frac{1}{6}$$

or $\frac{r_x}{r_z} = \frac{1}{30}$

or $\frac{r_z}{r_x} = \frac{30}{1}$

Hence, the ratio of rates of diffusion of Z and X is 30: 1.

19. The correct value of the gas constant R is close to

(a) 0.082 L atm K^{-1} mol^{-1}
(b) 0.082 L atm^{-1} mol
(c) 0.82 L atm K
(d) 0.082 L atm^{-1} K mol^{-1}

COMEDK 2019

Ans. (a) : $R = \frac{PV}{nT}$

For 1 mole of gas at STP

$$R = \frac{1 \times 22.4}{1 \times 273} = 0.082 \text{ L atm } K^{-1} mol^{-1}$$

20. The rate of diffusion of SO_2, CO_2 PCl_3 and SO_3 are in the following order

(a) $PCl_3 > SO_3 > SO_2 > CO_2$
(b) $CO_2 > SO_2 > PCl_3 > SO_3$
(c) $SO_2 > SO_3 > PCl_3 > CO_2$
(d) $CO_2 > SO_2 > SO_3 > PCl_3$

AIIMS 25 May 2019 (Evening)

Ans. (d): Graham's law states that at a constant temperature and for constant pressure gradient the rates of effusion of different gases are inversely proportional to the square root of their densities. According to the Graham's law –

$$\frac{r_1}{r_2} = \sqrt{\frac{M_2}{M_1}}$$

Where – M_2 = Molecular weight of second gas
M_1 = Molecular weight of first gas

From the above relation it is clear that the rate of diffusion is inversely proportional to the square root of the molecular weight of the gas.

$M_{PCl_3} = 137.33 \text{ g/mol}$ $M_{SO_3} = 80.06 \text{ g/mol}$

$M_{SO_2} = 64.066 \text{ g/mol}$ $M_{CO_2} = 44 \text{ g/mol}$

The increasing order of molecular weight of the gases are –

$$M_{CO_2} < M_{SO_2} < M_{SO_3} < M_{PCl_3}$$

Hence, the rate of diffusion has the following decreasing order –

$$CO_2 < SO_2 < SO_3 < PCl_3$$

21. Which of the following gases will have the highest rate of diffusion?

(a) CO_2 (b) N_2
(c) NH_3 (d) O_2

AIIMS-1994

Ans. (c): According to the Graham's law of diffusion – the rate of diffusion is inversely proportional to the square root of the molecular weight of the gases.

$$r \propto \frac{1}{\sqrt{M}}$$

Where r = rate of diffusion
M = molecular weight

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Hence, $M_{CO_2} = 44, M_{N_2} = 28, M_{NH_3} = 17, M_{O_2} = 32$ NH_3 has the less value of molecular weight due to which they get higher diffusion.

22. Assertion: Use of pressure cooker reduces cooking time.
Reason :At higher pressure cooking occurs faster.

(a) If both Assertion and Reason are correct and the Reason is a correct explanation of the Assertion.
(b) If both Assertion and Reason are correct but Reason is not a correct explanation of the Assertion.
(c) If the Assertion is correct but Reason is incorrect.
(d) If both the Assertion and Reason are incorrect.
(e) If the Assertion is incorrect but the Reason is correct.

AIIMS-2000

Ans. (a): Pressure cookers allow food to cook faster because it raises the pressure and therefore the temperature of the water in it, which ultimately cooks faster.
Hence, both assertion and reason are correct and the reason is a correct explanation of the assertion.

23. Gas in cylinder is maintained at 10 atm pressure and 300 K temperature. The cylinder will explode if pressure of gas is beyond 15atm. What is maximum temperature upto which gas can be heated?

(a) 400 K	(b) 500 K
(c) 450 K	(d) 250 K

AIIMS-27 May, 2018 (M)

Ans. (c): Given, $P_1 = 10$ atm $P_2 = 15$ atm
$T_1 = 300K$ $T_2 = ?$
According to the Gay Lussac's law –
At constant volume, pressure of a fixed amount of a gas varies directly with the temperature.

$$P \propto T$$

or $$\frac{P}{T} = K \text{ (constant)}$$

$$\therefore \frac{P_1}{T_1} = \frac{P_2}{T_2} \text{ (The volume is constant for the cylinder)}$$

$$\frac{10}{300} = \frac{15}{T_2}$$

$$T_2 = 450 \text{ K}$$

24. Two separate bulbs contain ideal gases A and B. The density of gas A is twice that of gas B. The molecular weight of A is half that of gas B. The two gases are at the same temperature. The ratio of the pressure of A to that of gas B is:

(a) 1/4	(b) 1
(c) 4	(d) 2

AIIMS-27 May, 2018 (E)

Ans. (c): Given –

For bulb A –	For bulb B –
$d_A = 2d_B$	$T_A = T_B = T$
$M_A = \frac{M_B}{2}$	$\frac{P_A}{P_B} = ?$

Form the ideal gas equation – we get

$$PV = nRT$$

or $$P = \frac{d}{M}RT$$

Where – P = Pressure of gas
d = Density of gas
M = Molecular weight
R = Gas constant
T = Temperature

$$\therefore P_A = \frac{d_A}{M_A}RT \quad \text{….. (i)}$$

and $$P_B = \frac{d_B}{M_B}RT \quad \text{….. (ii)}$$

Form equation (i) and (ii) – we get

$$\frac{P_A}{P_B} = \frac{d_A}{M_A} \times \frac{M_B}{d_B}$$

$$\frac{P_A}{P_B} = \frac{2d_B}{M_B} \times \frac{2M_B}{d_B}$$

or $$\frac{P_A}{P_B} = \frac{4}{1}$$

25. Cyclopropane and oxygen at partial pressure 170 torr and 570 torr respectively are mixed in a gas cylinder. What is the ratio of the number of moles of cyclopropane to the number of moles of oxygen (nC_3H_6/nO_2)?

(a) $\frac{170 \times 42}{570 \times 32} = 0.39$

(b) $\frac{170}{42} \Big/ \left(\frac{170}{42} + \frac{570}{32}\right) \approx 0.19$

(c) $\frac{170}{740} = 0.23$

(d) $\frac{170}{570} = 0.30$

AIIMS-2015

Ans. (d): Given, $p_{C_3H_6} = 170$ torr

$p_{O_2} = 570$ torr

$\frac{n_{C_3H_6}}{n_{O_2}} = ?$

let, p be the total pressure of the cylinder.
Form the relation between partial pressure and mole fraction – we get

$$p_{C_3H_6} = X_{C_3H_6}.P$$

$$p_{C_3H_6} = \frac{n_{C_3H_6}}{n_{C_3H_6} + n_{O_2}} \times P \quad \text{….(i)}$$

$$P_{O_2} = \frac{n_{O_2}}{n_{O_2} + n_{C_3H_6}} \times P \quad \text{….(ii)}$$

Form equation (I) and (II) – we get

$$\frac{p_{C_3H_6}}{P_{O_2}} = \frac{n_{C_3H_6}}{n_{O_2}} \times \frac{P}{P}$$

Or $$\frac{n_{C_3H_6}}{n_{O_2}} = \frac{170}{570} = 0.30$$

@apna_pdf

26. When a sample of gas is compressed at constant temperature from 15 atm to 60 atm, its volume changes from 76 cm^3 to $20.5cm^3$. Which of the following statements are possible explanations of this behavior?

(1) The gas behaves non- ideally

(2) The gas dimerises

(3) The gas is adsorbed into the vessel walls

(a) 1,2 and 3 (b) 1 and 2 only

(c) 2 and 3 only (d) 1 only

AIIMS-2016

Ans. (d): Given, $P_1 = 15$ atm $V_1 = 76\ cm^3$

$P_2 = 60$ atm $V_2 = 20.5\ cm^3$

From the mathematical expression of Boyle's law –

$$P_1V_1 = P_2V_2$$

$$15 \times 76 = 60 \times 20.5$$

$$1140 \neq 1230$$

$$\therefore \quad P_1V_1 \neq P_2V_2$$

Hence, from the above data it is clear that the gas behaves non-ideally. The given information is not sufficient to comment on other statement.

27. Pure hydrogen sulphide is stored in a tank of 100 litre capacity at 20ºC and 2 atm pressure. The mass of the gas will be

(a) 34 g (b) 340g

(c) 282.68g (d) 28.24 g

AIIMS-2017

Ans. (c): Given, volume = 100 litre

T = 20°C + 273 = 293 K

P = 2 atm

W = ?

Molecular weight of $H_2S(M) = 34$

From the ideal gas equation – we get

$$PV = nRT$$

Where – n = number of mole of the gas

$$Pv = \frac{W}{M}\cdot RT$$

Or $$W = \frac{PVM}{RT}$$

$$W = \frac{2 \times 100 \times 34}{0.0821 \times 293}$$

$$W = 282.74$$

$$W \approx 282.68\ g$$

28. A gas (1g) is kept at 4 bar pressure. If we add 2 g of gas B, then the total pressure inside the container is 6 bar. Which of the following is true?

(a) $M_A=2M_B$ (b) $M_B=2M_A$

(c) $M_A=4M_B$ (d) $M_B=4M_A$

AIIMS-26 May, 2018 (M)

Ans. (d): Given,

For gas A – For gas B –

$W_A = 1g$ $W_B = 2$ g

$P_A = 4$ bar $P_B = 6 - 4 = 2$ Bar

At the container, the volume and temperature are constant. Now, ideal gas equation can be written as for gas A and gas B.

$$P_AV = nRT$$

or $$P_AV = \frac{W_A}{M_A}\cdot RT \qquad ....(i)$$

Similarly, for gas B –

$$P_BV\frac{W_B}{M_B}\cdot RT \qquad ....(ii)$$

Putting the values as well as dividing equation (i) to the (ii) – we get

$$\frac{4V}{2V} = \frac{1}{M_A} \times \frac{M_B}{2}$$

or $$2 = \frac{M_B}{2M_A}$$

or $$M_B = 4M_A$$

29. A bottle of dry ammonia and a bottle of dry hydrogen chloride connected through a long tube are opened simultaneously at both ends. The white ammonium chloride ring first formed will be

(a) at the centre of the tube.

(b) near the hydrogen chloride bottle.

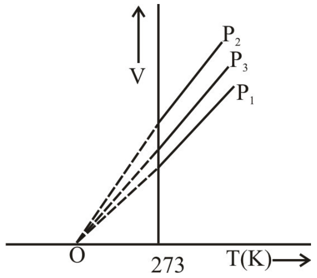
(c) near the ammonia bottle.

(d) throughout the length of the tube.

AIIMS-2014

Ans. (b): According to the Graham's law of diffusion, the rate of diffusion is inversely proportional to the square root of the molecular weight of the gas. The effusion of NH_3 take place fastly than the HCl because it has the less molecular weight than the HCl. Therefore, NH_3 will travel more distance than HCl in the same time interval and the two gas will first meet nearer to HCl end.

30. The volume- temperature graphs of a given mass of an ideal gas at constant pressure are shown below.



What is the correct order of pressure?

(a) $p_1 > p_3 > p_2$ (b) $p_1 > p_2 > p_3$

(c) $p_2 > p_3 > p_1$ (d) $p_2 > p_1 > p_3$

AIIMS-2008

Ans. (a): Boyle's law states that at constant temperature, the pressure of the fixed amount of gas varies inversely with its volume Mathematically, it can be written as –

$$P \propto \frac{1}{V}$$

or $$P = K_1\frac{1}{V}$$

Where K_1 = Proportionality constant.

@apna_pdf

In the given graph, P_2 has the maximum volume due to which they gets the lower value of pressure. On the other hand, P_1 has the least value of volume, it has the higher pressure.

Hence, the correct order of pressure will be –

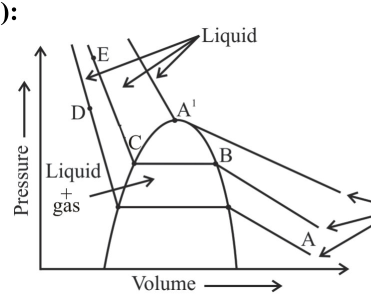
$P_1 > P_3 > P_2$

31. In P versus V graph, the horizontal line is found in which _____exists.

(a) Gas
(b) Liquid
(c) Equilibrium between gas and liquid
(d) Super critical temperature

AIIMS-2007

Ans. (c):



In the right side of the above graph, the CO_2 exists in the gas phase. A point like D represents liquid state and a point under the dome shaped area represents existence of liquid and gaseous carbon dioxide in equilibrium.

32. If P is pressure and ρ is density of a gas, then P and ρ are related as

(a) $P \propto \rho$
(b) $P \propto (1/\rho)$
(c) $P \propto \rho^2$
(d) $P \propto (1/\rho^2)$

AIIMS-2002

Ans. (a): The ideal gas equation for n mole can be written as –

$$PV = nRT$$

or $$P = \frac{W}{MV}RT$$

or $$P = \frac{\rho}{M}\cdot RT$$

or $$P \propto \rho$$

Hence, pressure of the gas is directly proportional to the density of gas.

33. At 298K, equal volumes of SO_2, CH_4 and O_2 are mixed in empty container. The total pressure exerted in 2.1 atm. The partial pressure of CH_4 in mixture is:

(a) 0.6 atm
(b) 1.2 atm
(c) 2.4 atm
(d) 3.6 atm

AIIMS-2000

Ans. (b): Given, Total Pressure (P) = 2.1 atm, $p_{CH_4} = ?$

Let, W be the weight of all gases.

$$\therefore\ n_{SO_2} = \frac{W}{64}, \qquad n_{CH_4} = \frac{W}{16}, \qquad n_{O_2} = \frac{W}{32}$$

$$p_{CH_4} = \frac{n_{CH_4}}{n_{CH_4} + n_{SO_2} + n_{O_2}} \times \text{Total pressure}$$

$$p_{CH_4} = \frac{\frac{W}{16}}{\frac{W}{16} + \frac{W}{64} + \frac{W}{32}} \times 2.1$$

$$p_{CH_4} = \frac{1}{\left(1 + \frac{1}{4} + \frac{1}{2}\right)} \times 2.1$$

$$p_{CH_4} = \frac{1}{\left(\frac{7}{4}\right)} \times 2.1$$

$$p_{CH_4} = \frac{2.1 \times 4}{7}$$

$$p_{CH_4} = 1.2 \text{ atm}$$

34. A gas occupies a volume of 300 cc at 27ºC and 620 mm pressure. The volume of gas at 47°C and 640 mm pressure is:

(a) 260cc
(b) 310 cc
(c) 390cc
(d) 450 cc

AIIMS-1997

Ans. (b): Given, $V_1 = 300$ cc, $V_2 = ?$

$T_1 = 27°C + 273 = 300$ K $T_2 = 47°C + 273 = 320$ K

$P_1 = 620$ mm Hg $P_2 = 640$ mm Hg

If temperature, volume and pressure of a fixed amount of gas vary from T_1, V_1 and P_1 to T_2, V_2 and P_2 then we can write-

$$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$$

$$\frac{620 \times 300}{300} = \frac{640 \times V_2}{320}$$

or $$V_2 = 310 \text{ cc}$$

35. On the top of a mountain, water boils at :

(a) high temperature
(b) same temperature
(c) high pressure
(d) low temperature

AP-EAMCET (Engg.) 2015

Ans. (d) : On the top of a mountain, water boils at low temperature. Pressure is directly proportional to temperature. At low pressure, boiling point of water come down.

36. When a perfect gas a 27° is heated at a constant pressure, to a final temperature of 327°C, then the volume of the gas increases to _____ times the original

(a) 3
(b) 4
(c) 2
(d) 6

AP- EAPCET- 07-09-2021, Shift-I

Ans. (c) : Given, $T_1 = 27°C = 300$ K

$T_2 = 327°C = 600K$, $V_1 = V$, $V_2 = ?$

Since, the process is a constant pressure process, apply Charle's law-

$$\frac{V_1}{V_2} = \frac{T_1}{T_2}$$

@apna_pdf

$$\frac{V}{V_2} = \frac{300}{600}$$

$$\frac{V}{V_2} = \frac{1}{2}$$

$$\boxed{V_2 = 2V}$$

So, the volume of gas increase to '2' times the original

37. CH_4 diffuses two times faster than a gas X. The number of molecules present in 32 g of gas X is (N is Avogadro number)

(a) N (b) $\frac{N}{2}$

(c) $\frac{N}{4}$ (d) $\frac{N}{16}$

AP-EAMCET- (Engg.) - 2010

Ans. (b) : According to Graham's law of diffusion

$$\frac{r_{CH_4}}{r_x} = \sqrt{\frac{M_x}{M_{CH_4}}}$$

Given, $r_{CH_4} = 2 \cdot r_x$

$$\frac{2rx}{rx} = \sqrt{\frac{Mx}{16}}$$

So, $2 = \sqrt{\frac{M_x}{16}}$

$M_x = 4 \times 16 = 64$

Thus, the molecular mass of gas X is 64.

Number of molecules of gas X in 32 gm gas $= \frac{32}{64} \times N$

$$= \frac{N}{2}$$

38. The volume of oxygen gas liberated at 27°C and 760 mm Hg pressure when 24.5 g of $KClO_3$ is heated, is (M. wt. of $KClO_3$ = 122.5)

(a) 4.48 L (b) 9.6 L

(c) 7.4 L (d) 11.2 L

AP - EAMCET(MEDICAL) - 2009

Ans. (c) : The decomposition of KCl_3 can be written as–

$$2KClO_3 \longrightarrow 2KCl + 3O_2$$

At STP 2×122.5 $3 \times 22.4 = 67.2$ L

$= 245$

$\because$ When 245g $KClO_3$ is heated, then amount of oxygen liberated i.e = 67.2 L

$\therefore$ When 24.5g $KClO_3$ is heated, liberated oxygen $= \frac{67.2 \times 24.5}{245} = 6.72$ L

The given amount of O_2 was librated at STP. Therefore, at 27°C and 760 mm Hg pressure, the volume of liberated oxygen will be–

$$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$$

or $$V_2 = \frac{P_1V_1}{T_1} \times \frac{T_2}{P_2}$$

$$V_2 = \frac{760 \times 6.72}{273} \times \frac{300}{760}$$

$V_2 = 7.38$ L

$V_2 \approx 7.4$ L

39. A gaseous mixture containing He, CH_4 and SO_2 was allowed to effuse through a fine hole then find what molar ratio of gases coming out initially? (Given mixture contains He, CH_4 and SO_2 in 1 : 2 : 3 mole ratio).

(a) $\sqrt{2} : \sqrt{2} : 3$ (b) 2 : 2 : 3

(c) 4 : 4 : 3 (d) 1 : 1 : 3

VITEEE-2014

Ans. (c) : Given mole ratio of He, CH_4 and SO_2 is 1:2:3 respectively.

$$\frac{n'_{He}}{n'_{CH_4}} = \frac{1}{2}\sqrt{\frac{\text{molar mass of } CH_4}{\text{molar mass of He}}}$$

$$= \frac{1}{2}\sqrt{\frac{16}{4}}$$

$$= \frac{1}{2} \times 2 = \frac{1}{1} = 1$$

$$\frac{n'_{He}}{n'_{SO_2}} = \frac{1}{2}\sqrt{\frac{64}{4}} = \frac{4}{3}$$

So, The molar ratio of the gases coming out will be–

$$n_{He} : n_{CH_4} : n_{SO_2} = 4:4:3$$

40. Two glass bulbs A and B are connected by a very small tube having a stop-cock. Both A has a volume of 100 cm^3 and contained the gas while bulb B was empty. On opening stop-clock, the pressure fell down to 40%. The volume of the bulb B must be

(a) 75 cm^3 (b) 125 cm^3

(c) 150 cm^3 (d) 250 cm^3

VITEEE- 2011

Ans. (c) : According to the Boyle's law – at the constant temperature. The pressure of the gas is inversely propotimal to it's volume.

$$\therefore \ P \propto \frac{1}{V}$$

i.e. for two gases –

$$P_1 V_1 = P_2 V_2$$

Given – Glass bulb (A) Glass bulb (B)

$P_1 = P$ $P_2 = \frac{P \times 40}{100}$

$V_1 = 100$ cm^3 $V_2 = ?$

$\therefore$ $P_1V_1 = P_2V_2$

or $$V_2 = \frac{P_1V_1}{P_2}$$

$$V_2 = \frac{\cancel{P} \times 100 \times 100}{\cancel{P} \times 40}$$

$$V_2 = 250 \text{cm}^3$$

$\therefore$ Volume of bulb B = 250 – 100 = 150 cm^3

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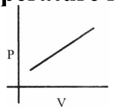
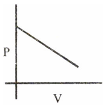
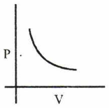
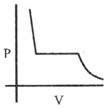
41. Graph between P & V below critical temperature is:

(a) 

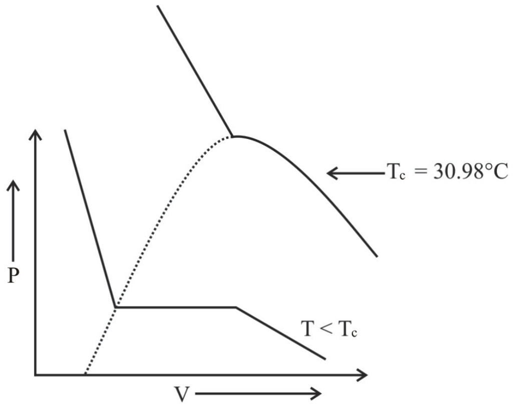
(b) 

(c) 

(d) 

AIIMS 26 May 2019 (Evening)

Ans. (d): Critical temperature of a substance is the temperature at and above which vapour of the substance cannot be liquefied, no matter how much pressure is applied.



42. A 2.5 liter flask contains 0.25 mol each of sulphur dioxide and nitrogen gas at 27°C. The total pressure exerted by the mixture of the two gases will be

(a) 4.98×10^5 Pa (b) 2.49×10^5 Pa
(c) 4.98×10^{10} Pa (d) 2.49×10^{10} Pa

[Given : R=8.314 $JK^{-1}mol^{-1}$]

AMU – 2007

Ans. (a) : Total number of moles of two gases = 0.5 mole

Total pressure exerted by two gases, $P = \dfrac{nRT}{V}$

Here, n = 0.5, R = 8.314 J mol^{-1} K^{-1}, T = 300K,
V = 2.5 liter = 2.5×10^3 cm^3
Here R = 8.314 K^{-1} mol^{-1} = 8.314 k Pa K^{-1} mol^{-1}
= 8.314×10^3 Pa K^{-1} mol^{-1} cm^3

$$p = \frac{0.25\times8.314\times10^3\times300}{2.5} \text{ Pa} = 498.84\times10^3 \text{ Pa}$$
$= 4.98\times10^5$ Pa

43. Which of the following variable determine the state of a system?

(a) Volume and temperature
(b) Pressure and temperature
(c) Volume, pressure, and temperature
(d) Volume, pressure, temperature and concentration

AMU–2003

Ans. (c) : From the ideal gas equation-
PV = nRT
Where- P = Pressure of the gas
V = Volume of the gas
n = Number of the gas
R = Gas constant
T = Absolute temperature

Ideal gas equation is a relation between four variables and it describes the state of any gas, therefore, it is also called equation of state.

44. Standard boiling point of a liquid is

(a) equal to the normal boiling point
(b) slightly lower than the normal boiling point
(c) slightly higher than the normal boiling point
(d) The boiling point at 1 atm pressure

Assam CEE-2019

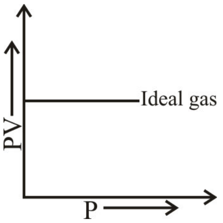
Ans. (d) : Boiling point at 1 atm pressure also it is slightly lower than normal boiling point of liquid.

45. Slope between PV and P at constant temperature is :

(a) zero (b) 1
(c) $\dfrac{1}{2}$ (d) $\dfrac{1}{\sqrt{2}}$

BCECE-2004

Ans. (a) : When we plot PV vs. P plot of gases because at constant temperature, PV will be constant (Boyle's law) and PV vs. P graph at all pressures will be a straight line parallel to X-axis. In this situation, the slope between PV and P is zero.



46. If two molecules of A and B having mass 100 kg and 64 kg and rate of diffusion of A is 12×10^{-3}, then what will be the rate of diffusion of B?

(a) 15×10^{-3} (b) 64×10^{-3}
(c) 5×10^{-3} (d) 46×10^{-3}

BCECE-2008

Ans. (a) : Given data, M_A = 100 kg , $r_A = 12 \times 10^{-3}$
M_B = 64 kg, r_B = ?

The rate of diffusion are directly proportional to their molecular weights, M_A and M_B.

$$\therefore \quad \frac{r_A}{r_B} = \sqrt{\frac{M_B}{M_A}}$$
$$= \frac{12\times10^{-3}}{r_B} = \sqrt{\frac{64}{100}}$$
$$= \frac{12\times10^{-3}}{r_B} = \frac{8}{10}$$
$r_B = 15 \times 10^{-3}$

47. At a constant volume the specific heat of a gas is 0.05 and its molecular weights is 40. The gas is :

(a) Monoatomic (b) Diatomic
(c) Triatomic (d) None of above

BITSAT 2010

@apna_pdf

Ans. (a) : $q = \frac{c}{m}$

$\Rightarrow C_V = q \times m$

$= C_V = q \times m$

$= 0.05 \times 40$

$= 3.0$ cal

$C_P - C_V = R$

$C_P = C_V + R$

$= 3 + 2$

$= 5$

$\frac{C_P}{C_V} = \frac{5}{3} = 1.66$

Monoatomic gas.

48. 100 ml O_2 and H_2 kept at same temperature and pressure. What is true about their number of molecules.

(a) $NO_2 > NH_2$ (b) $NO_2 < NH_2$

(c) $NO_2 = NH_2$ (d) $NO_2 + NH_2 = 1$ mole

BITSAT 2018

Ans. (c) : This is Avogadro's hypothesis.

According to this, equal volume of all gases contain equal no. of molecules under similar condition of temperature and pressure.

49. The predominant intermolecular forces present in ethyl acetate, a liquid, are:

(a) London dispersion and dipole-dipole

(b) London dispersion, dipole-dipole and hydrogen bonding

(c) Dipole-dipole and hydrogen bonding

(d) Hydrogen bonding and London dispersion

[JEE Main 2020, 8 Jan Shift-I]

Ans. (a) : Force of attraction between two temporary dipoles is known as London force. Another name for this force is dispersion force. Here, ethyl acetate has the temporary dipole whereas liquid has permanent dipole due to which dipole-dipole forces act as the liquid.

50. Based on kinetic theory of gases following laws can be proved

(a) Boyle's law (b) Charles' law

(c) Avogadro's law (d) All of these

[AIEEE 2002]

Ans. (d) : We can deduce gas laws from kinetic theory of gases as follows-

(i) Boyle's law

$$P = \frac{1}{3}\frac{nm}{V}V_{rms}^2$$

$$PV = \frac{1}{3}\, nm\, V_{rms}^2$$

Now, as V_{rms} is a function of temperature above, so if temperature is constant, V_{rms} is constant. Hence, at constant temperature, the term an right hand side of equation is a constant.

$\therefore$ PV = constant

(ii) Charles' law-

$$P = \frac{1}{3}\frac{mn}{V}\; V_{rms}^2$$

or $$V = \frac{2n}{3P}\left(\frac{1}{2}mV_{rms}^2\right)$$

$$V = \frac{2}{3}\frac{n}{P}\frac{3}{2}K_BT$$

So, when P = constant then V = T

or $\frac{V}{T} = a$ (constant)

(iii) Avogadro's law-

Let, there are two gases under same condition of pressure, volume and temperature, then for gas 1,

$$PV = \frac{1}{3}m_1n_1\left(V_1\right)_{rms}^2$$

for gas 2,

$$PV = \frac{1}{3}m_2n_2\left(V_2\right)_{rms}^2$$

As the temperature is same, $\frac{1}{2}m_1\left(V_1\right)_{rms} = \frac{1}{2}m_2\left(V_2\right)_{rms}$

$\therefore$ $n_1 = n_2$

Equal volume of all gases at same pressure and temperature contains equal number of molecules.

51. When r. p and M represent rate of diffusion, pressure and molecular mass, respectively, then the ratio of the rates of diffusions (r_A/r_B) of two gases A and B is given as

(a) $\left(p_A/p_B\right)^{1/2}\left(M_A/M_B\right)$

(b) $\left(p_A/p_B\right)\left(M_B/M_A\right)^{1/2}$

(c) $\left(p_A/p_B\right)^{1/2}\left(M_B/M_A\right)$

(d) $\left(p_A/p_b\right)\left(M_A/M_B\right)^{1/2}$

[AIEEE 2011]

Ans. (b) : According to Graham's law of diffusion

$$r_d \propto \frac{1}{\sqrt{\text{Molar mass}}}$$

At constant temperature

$$r_d \propto \frac{\text{pressure}}{\sqrt{\text{Molar mass}}}$$

$$\frac{r_A}{r_B} = \frac{P_A/\sqrt{M_A}}{P_B/\sqrt{M_B}}$$

$$\frac{r_A}{r_B} = \left(\frac{P_A}{P_B}\right)\left(\frac{M_B}{M_A}\right)^{1/2}$$

52. If 10^{-4} dm^3 water is introduced into a 1.0 dm^3 flask at 300 K, then how many moles of water are in the vapour phase when equilibrium is established?

(Given, vapour pressure of H_2O at 300 K is 3170 Pa;

R = 8.314 JK^{-1}mol^{-1}

(a) 5.56×10^{-3} mol (b) 1.53×10^{-2} mol

(c) 4.48×10^{-2} mol (d) 1.27×10^{-3} mol

[AIEEE 2010]

Ans. (d) : Given: - T = 300K, R = 8.314 JK^{-1}mol^{-1}

Vapour pressure (p) = 3170 Pa

Volume of water = 10^{-4} dm^3

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Volume of flask = 1 $dm^3 = 10^{-3}$ m^3

Number of moles = (n) = ?

As we know that vapour pressure doesn't depends on volume of water. So we use volume of flask (V).

From ideal gas equation,

$$n=\frac{PV}{RT}$$

$$n=\frac{3170\times10^{-3}}{300\times8.314}$$

n= 1.27×10^{-3} mol

53. An open vessel at 27ºC is heated until two fifth of the air (assumed as an ideal gas) in it has escaped from the vessel. Assuming that the volume of the vessel remains constant, the temperature at which the vessel has been heated is

(a) 750 K (b) 500 K

(c) 750ºC (d) 500ºC

[JEE Main 2019, 12 Jan Shift-II]

Ans. (b) : Given :- T_1 = 27°C = 300K

$$n_1=n,\ n_2=n-\frac{2}{5}n=\frac{3}{5}n.$$

Ideal gas equation at constant pressure and volume,

nT = constant

$$n_1T_1=n_2T_2$$

$$T_2=\frac{n_1T_1}{n_2}$$

$$T_2=\frac{n\times(300)}{\frac{3}{5}n}=\frac{300\times5}{3}=500K$$

54. The volume of gas A is twice than that of gas B. The compressibility factor of gas A is thrice than that of gas B at same temperature. The pressures of the gases for equal number of moles are

(a) $p_A=2p_B$ (b) $2p_A=3p_B$

(c) $p_A=3p_B$ (d) $3p_A=2p_B$

[JEE Main 2019, 12 Jan Shift-I]

Ans. (b) : Compressibility factor (Z) = $\frac{PV}{nRT}$

At constant temperature and moles, $\frac{Z}{PV}$ = constant

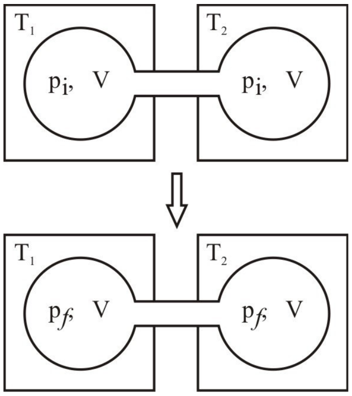
$$Z_A=3Z_B, V_A=2V_B$$

$$\frac{Z_A}{P_AV_A}=\frac{Z_B}{P_BV_B}$$

$$\frac{P_A}{P_B}=\frac{Z_A}{Z_B}\times\frac{V_B}{V_A}=\frac{3}{2}$$

$$2P_A=3P_B$$

55. Two closed bulbs of equal volume (V) containing an ideal gas initially at pressure, p_i and temperature T_1 are connected through a narrow tube of negligible volume as shown in the figure below. The temperature of one of the bulbs is then raised to T_2. The final pressure p_f is



(a) $2p_i\left(\frac{T_1}{T_1+T_2}\right)$ (b) $2p_i\left(\frac{T_2}{T_1+T_2}\right)$

(c) $2p_i\left(\frac{T_1T_2}{T_1+T_2}\right)$ (d) $p_i\left(\frac{T_1T_2}{T_1+T_2}\right)$

JEE Main-2016

Ans. (b) : For closed system, total number of mole before and after increment of temperature is equal i.e.,

$$(n_1+n_2)_i\,(n_1+n_2)_f$$

$n=\frac{PV}{RT}$ from ideal gas equation

$$\frac{P_iV}{RT_1}+\frac{P_iV}{R\cdot T_1}=\frac{P_fV}{RT_1}+\frac{P_fV}{RT_2}$$

$$\frac{2P_i}{T_1}=\frac{P_f}{T_1}+\frac{P_f}{T_2}=P_f\left(\frac{T_1+T_2}{T_1\times T_2}\right)$$

$$P_f=\frac{2P_i}{T_1}\left(\frac{T_1+T_2}{T_1\times T_2}\right)$$

$$P_f=\frac{2PiT_1.T_2}{T_1(T_1+T_2)}$$

$$\boxed{P_f=\frac{2P_iT_2}{T_1+T_2}}$$

56. The intermolecular interaction that is dependent on the inverse cube of distance between the molecules is

(a) ion-ion interaction

(b) ion-dipole interaction

(c) London force

(d) Hydrogen bond

[JEE Main 2015]

Ans. (b) : Ion-ion interaction is dependent on the square of distance, i.e. ion-ion interaction $\propto\frac{1}{r^2}$

Similarly, ion-dipole interaction $\propto\frac{1}{r^3}$

London forces $\propto\frac{1}{r^6}$

And dipole-dipole interaction $\propto\frac{1}{r^3}$

Superficially it seems as both ion dipole interaction and hydrogen bonding vary with the inverse cube of

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distance between the molecules but when we look at the exact expression of field (force) created in two situations it comes as

$$|E| \text{ or } |F| = \frac{2|P|}{4\pi\varepsilon_0 r^3}$$

(In case of ion-dipole interaction)

And $$F = \frac{2q^2r - 4q^2a}{4\pi\varepsilon_0 r^3}$$

(In case of dipole-dipole interaction)

From the above it is very clear, the ion-dipole interaction is the better answer as compared to dipole-dipole interaction i.e. hydrogen bonding.

57. A spherical balloon of radius 3 cm containing helium gas has a pressure of 48×10^{-3} bar. At the same temperature, the pressure, of a spherical balloon of radius 12 cm containing the same amount of gas will be.......x 10^{-6} bar.

[JEE Main 2020, 6 Sep Shift-I]

Ans. (750) : Given:- $P_1 = 48 \times 10^{-3}$ bar

$r_1 = 3\text{cm}$ $r_2 = 12$ cm

$P_2 = ?$

$$\text{Initial Volume } (V_1) = \frac{4}{3}\pi r_1^3 = \frac{4}{3}\pi(3)^3$$

$$\text{Final volume} = (V_2) = \frac{4}{3}\pi r_2^3 = \frac{4}{3}\pi(12)^3$$

Ideal gas equation at constant temperature,

PV = constant

$P_1V_1 = P_2V_2$

$$P_2 = \frac{48\times10^{-3}\times\frac{4}{3}\pi(3)^3}{\frac{4}{3}\pi(12)^3}$$

$= 750 \times 10^{-6}$ bar

58. The relative strength of interionic /intermolecular forces in decreasing order is

(a) dipole-dipole>ion-dipole>ion-ion
(b) ion-ion>ion-dipole>dipole-dipole
(c) ion-dipole>ion-ion>dipole-dipole
(d) ion-dipole>dipole-dipole>ion-ion

[JEE Main 2020, 7 Jan Shift-I]

Ans. (b) : Ion-Ion interaction are stronger because they have stronger electrostatic force of attraction whereas dipoles have partial charges and hence the electrostatic force of attraction is the weak. The relative strength of inter ionic/intermolecular forces in decreasing order is Ion-ion > ion-dipole > dipole - dipole.

59. A car tyre is filled with nitrogen gas 35 psi at 27ºC. It will burst if pressure exceeds 40 psi. The temperature in ºC at which the car tyre will burst is......
(Rounded-off to the nearest integer).

[JEE Main 2021, 25 Feb Shift-I]

Ans. (70) : Given :- $P_1 = 35$ psi, $P_2 = 40$ psi

$T_1 = 27°C = 300K$, $T_2 = ?$

From ideal gas equation, at constant volume

$$\frac{P}{T} = \text{constant}$$

$$\frac{P_1}{T_1} = \frac{P_2}{T_2}$$

$$T_2 = 40 \times \frac{300}{35} = 342.85\,K$$

$$T_2 = 342.85 - 273.15 \approx 70°C$$

60. The volume occupied by 4.75 g of acetylene gas at 50ºC and 740 mm Hg pressure is.......L (Rounded off to the nearest integer).
[Given, R = 0.0821 L atm K^{-1} mol^{-1}]

[JEE Main 2021, 24 Feb Shift-II]

Ans. (5) : Given :- P = 740 mm Hg = $\frac{740}{760}$ atm

T = 50°C = 323K, w = 4.75g

Volume (V) = ?

$$\text{Moles of acetylene gas (n)} = \frac{w}{M} = \frac{4.75}{26}\text{mol}$$

From ideal gas equation,

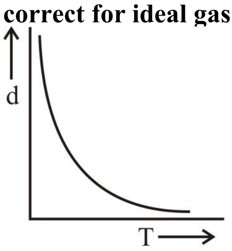
PV = nRT

$$V = \frac{4.75}{26}\times\frac{0.0821\times323}{\frac{740}{760}}$$

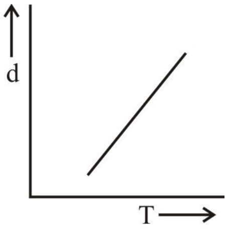
$$= \frac{4.75\times0.0821\times323\times760}{25\times740}$$

$V \approx 5$ L

61. Which one of the following graphs is not correct for ideal gas?



(i)



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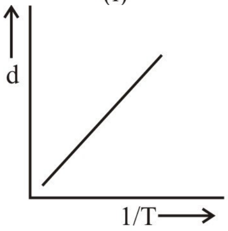
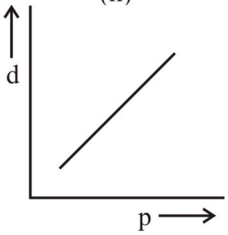


(iii)



(iv)

d = density, p = pressure,
T = temperature

(a) III (b) I
(c) IV (d) II

[JEE Main 2020, 2 Sep Shift-I]

Ans. (d) : Ideal gas equation,

PV = nRT

$$\text{Density (d)} = \frac{\text{Mass}(m)}{\text{Volume}(V)}$$

$$\text{Mole (m)} = \frac{\text{Mass}(m)}{\text{Molar mass}(M)}$$

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$$PV = \frac{m}{M}RT$$

$$d = \frac{m}{V} = \frac{PM}{RT}$$

At constant therefore, $d \propto$ Pressure (P)

$d \propto$ Molar mass (M)

$$d \propto \frac{1}{\text{Temperature}(T)}$$

d vs T graph is hyperbola

d vs $1/T$ is straight line

d vs P is straight line

62. The pressure exerted by a non-reactive gaseous mixture of 6.4 g of methane and 8.8 g of carbon dioxide in a 10L vessel at 27ºC is…….kPa (Round off to the nearest integer) (Assume gases are ideal, $R = 8.314$ J mol^{-1} K^{-1} Atomic mass = C: 12.0 u, H: 1.0 u, 0:16.0 u)

[JEE Main 2021, 17 March Shift-I]

Ans. (150) Given:- V=10 L=10^{-2} m^3, T = 27°C = 300K

$$n_{CH_4} = \frac{6.4}{16} = 0.4 \text{ mol}$$

$$n_{CO_2} = \frac{8.8}{4.4} = 0.2 \text{ mol}$$

$n = n_{CH_4} + n_{CO_2} = 0.4 + 0.2 = 0.6$ mol

P = ?

From ideal gas equation

PV = nRT

$$P = \frac{nRT}{V}$$

$$P = \frac{0.6 \times 8.314 \times 300}{10^{-2}}, \quad P \approx 150 \text{k Pa}$$

63. An LPG cylinder contains gas at a pressure of 300 kPa at 27ºC. The cylinder can withstand the pressure of 12×10^6 Pa. The room in which the cylinder is kept catches fire. The minimum temperature at which the bursting of cylinder will take place is…….ºC. (Nearest integer)

[JEE Main 2021, 25 July Shift-II]

Ans. (927) : Given :– T_1 = 27°C = 300K

P_1 = 300k Pa $\quad$ $P_2 = 1.2 \times 10^6$ Pa

Ideal gas equation at constant volume,

$$\frac{P}{T} = \text{constant}$$

$$\frac{P_1}{T_1} = \frac{P_2}{T_2}$$

$$T_2 = \frac{1.2 \times 10^6 \times 300}{300 \times 10^3} = 1200K$$

$$T_2 = 927°C$$

64. An empty LPG cylinder weight 14.8 kg. When full, it weight 29.0 kg and shows a pressure of 3.47 atm. In the course of use at ambient temperature, the mass of the cylinder is reduced to 23.0 kg. The final pressure in side of the cylinder is…….atm. (Nearest integer)

[JEE Main 2021, 1 Sep Shift-II]

Ans. (2) : Given :- Initial weight of gas = 29 –14.8

= 14.2 kg

= 14200g

Final weight of gas = 23 – 14.8 = 8.2 kg = 8200g

P_1 = 3.47 atm

From ideal gas equation at constant temperature and volume,

$$\frac{P}{n} = \text{Constant}$$

$$\frac{P_1}{n_1} = \frac{P_2}{n_2}$$

$$P_2 = \frac{3.47}{\frac{14200}{M.M}} \times \frac{8200}{M.M} = \frac{3.47 \times 8200}{14200}$$

P_2 = 2 atm

65. Among the following statements, that which was not proposed by Dalton was

(a) Chemical reactions involve reorganization of atoms. These are neither created nor destroyed in a chemical reaction.

(b) When gases combine or reproduced in a chemical reaction they do so in a simple ratio by volume provided all gases are at the same T and P.

(c) All the atoms of a given element have identical properties including identical mass. Atoms of different elements differ in mass.

(d) Matter consists of indivisible atoms.

[JEE Main 2020, 7 Jan Shift-I]

Ans. (b) : When gases combine or reproduced in a chemical reaction they do so in a simple ratio by volume provided all gases are at the same temperature and pressure. This is the Gay Lussac's law.

Volume $\propto$ No. of moles

So, only this statement is not given by Dalton.

66. Which equation will explain the nature of PV versus P curve for CO_2 gas at moderately low pressure ?

(a) PV=RT+Pb $\quad$ (b) PV=RT+a/V

(c) PV=RT–a/V $\quad$ (d) PV=RT–aV

J & K CET-(2018)

Ans. (c) : Vander Waal's equation for real gas

$$\left(P + \frac{an^2}{v^2}\right)(v - nb) = nRT$$

For 1 mole gas,

$$\left(P + \frac{a}{v^2}\right)(v - b) = RT$$

At moderately low pressure,

$V \gg b$

$$\therefore \left(P + \frac{a}{v^2}\right)V = RT$$

$$PV + \frac{a}{v} = RT$$

$$PV = RT - \frac{a}{V}$$

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67. The boiling point of water decreases at high altitudes because

(a) the atmospheric pressure is low
(b) the temperature is low
(c) the atmospheric pressure is high
(d) the temperature is high

J & K CET-(2005)

Ans. (a) : Water starts boiling when vapour pressure is equal to atmospheric pressure This temperature is known as boiling point of water. At high altitude boiling point of water decreases because the atmospheric pressure is also decreases.

68. Which of the following is the true value of the gas constant R in Joules/degree/mole?

(a) 8.314
(b) 6.023×10^{23}
(c) 8.314×10^{7}
(d) 6.023

J & K CET-(2002)

Ans.(a): For STP

n = 1 mole
T = 0°C = 273k
$P = 1.01 \times 10^5\ N/M^2$
V = 22.4 liter
$= 22.4 \times 10^{-3}\ m^3$

from ideal gas equation–

PV = nRT

$$R = \frac{PV}{nT}$$

$$R = \frac{1.01\times10^5\times22.4\times10^{-3}}{1\times273}$$

$$\boxed{R = 8.31\,Jmol^{-1}k^{-1}}$$

69. Five grams each of the following gas at 87°C and 750 mm pressure is taken. The gas with least volume is

(a) HF
(b) HCl
(c) HBr
(d) HI

J & K CET-(2000)

Ans. (d) : According to ideal gas equation,

PV = nRT

$$PV = \frac{w}{M}RT \qquad \left\{mole(n) = \frac{weight(w)}{Molar\,mass\,(M)}\right\}$$

From above equation, we said that, as molar mass of gas increases, volume will decreases.

HI molecule will have highest molar mass. Hence HI have least volume.

70. The carbon di-oxide gas does not follow gaseous laws at all ranges of pressure and temperature because:

(a) it is triatomic gas
(b) its internal energy is quite high
(c) there is attraction between its molecules
(d) it solidify at low temperature

JCECE - 2004

Ans. (c) : CO_2 is a real gas. So, it does not follow kinetic theory of gases, gas law and ideal gas equation.

Ideal gases do not show intermolecular force of attraction but CO_2 is real gas. It shows intermolecular force of attraction between its molecules.

71. If rate of diffusion of CH_4 is twice than that of a gas *x*, then its molecular mass is :

(a) 64 g
(b) 16 g
(c) 32 g
(d) 8 g

JCECE - 2006

Ans. (a) : According to Graham's law of diffusion, rate of diffusion $(r_d) \propto \frac{1}{\sqrt{Molecular\,Mass}}$

It is given that, $r_{CH_4} = 2r_x$

$$\frac{r_x}{r_{CH_4}} = \sqrt{\frac{M_{CH_4}}{M_a}} \quad \Rightarrow \quad \frac{r_x}{2r_x} = \sqrt{\frac{16}{x}}$$

$$\frac{1}{(2)^2} = \frac{16}{x}$$

$$x = 16\times4 = 64$$

72. Avogadro's hypothesis states that:

(a) The ideal gas consists of a large number of small particles called molecules
(b) Under the same conditions of temperature and pressure equal volumes of gases contain the same number of molecules
(c) Volume of a definite quantity of gas at constant pressure is directly proportional to absolute temperature
(d) A given mass of gas at constant pressure is directly proportional to absolute temperature

JCECE - 2005

Ans. (b) : According to Avogadro's law, equal volumes of gases contain the same number of molecules at constant temperature and pressure.

Volume (V) ∝ Number of molecules

73. The volume of a gas measured at 27°C and 1 atm pressure is 10L. To reduce the volume to 2L at 1 atm pressure, the temperature required is

(a) 60 K
(b) 75 K
(c) 150 K
(d) 225 K

JCECE - 2007

Ans. (a) : Given :-

$V_1 = 10L \qquad V_2 = 2L$

$P = 1atm \qquad T = 27°C = 300K$

From ideal gas equation at constant pressure

$$\frac{V}{T} = constant$$

$$\frac{V_1}{T_1} = \frac{V_2}{V_2} \quad \Rightarrow \quad T_2 = \frac{V_2}{V_1}\times T_1$$

$$T_2 = \frac{2}{10}\times300 = 60K$$

74. A gas mixture contains O_2 and N_2 in the ratio of 1 : 4 by weight. The ratio of their number of molecules is

(a) 1 : 8
(b) 1 : 4
(c) 3 : 16
(d) 7 : 32

JIPMER-2008

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Ans. (d) : Given :- $\frac{w_{O_2}}{w_{N_2}} = \frac{1}{4}$

Molecular mass of $O_2 = 32$

Molecular mass of $N_2 = 28$

$$\frac{n_{O_2}}{n_{N_2}} = \frac{w_{O_2}/M_{O_2}}{w_{N_2}/M_{N_2}} = \frac{w_{O_2}}{w_{N_2}} \times \frac{M_{O_2}}{M_{N_2}}$$

$$\frac{n_{O_2}}{n_{N_2}} = \frac{1}{4} \times \frac{28}{302} = \frac{7}{32}$$

Number of molecules = mole × N_A

$$\frac{\text{Number of molecules of } O_2}{\text{Number of molecules of } N_2} = \frac{7 \times N_A}{32 \times N_A}$$

$$= \frac{7}{32}$$

75. Ratio of molecular weights of A and B is $\frac{4}{25}$ then ratio of rates of diffusion will be

(a) 5 : 1 (b) 5 : 2

(c) 25 : 3 (d) 25 : 4

JIPMER-2005

Ans. (b)

Given,

$$\frac{\text{Molecular weight of } (M_A)}{\text{Molecular weight of } B(M_B)} = \frac{4}{25}$$

Find $\frac{r_A}{r_B}$

According to Graham's law of diffusion

$$\text{rate of diffusion} \propto \frac{1}{\sqrt{\text{Molecular weight}}}$$

$$\frac{r_A}{r_B} = \sqrt{\frac{M_B}{M_A}} = \sqrt{\frac{25}{4}} = \frac{5}{2}$$

$r_A : r_B = 5 : 2$

76. Moles of N_2 = 0.4 and moles of O_2 = 0.1 find (P_{N_2}) Partial pressure of N_2 at atmospheric pressure.

(a) 0.2 atm (b) 0.8 atm

(c) 0.6 atm (d) 0.4 atm

JIPMER-2019

Ans. (b) : Given that,

Moles of $N_2 = 0.4$

Moles of $O_2 = 0.1$

Then, mole fraction of $N_2 = \frac{0.4}{0.4+0.1} = 0.8$

We know that –

Partial pressure = mole fraction × total pressure

= 0.8 × 1 = 0.8 atm

77. If V = 1 litre, 10 mole of H_2 and 10 mole of N_2 gas are mixed at temperature 26°C. Then calculate pressure of the gas.

(a) 491 atm (b) 300 atm

(c) 550 atm (d) 600 atm

JIPMER-2019

Ans. (a) : Given,

V = 1L T = 26°C = 299 K

$n_T = 10 + 10 = 20$ mole

From ideal gas equation,

PV = nRT

$$P = \frac{nRT}{V} = \frac{20 \times 0.0821 \times 299}{1}$$

≈ 491 atm

78. Which of the following equations does not represent Charles's law for a given mass of gas at constant pressure?

(a) $\frac{V}{T} = K$

(b) log V = log K + log T

(c) log K = log V + log T

(d) $\frac{d(\text{In } V)}{dT} = \frac{1}{T}$

Karnataka-CET-2019

Ans. (c) : According to Charle's law, volume of a definite quantity of gas at constant pressure is directly proportional to absolute temperature.

$$V \propto T$$

$$\frac{V}{T} = \text{constant} = K$$

Taking log on both side

logV – logT = logK

logV = logK + logT

Differentiating both side w.r.t temperature

$$\frac{d(\ln V)}{dT} = \frac{d}{dT}\log T = \frac{1}{T}$$

79. 0.5 mole of each of H_2, SO_2 and CH_4 are kept in a container. A hole was made in the container. After 3 hours the order of partial pressure in the container will be

(a) $pSO_2 > pH_2 > pCH_4$ (b) $pSO_2 > pCH_4 > pH_2$

(c) $pH_2 > pSO_2 > pCH_4$ (d) $pH_2 > pCH_4 > pSO_2$

Karnataka-CET, 2009

Ans. (b) : Rate of diffusion $\propto \frac{1}{\sqrt{\text{molecular mass}}}$.

Lighter the gas, more is the rate of diffusion.

∴ Order of diffusion : $H_2 > CH_4 > SO_2$

Hence, order of partial pressure is

$pSO_2 > pCH_4 > pH_2$

80. In order to increase the volume of a gas by 10%, the pressure of the gas should be

(a) increased by 10% (b) increased by 1%

(c) decreased by 10% (d) decreased by 1%

KARNATAKA-CET, 2008

Ans. (c) : According to Boyle's law,

$$p \propto \frac{1}{V}$$

Hence, in order to increase the volume of a gas by 10%, the pressure of the gas should be decreased by 10%.

81. The ratio of rate of diffusion of SO_2 (M = 64) and oxygen (M = 32) is :

(a) 1 : 1 (b) 2 : 1

(c) 1 : 2 (d) 1 : 1.414

Manipal-2019

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Ans. (d) : According to Graham's law of diffusion,

$$\text{rate of diffusion} \propto \frac{1}{\sqrt{\text{Molar mass}}}$$

$$\frac{r_{SO_2}}{r_{O_2}} = \sqrt{\frac{M_{O_2}}{M_{SO_2}}} = \sqrt{\frac{32}{64}} = \frac{1}{\sqrt{2}}$$

$$r_{SO_2} : r_{O_2} = 1 : 1.414$$

82. In liquid gas equilibrium, the pressure of vapours above the liquid is constant at

(a) Constant temperature
(b) Low temperature
(c) High temperature
(d) None of these

AIPMT-1995

Ans. (a) : At equilibrium, amount of vapour is same until temperature is not changed. Vapour pressure only depends on temperature. If temperature is kept constant then vapour pressure is also constant at equilibrium.

83. The beans are cooked earlier in pressure cooker because

(a) boiling point increase with increasing pressure
(b) boiling point decrease with increasing pressure
(c) extra pressure of pressure cooker softens the beans
(d) internal energy is not lost while cooking in pressure cooker

NEET-2011

Ans. (a) : In pressure cooker, as pressure on the particle increases they comes closer due to the increases in kinetic energy of particles, which further increases the temperature inside the pressure cooker. Thus boiling point increases, which help beans to cooked earlier.

84. A gas at 350 K and 15 bar has molar volume 20 percent smaller than that for an ideal gas under the same conditions. The correct option about the gas and its compressibility factor (Z) is

(a) $Z < 1$ and repulsive forces are dominant
(b) $Z > 1$ and attractive forces are dominant
(c) $Z > 1$ and repulsive forces are dominant
(d) $Z < 1$ and attractive forces are dominant

NEET-2019

Ans. (d) : Compressibility factor (Z) = $\frac{V_{real}}{V_{ideal}}$

For given gas, $\frac{V_{real}}{V_{ideal}} < 1$

Then compressibility factor (Z) is also less than 1

$Z < 1$

If $Z < 1$ then, attractive force are dominant on gaseous molecules.

85. At STP, 0.50 mol H_2 gas and 1.0 mol He gas

(a) have equal average kinetic energies
(b) have equal molecular speeds
(c) occupy equal volumes
(d) have equal effusion rates

NEET-1993

Ans. (a) : Average kinetic energy of gases is depends only on the temperature So, H_2 and He gas will have equal average kinetic energies

$$\text{Kinetic energy} = \frac{3}{2}RT$$

86. Correct gas equation is

(a) $\frac{V_1T_2}{P_1} = \frac{V_2T_1}{P_2}$
(b) $\frac{P_1V_1}{P_2V_2} = \frac{T_1}{T_2}$
(c) $\frac{P_1T_1}{V_1} = \frac{P_2V_2}{T_2}$
(d) $\frac{V_1V_2}{T_1T_2} = P_1P_2$

NEET-1989

Ans. (b) : According to ideal gas equation,

$PV = nRT$

for 1 mole

$$\frac{PV}{T} = \text{constant}$$

$$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$$

$$\frac{P_1V_1}{P_2V_2} = \frac{T_1}{T_2}$$

87. A gaseous mixture was prepared by taking equal moles of CO and N_2. If the total pressure of the mixture was found 1 atmosphere, the partial pressure of the nitrogen (N_2) in the mixture is

(a) 0.5 atm
(b) 0.8 atm
(c) 0.9 atm
(d) 1 atm

NEET-2011

Ans. (a) : Given : Total Pressure = 1 atm

Weight of N_2 = weight of CO
Molar mass of CO = 28
Molar mass of N_2 = 28

$$\text{Mole fraction of } N_2 = \frac{w/28}{\frac{w}{28} + \frac{w}{28}} = \frac{1}{2} = 0.5$$

Partial pressure = Mole fraction × Total pressure

$$P_{N_2} = 0.5 \times 1 = 0.5 \text{ atm}$$

88. A bubble of air is underwater at temperature 15°C and the pressure 1.5 bar. If the bubble rises to the surface where the temperature is 25°C and the pressure is 1.0 bar, what will happen to the volume of the bubble

(a) volume will become greater by a factor of 1.6.
(b) volume will become greater by a factor of 1.1
(c) volume will become smaller by a factor of 0.70
(d) volume will become greater by a factor of 2.5

NEET-2011

Ans. (a) : Given : $T_1 = 15^\circ C = 288$ K

$T_2 = 25^\circ C = 298$ K
$P_1 = 1.5$ bar $\qquad P_2 = 1$ bar

According to ideal gas equation,

$PV = nRT$

$$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$$

@apna_pdf

$$\frac{V_2}{V_1} = \frac{1.5 \times 298}{288}$$

$$\frac{V_2}{V_1} = 1.55$$

$V_2 = 1.55\ V_1$

So, volume will become greater by a factor of 1.6.

89. The pressure exerted by 6.0 g of methane gas in a 0.03 m^3 vessel at 129^{o}C is (Atomic masses : C =12.01, H = 1.01 and R= 8.314 K^{-1} mol^{-1})

(a) 215216 Pa (b) 13409 Pa
(c) 41648 Pa (d) 31684Pa

NEET-2010

Ans. (c) : Given : W = 6g, V = 0.03 m^3

T = 129°C = 402 K

P = ?

From ideal gas equation,

$$P = \frac{nRT}{V} = \frac{\frac{6}{16.05} \times 8.314 \times 402}{0.03}$$

P = 41647.7 Pa

P = 41648 Pa

90. Which of the following mixtures of gases does not obey Dalton's law of partial pressure?

(a) Cl_2 and SO_2 (b) CO_2 and He
(c) O_2 and CO_2 (d) N_2 and O_2

NEET-1996

JIPMER-2019

Ans. (a) : Non-reacting gases does not follow Dalton's law of partial pressure.

So, SO_2 and Cl_2 mixture of gases does not obey Dalton's law of partial pressure because they react and form SO_2Cl_2.

91. At what temperature, the rate of effusion of N_2 would be 1.625 times than the rate of SO_2 at 50^{o}C?

(a) 373 K (b) 620 K
(c) 100 K (d) 173 K

NEET-1996

Ans. (c) : Given : $\frac{r_{N_2}}{r_{SO_2}} = 1.625$

$$\text{Rate of effusion} \propto \sqrt{\text{Temperature}}$$

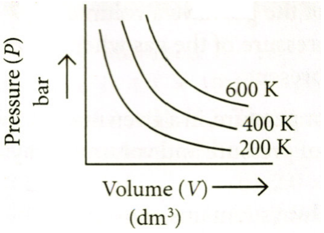
$$\propto \frac{1}{\sqrt{\text{Molor Mass}}}$$

$$\frac{r_{N_2}}{r_{SO_2}} = \sqrt{\frac{T_{N_2}}{28} \times \frac{64}{323}} = 1.625$$

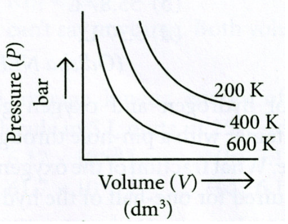
$$T_{N_2} = 373\ K = 100°C$$

92. Choose the correct option for graphical representation of Boyle's law, which shows a graph of pressure vs volume of a gas at different temperatures.

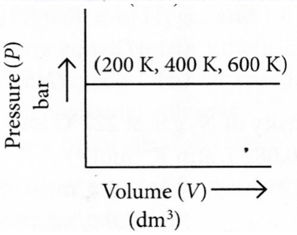
(a)



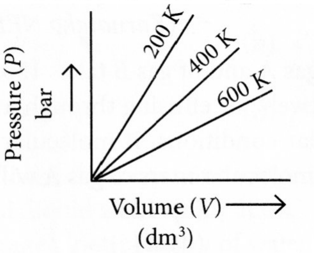
(b)



(c)



(d)



NEET-2021

Ans. (a) : According to Boyle's law

$$P \propto \frac{1}{V}$$

Pressure is inversely proportional to volume at constant temperature.

PV = constant

As the magnitude of PV increases, temperature also increases. Hence option (a) is correct.

93. At 25^{o}C and 730 mm pressure, 380 mL of dry oxygen was collected. If the temperature is constant, what volume will the oxygen occupy at 760 mm pressure?

(a) 569 mL (b) 365 mL
(c) 265 mL (d) 621 mL

NEET-1999

Ans. (b) : Given : T = 25°C = 298 K

V_1 = 380 mL, P_1 = 730 mm

P_2 = 760 mm

V_2 = ?

According to ideal gas equation at constant temperature.

PV = constant

$P_1V_1 = P_2V_2$

$730 \times 380 = 760 \times V_2$

$$V_2 = \frac{730 \times 380}{760}$$

V_2 = 365 mL

@apna_pdf

94. Pressure remaining the same, the volume of a given mass of an ideal gas increase for every degree centigrade rise in temperature by definite fraction of its volume at

(a) 0^oC

(b) its critical temperature

(c) absolute zero

(d) its Boyle temperature

NEET-1989

Ans. (a) : $V_T = V_0 (1 + \propto T)$

V_0 is the volume at 0°C

for 1° rise in temperature,

$V_T = V_0 (1 + \propto)$

$V_T = V_0 + V_0 \propto$

$V_T - V_0 = V_0 \propto$

$DV = V_0 \propto$

Where $\propto$ is definite fraction

Hence, Volume V_0 is at 0°C temperature

95. Choose the correct option for the total pressure (in atm) in a mixture of 4 g O_2 and 2 g H_2 confined in a total volume of on litre at 0^oC is [Given R = 0.082 L atm $mol^{-1}K^{-1}$, T = 273K]

(a) 26.02	(b) 2.518
(c) 2.602	(d) 25.18

NEET-2021

Ans. (d) : Given : $W_{O_2} = 4g$, $W_{H_2} = 2g$

V = 1L T = 0°C = 273 K

Total Pressure (P_T) = ?

$$\text{Total moles} = \frac{4}{32} + \frac{2}{2} = \frac{9}{8} \text{ mole}$$

From ideal gas equation,

PV = nRT

$$P = \frac{nRT}{v} = \frac{9}{8} \times \frac{0.082 \times 273}{1}$$

P = 25.18 atm

96. A mixture of N_2 and Ar gases in a cylinder contains 7 g of N_2 and 8 g of Ar. If the total pressure of the mixture of the gases in the cylinder is 27 bar, the partial pressure of N_2 is [Use atomic masses (in g mol^{-1}) : N = 14, Ar = 40]

(a) 9 bar	(b) 12 bar
(c) 15 bar	(d) 18 bar

NEET-2020

Ans. (c) : Given : Weight of N_2 = 7g

Weight of Ar = 8g

Total pressure = 27 bar

Molar mass of N_2 = 28

Molar mass of Ne = 40

$$\text{Mole fraction of } N_2 = \frac{7/28}{\frac{7}{28} + \frac{8}{40}} = \frac{5}{9}$$

Partial Pressure = Mole fraction × Total Pressure

$$P_{N_2} = \frac{5}{9} \times 27 = 15 \text{ bar}$$

97. The volume occupied by 1.8g of water vapour at 374^oC and 1 bar pressure will be (Use R = 0.083 bar L K^{-1} mol^{-1})

(a) 96.66 L	(b) 55.87 L
(c) 3.10 L	(d) 5.37 L

NEET-Odisha-2019

Ans. (d) : Given : w = 1.8 g

T = 374°C = 647 K P = 1 bar

According to ideal gas equation

$$V = \frac{nRT}{P} = \frac{\frac{w}{M}RT}{P}$$

$$V = \frac{1.8 \times 0.083 \times 647}{18 \times 1}$$

V = 5.37 L

98. Equal moles of hydrogen and oxygen gases are placed in a container with a pin-hole through which both can escape. What fraction of the oxygen escape in the time required for one-half of the hydrogen to escape?

(a) 3/8	(b) 1/2
(c) 1/8	(d) 1/4

NEET-2016

Ans. (c) : Given :

Fraction of hydrogen escaped-

$$= \frac{1}{2} \times \text{Total mole (x) of hydrogen}$$

$$\frac{r_{O_2}}{r_{H_2}} = \frac{V_{O_2}/t_{O_2}}{V_{H_2}/t_{H_2}} = \sqrt{\frac{M_{H_2}}{M_{O_2}}}$$

$$\frac{V_{O_2}}{V_{H_2}} = \sqrt{\frac{M_{H_2}}{M_{O_2}}}$$

$$t_{O_2} = t_{H_2}$$

$$\frac{V_{O_2}}{\frac{1}{2}} = \sqrt{\frac{2}{32}} = \sqrt{\frac{1}{16}}$$

$$2V_{O_2} = \frac{1}{4}$$

$$V_{O_2} = \frac{1}{8}$$

99. What is the density of N_2 gas at 227^oC and 5.00 atm pressure? (R = 0.082 L atm K^{-1} mol^{-1})

(a) 1.40 g/mL	(b) 2.81 g/mL
(c) 3.41 g/mL	(d) 0.29 g/mL

NEET-Karnataka 2013

Ans. (c) : Given : T = 227°C = 500 K

P = 5 atm, Molar mass of N_2 (M) = 28

From ideal gas equation,

$$PV = nRT = \frac{w}{M}RT$$

$$\frac{w}{V} = \text{density (d)}$$

$$d = \frac{PM}{RT} = \frac{5 \times 28}{500 \times 0.082}$$

d = 3.41 g/mL

@apna_pdf

100. Equal masses of H_2, O_2 and methane have been taken in a container of volume V at temperature 27°C in identical conditions. The ratio of the volumes of gases $H_2 : O_2$: methane would be

(a) 8 : 16 : 1 (b) 16 : 8 : 1
(c) 16 : 1 : 2 (d) 8 : 1 : 2

NEET-2014

Ans. (c) : According to Avogadro's law, volume of gas is directly proportional to the number of moles of gas at constant temperature and pressure.

$$V \propto n$$

$$V_{H_2} : V_{O_2} : V_{CH_4} = n_{H_2} : n_{O_2} : n_{CH_4}$$

$$\text{mole} = \frac{\text{weight}}{\text{molar mass}}$$

$$V_{H_2} : V_{O_2} : V_{CH_4} = \frac{w}{2} : \frac{w}{32} : \frac{w}{16}$$

$$= 16 : 1 : 2$$

101. What volume of oxygen as (O_2) measured at 0°C and 1 atm, is needed to burn completely 1 L of propane gas (C_3H_8) measured under the same conditions?

(a) 5 L (b) 10 L
(c) 7 L (d) 6 L

NEET-2008

Ans. (a) : $C_3H_8 + 5O_2 \longrightarrow 3CO_2 + 4H_2O$

From the balanced chemical reaction, we know that for combustion of 1L of propane gas, 5L of oxygen gas is required.

102. 0.24 g of a volatile gas, upon vaporization, gives 45 mL vapour at NTP. What will be the vapour density of the substance? (Density of H_2 = 0.089 g/L)

(a) 95.93 (b) 59.93
(c) 95.39 (d) 5.993

NEET-1996

Ans. (b) : Vapour density = $\frac{\text{Molar mass}}{2}$

$$\text{Mole} = \frac{\text{weight}}{\text{molar mass}} = \frac{\text{volume (in L)}}{22.4\text{L}} = \frac{V(\text{in mL})}{22400}$$

$$\text{Molar mass} = \frac{w}{V} \times 22400$$

$$= \frac{0.24}{45} \times 22400$$

$$= 119.46$$

$$\text{Vapour density} = \frac{119.46}{2}$$

$$= 59.73$$

103. Mark the correct statement.

(a) For a chemical reaction to be feasible, ΔG should be zero
(b) Entropy is a measure of order of a system
(c) For a chemical reaction to be feasible, ΔG increases
(d) The total energy of an isolated system is constant

UP CPMT-2014

Ans.(d): According to first law of thermodynamic, the total energy of an isolated system remain constant. Energy can neither be created nor destroyed. It may be change one form to another form.

104. Mark out of the wrong expression.

(a) Boyle's temperature, $T_B = \frac{a}{bR}$

(b) Critical pressure, $p_c = \frac{a}{27b^2}$

(c) Critical volume, $T_c = \frac{8a}{27Rb}$

(d) Critical volume, $V_c = 3b$

UP CPMT-2011

Ans. (a) : Boyle's temperature, $T_B = \frac{a}{Rb}$

105. A mixture of gases having different molecular weights is separated by which method ?

(a) Atmolysis
(b) Metathesis
(c) Ostwald and Walker method
(d) Reverse osmosis

UP CPMT-2010

Ans. (a): Diffusion method is used to separate a mixture of gases having different molecular weights as rate of diffusion varies inversely with molecular mass, i.e.

$$r \propto \frac{1}{\sqrt{M}}$$

This method is called atmolysis.

106. Which is the correct relation for diffusion of gases?

(a) $r \propto d$ (b) $r \propto \sqrt{d}$
(c) $r \propto \frac{1}{\sqrt{d}}$ (d) None of these

UP CPMT-2005

Ans. (c): According to Graham's law of diffusion,

$$r \propto \frac{1}{\sqrt{d}}$$

Where, r = rate of diffusion of gas
d = density of gas

107. A gaseous mixture contains 56 g of N_2, 44 g of CO_2 and 16 g of CH_4. The total pressure of mixture is 720 mm of Hg. The partial pressure of methane is

(a) 75 atm (b) 160 atm
(c) 180 atm (d) 215 atm

UP CPMT-2003
A-P EAMCET 1991

Ans. (c) : Partial pressure of CH_4
= mole fraction of CH_4 × total pressure
Given, mass of N_2= 56 g, mass of CO_2 = 44 g
Mass of CH_4= 16 g

$$\text{Moles of } N_2 = \frac{\text{mass}}{\text{mol.wt.}} = \frac{56}{28} = 2$$

$$\text{Moles of } CO_2 = \frac{\text{mass}}{\text{mol.wt.}} = \frac{44}{44} = 1$$

@apna_pdf

Moles of CH_4= $\frac{\text{mass}}{\text{mol.wt.}}=\frac{16}{16}=1$

$\therefore$ Total moles = moles of N_2+moles of CO_2+moles of CH_4

= 2+1+1

= 1

$\therefore$ Mole fraction of CH_4= $\frac{\text{moles of } CH_4}{\text{total moles}}=\frac{1}{4}$

$\therefore$ Partial pressure of CH_4= $\frac{1}{4}\times 720$ atm

= 180 atm

108. At identical temperature and pressure, the rate of diffusion of hydrogen gas is $3\sqrt{3}$ times that of a hydrocarbon having molecular formula C_nH_{2n-2} What is the value of n?

(a) 1
(b) 4
(c) 3
(d) 8

WB-JEE-2010

Ans. (b) : Given,

$$\frac{r_{H_2}}{r_{C_nH_{2n-2}}}=3\sqrt{3}$$

Let molar mass of $r_{C_nH_{2n-2}}=M$

According to Graham's law of diffusion.

Rate of diffusion $\propto \frac{1}{\sqrt{\text{Molar Mass}}}$

$$\frac{r_{H_2}}{r_{C_nH_{2n-2}}}=\sqrt{\frac{M}{2}}$$

$$\left(3\sqrt{3}\right)^2=\frac{M}{2}$$

M = 27 × 2 = 54

12n + 1(2n – 2) = 54

14n – 2 = 54

14n = 56

n = 4

109. In a flask, the weight ratio of CH_4 (g) and SO_2 (g) at 298 K and 1 bar is 1 : 2. The ratio of the number of molecules of SO_2(g) and CH_4 (g) is

(a) 1:4
(b) 4:1
(c) 1:2
(d) 2:1

WB-JEE-2017

Ans. (c) : Given,

$$\frac{w_{CH_4}}{w_{SO_2}}=\frac{1}{2}$$

$$\text{Mole}=\frac{\text{weight}}{\text{molar mass}}$$

$$\frac{n_{CH_4}}{n_{SO_2}}=\frac{w_{CH_4}}{M_{CH_4}}\times\frac{M_{SO_2}}{w_{SO_2}}$$

$$\frac{1}{2}\times\frac{64}{16}=2$$

No. of molecules = mole × N_A

$$\frac{\text{No. of molecules of } SO_2}{\text{No. of molecules of } CH_4}=\frac{n_{SO_2}}{n_{CH_4}}=\frac{1}{2}$$

110. At 273 K temperature and 76 cm Hg pressure, the density of a gas is 1.964 g L^{-1}. The gas is

(a) CH_4
(b) CO
(c) He
(d) CO_2

WB-JEE-2020

Ans. (d) : Given, T = 273 K

P = 76 cm Hg = 760 mmHg = 1atm

d = 1.964

According to ideal gas equation,

$$d=\frac{PM}{RT}\Rightarrow\frac{1\times M}{0.0821\times 273}=1.964$$

M = 1.964 × 0.0821 × 273

M = 44

Hence, molar mass of CO_2 is 44.

111. Equal masses of ethane and hydrogen are mixed in an empty container at 298 K.The fraction of total pressure exerted by hydrogen is

(a) 15:16
(b) 1:1
(c) 1:4
(d) 1:6

WB-JEE-2020

Ans. (a) : Given, mass of ethane = mass of hydrogen = x

We know that,

Molar mass of ethane (C_2H_6) = 30

Molar mass of hydrogen (H_2) = 2

Then,

Moles of ethane $=\frac{x}{30}$

Moles of hydrogen $=\frac{x}{2}$

Mole fraction of hydrogen $=\frac{x/2}{x/2+x/30}$

Partial pressure of hydrogen = mole fraction of H_2 × total pressure

Then,

$$\frac{\text{Partial pressure of } H_2}{\text{Total pressure}}=\text{mole fraction of } H_2$$

$$=\frac{x/2}{x/2+x/30}=\frac{15}{16}$$

112. A mixture of 40 g of oxygen and 40 g of helium has a total pressure of 0.9 atm. The partial pressure of oxygen is

(a) 0.5 atm
(b) 0.1 atm
(c) 0.9 atm
(d) 0.2 atm

AIIMS-1994

Ans. (b) : Given :-

Amount of oxygen = 40g

Amount of helium = 40g

Total pressure (P) = 0.9 atm

Partial pressure of oxygen $\left(p_{O_2}\right)$=?

$\therefore$ moles of oxygen $\left(n_{O_2}\right)=\frac{40}{32}$

Moles of helium $\left(n_{He_2}\right)=\frac{40}{4}=10$

@apna_pdf

Now,

$$p_{O_2} = X_{mixture} \times \text{Total pressure}$$

$$p_{O_2} = \frac{n_{O_2}}{n_{O_2} + n_{He_2}} \times 0.9$$

$$p_{O_2} = \frac{\frac{40}{32}}{\frac{40}{32} + 10} \times 0.9$$

$$p_{O_2} = \frac{40}{32} \times \frac{4}{45} \times 0.9$$

$$p_{O_2} = 0.1 \text{ atm}$$

2. Ideal Gas Equation and Related Gas Laws

113. A 10 L flask contains 64 g of oxygen at 27°C (Assume O_2 gas is behaving ideally). The pressure inside the flask in bar is
(Given R = 0.0831 L bar K^{-1} mol^{-1}

(a) 4.9 (b) 2.5
(c) 498.6 (d) 49.8

NEET-17.07.2022

Ans. (a) : Given that, T = 27°C = 273 + 27 = 300 K
V = 10.0 L, R = 0.0831 L Bar K^{-1} mol^{-1}

$\because$ Moles of $O_2 = \frac{64}{32} = 2$ mole

From ideal gas equation,

$$PV = nRT$$

$$P = \frac{nRT}{V}$$

$$= \frac{2 \times 0.0831}{10.0} \times 300$$

P = 4.986 Bar

114. 100 g of an ideal gas is kept in a cylinder of 416 L volume at 27°C under 1.5 bar pressure. The molar mass of the gas is ________ g mol^{-1} (Nearest integer).
(Given : R = 0.083 L bar K^{-1} mol^{-1})

JEE Main-28.06.2022, Shift-II

Ans. (4) : Given that: $R = 0.083 \text{ L bar } K^{-1} mol^{-1}$

$V = 416 L$, $P = 1.5 bar$, $T = 27°C$

From ideal gas equation

$$PV = \frac{mRT}{M}$$

$$\boxed{n = \frac{m}{M}}$$

$$1.5 \times 416 = \frac{100}{M} \times 0.83 \times 300$$

$$M = 3.99$$

115. A vessel contains equal volumes of SO_2 and CH_4. Through a small hole the gases effused into vacuum. After 200 seconds the total volume is reduced to half. What is the ratio of SO_2 and CH_4 remaining in the vessel?

(a) 1 : 2 (b) 2 : 1
(c) 1 : 1 (d) 1 : 4

AP-EAMCET (Med.)-1999

Ans. (b) : According to the Graham's law of diffusion.

$$\frac{V_{SO_2}}{V_{CH_4}} = \sqrt{\frac{M_{CH_4}}{M_{SO_2}}} = \sqrt{\frac{16}{64}} = \sqrt{\frac{1}{4}} = \frac{1}{2}$$

or $V_{SO_2} : V_{CH_4} = 1 : 2$

So, SO_2 and CH_4 effused in the ratio 1 : 2. Hence, the amount of remaining in the vessel will be ratio SO_2 : CH_4 = 2 : 1.

116. If the pressure and the absolute temperature of a given mass of gas are doubled, the new volume will be …….. of the initial volume

(a) double (b) half
(c) triple (d) same

A-P EAMCET 1991

Ans. (d) : Let initial pressure = P_1
Final pressure $P_2 = 2P_1$
Initial temperature = T_1
Final temperature $T_2 = 2T_1$
Initial volume = V_1
Final volume = V_2
$\therefore$ From ideal gas equation at constant number of moles

$$PV \propto T$$

$$\frac{P_1V_1}{P_2V_2} = \frac{T_1}{T_2}$$

$$\frac{P \times V_1}{2P \times V_2} = \frac{T}{2T}$$

$$\boxed{V_1 = V_2}$$

117. A sample of gas has a volume of 0.2 L measured at 1 atm pressure and 0ºC. At the same pressure but at 273ºC, its volume becomes

(a) 0.1 L (b) 0.4 L
(c) 0.8 L (d) 0.6 L

A-P EAMCET 1992, 93

Ans. (b) : Given that, $V_1 = 0.2$ L, V_2 = ?
$P_1 = 1$ atm, $P_2 = 1$ atm
T_1 = 0ºC = 273 K, T_2 = 273ºC = 273+273 = 546 K
The combined gas law is given as–

$$\therefore \quad \frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$$

$$V_2 = \frac{1 \times 0.2 \times 546}{1 \times 273} = 0.4 \text{ L}$$

118. The molecular weight of a gas that diffuses twice as rapidly as a gas with molecular weight 64, is

(a) 6.4 (b) 8
(c) 128 (d) 16

A-P EAMCET 1994

Ans. (d) : Given that, $r_1 = r$, $r_2 = 2r$, $M_1 = 64$, M_2 = ?

$$\therefore \quad \frac{r_1}{r_2} = \sqrt{\frac{M_2}{M_1}}$$

$$\frac{r}{2r} = \sqrt{\frac{M_2}{64}}$$

@apna_pdf

Squaring both side, we get

$$\frac{1}{4} = \frac{M_2}{64}$$

or $M_2 = \frac{64}{4}$

or $M_2 = 16$

119. A flask contains 3g H_2 and 24 g O_2, The partial pressure of hydrogen in the mixture is

(a) 1/8th of the total pressure
(b) 1/9th of the total pressure
(c) 1/2nd of the total pressure
(d) 2/3rd of the total pressure

A-P EAMCET 1994

Ans. (d) : Given, weight of H_2 = 3 gm

$\therefore$ No. of mole of $H_2 = \frac{3}{2}$ mole

and weight of O_2 = 24 gm

$\therefore$ No. of mole of $O_2 = \frac{24}{32} = \frac{3}{4}$ mole

Hence, the partial pressure of $H_2 = \frac{3/2}{3/2+3/4} \times P$

$$= \frac{3/2}{9/4} \times P$$

$$= \frac{2}{3} \text{ of the total pressure}$$

120. One mole of argon gas will have least density at

(a) STP (b) 0ºC and 2 atm
(c) 273ºC and 2 atm (d) 273ºC and 1 atm

A-P EAMCET 1998

Ans. (d) : Density $(\rho) = \frac{PM}{RT}$

Density $\propto \frac{1}{\text{temperature}}$

or Density $\propto$ pressure

Therefore, the density will be minimum when the ratio of pressure to temperature is minimum.

121. A mixture contains 16 g of oxygen, 28 g of nitrogen and 8g of CH_4. Total pressure of mixture is 740 mm. What is the partial pressure of nitrogen in mm?

(a) 185 (b) 370
(c) 555 (d) 740

A-P EAMCET 1999

Ans. (b) : Given that, Total pressure = 740 mm

No. of moles of oxygen$= \frac{16}{32} = 0.5$ moles

No. of moles of nitrogen $= \frac{28}{28} = 1.0$ moles

No. of moles of $CH_4 = \frac{8}{16} = 0.5$ moles

$\therefore$ Total number of moles = 0.5 + 1.0 + 0.5 = 2 moles

Mole fraction of N_2 = 1/2 = 0.5

Since, Partial pressure of N_2 = mole fraction of N_2 × total pressure

= 0.5 × 740 = 370 mm

122. What is the numerical value of the gas constant R in J mol^{-1} K^{-1}?

(a) 0.0821 (b) 8.314×10^7
(c) 8.314 (d) 1.987

A-P EAMCET 1999

Ans. (c) : The gas constant is inversely used in diverse disciplines. Hence it is expressed in many units. Some gas constant value in different units are listed below–

$R = 8.314 \times 10^7$ erg mol^{-1} K^{-1}

= 8.314 J mol^{-1} K^{-1}

= 0.08205 L atm mol^{-1} K^{-1}

123. 4 g of an ideal gas occupies 5.6035 L of volume at 546 K and 2 atm pressure. What is its molecular weight?

(a) 4 (b) 16
(c) 32 (d) 64

A-P EAMCET 2002

Ans. (b) : Given that,

w = 4 gm, V = 5.6035 L, T = 546 K

P = 2 atm.

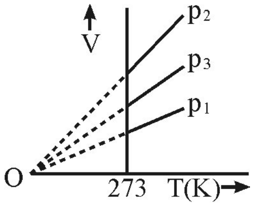
From and ideal gas equation –

$\therefore \quad \frac{M}{w} = \frac{RT}{PV}$

or $\quad \frac{M}{4} = \frac{0.084 \times 546}{2 \times 5.6035}$

or $\quad M = 16$

124. The volume-temperature graphs of a given mass of an ideal gas at constant pressures are shown below. What is the correct order of pressures?



(a) $p_1 > p_3 > p_2$ (b) $p_1 > p_2 > p_3$
(c) $p_2 > p_3 > p_1$ (d) $p_2 > p_1 > p_3$

A-P EAMCET 2006

Ans. (a) : For ideal gas equation–

$PV = nRT$

At constant pressure, V = KT

So, the graph will be a straight line with slope K = nR/P

Higher the slope lower will be the pressure.

Hence the correct order of pressure–

$$P_1 > P_3 > P_2$$

125. Henry's law constant for CO_2 in water is 1.67×10^8Pa at 298 K. Calculate the approximate quantity of CO_2 in 500 ml of soda water when packed under 5 atm CO_2 at 298 K.

(a) 3.7g (b) 1.84 g
(c) 2.2 g (d) 4.4 g

AP-EAMCET 25-08-2021 Shift - I

Ans. (a) : Given,

$P_{CO_2} = 5\text{atm}$

$P_{CO_2} = 5 \times 1.013 \times 10^5$ Pa

Henry's Law

$p = K_H.x$

@apna_pdf

Where, p = Partial pressure of gas
K_H = Henry's law constant
x = Mole fraction of gas

$$\therefore \quad x = \frac{5\times1.013\times10^5}{1.67\times10^8}$$

$$X_{CO_2} = \frac{n_{CO_2}}{n_{CO_2} + n_{H_2O}}$$

$$X_{CO_2} = \frac{n_{CO_2}}{n_{CO_2} + \frac{500}{18}} = \frac{5\times1.013\times10^5}{1.67\times10^8} = 0.003032$$

$$n_{CO_2} = 0.0843$$

Mass of CO_2 dissolved = 0.087 × 44
= 3.7 gm

126. An ideal gas expanded irreversibly against 10 bar pressure from 20 L to 30 L. Calculate q if the process is Isoenthalpic. (1 L. bar = 100 J)

(a) 0 (b) 100 J
(c) –100 J (d) 10 kJ

AP-EAMCET 25-08-2021 Shift - I

Ans. (d) :
$W_{irr} = -P(V_2 - V_1)$
$= -10\,(30 - 20)$
$= -100$ lit × bar
$= -100 \times 100$ Joule
$= -10{,}000$ Joule
$= -10$ kJ

Since the change in enthalpy is 0 and the work done will be equal to the –q.

127. A gas deviates most from ideal behavior when it is subjected to____.

(a) Low temperature & high pressure
(b) High temperature & low pressure
(c) High temperature & high pressure
(d) Low temperature & Low pressure

AP-EAMCET 25-08-2021 Shift - I

Ans. (a) : At low temperature and high pressure, gaseous atoms or molecules get closer to each other and vander Waal forces operates. So molecules or atoms start attracting each other. Hence a gas deviate the most from its ideal behaviour.

128. The volume of 2.8 g of carbon monoxide at 27ºC and 0.821 atm. pressure is (R= 0.0821 L atm. K^{-1} mol^{-1})

(a) 1.5 L (b) 0.3 L
(c) 3 L (d) 30 L

AP EAMCET (Medical) -1998

Ans. (c): Given that,
Amount of carbon monoxide = 2.8 g
T = 27 + 273 = 300 K
P = 0.821 atm
R = 0.0821 L atm K^{-1} mol^{-1}

Now, from the ideal gas equation–

$$PV = \frac{w}{M}\cdot RT$$

$$\text{or} \quad V = \frac{w}{M\times P}\times R\times T$$

$$\text{or} \quad V = \frac{2.8}{28\times0.821}\times0.0821\times300$$

or V = 3 litre.

129. Which of the following is not an ideal solution?

(a) Benzene and Toluene
(b) Chloro-benzene and 1,2-dichloro benzene
(c) Methyl iodide and Isopropanol
(d) Ethyl bromide and Methyl bromide

AP EAPCET 25.08.2021, Shift-II

Ans. (c) : A solution in which the interaction between molecules of the components does not differ from the interactions between the molecules of each component.
Ideal solution are – n-Heptane and n-Hexane, Chlorobenzene and bromobenzene, Benzene and toluene, Carbon tetrachloride and silicon tetrachloride, Ethyl and Methyl bromide.

130. Which of the following options correctly represents the relations of compressibility factor (z) and van der Waals equation for mole of gas at low pressure?

(a) $z + \frac{a}{VAT} = 1$ (b) $z + \frac{Pb}{RT} = 1$
(c) $z = 1 + \frac{RT}{Pb}$ **(d)** $z = 1 + \frac{Pb}{RT}$

TS EAMCET 10.08.2021, Shift-I

Ans. (a) : Compressibility factor(z) = $\frac{PV}{RT}$

For one male of gas
Van der waal's equation

$$\left(P + \frac{a}{V^2}\right)(V - b) = RT$$

At low pressure V-b $\approx V$

$$\text{Then} \quad \left(P + \frac{a}{V^2}\right)V = RT$$

$$PV + \frac{a}{V} = RT$$

$$PV = RT - \frac{a}{V}$$

$$\frac{PV}{RT} = 1 - \frac{a}{VRT} \qquad \left[z = \frac{PV}{RT}\right]$$

$$\text{So} \quad z = 1 - \frac{a}{VRT} \qquad or\ \boxed{z + \frac{a}{VRT} = 1}$$

131. At 27°C in a 10 L flask 4.0 g of an ideal gaseous mixture containing. He (molar mass 4.0 g mol^{-1}) and Ne (molar mass 20g mol^{-1}) has a pressure of 1.23 atm. What is the mass % of neon? (R = 0.082 L atm K^{-1} mol^{-1})

(a) 25.2 (b) 62.5
(c) 84.2 (d) 74.2

AP EAMCET-2017

Ans. (b) : Given,
Volume (V) = 10 lit
T = 27°C = 27 + 273 = 300K
$W = W_1 + W_2 = 4$ gm ……(i)
$M_{(He)}$ = 4 g/mole
$M_{(Ne)}$ = 20 g/mole

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P = 1.23 atm

$\therefore$ PV = $(n_1 + n_2)$ RT

$$\frac{1.23\times10}{0.082\times300} = \frac{W_1}{4}+\frac{W_2}{20}$$

$$0.5 = \frac{5W_1+W_2}{20}$$

or $5W_1 + W_2 = 10$ …… (ii)

Form equation (i) and (ii) we get

$5W_1 + (4 - W_1) = 10$

$4W_1 = 6$

$W_1 = 6/4 = 1.5$

Putting the value of W_1 in equation (i)

We get –

$1.5 + W_2 = 4$

$\Rightarrow W_2 = 2.5$

Hence, mass % of Neon = $\frac{2.5\times100}{4}$

= 62.5%

132. Which is the correct expression, that relates changes of entropy for an ideal gas at constant temperature in the following

(a) $\Delta s = nRT\ln\frac{P_2}{P_1}$

(b) $\Delta s = T(P_2 - P_1)$

(c) $\Delta s = nR\ln\frac{P_1}{P_2}$

(d) $\Delta s = 2.303nRT\ln\frac{P_1}{P_2}$

MPPET-2008

Ans. (c) :

$$\Delta s = nR\ln\frac{P_1}{P_2}$$

Where Δs = Change in entropy

R = Gas constant

P_1 and P_2 are pressure.

133. The temperature at which 4 moles of a gas occupy 5 dm^3 volume at 3.32 bar pressure is

(a) 50 K (b) 50 °C

(c) 27 °C (d) 100 K

AP EAMCET (Engg.) 18.09.2020, Shift-I
AP EAMCET (Engg.) 21.09.2020, Shift-II

Ans. (a) : Given,

P = pressure = 332 bar $\simeq$ 3.32 atm

V = volume = 5 dm^3 = 5 L

n = 4 mol

and we known,

R = 0.082 L atm mol^{-1} K^{-1}

For n mole of an ideal gas,

PV = nRT

$$\Rightarrow \quad T = \frac{pV}{nR} = \frac{332\times5}{4\times0.082}$$

= 50.60 K $\simeq$ 50 K

134. At STP, if 5.6 litres of a gas weights 7.5 g, then identify the gas.

(a) CO (b) NO

(c) NO_2 (d) CO_2

AP EAMCET (Engg.) 21.09.2020, Shift-II

Ans. (b) : Given,

At STP 5.6L of a gas weight 7.5g.

We know,

22.4L gas, contain 1 mole at STP

Then, 1L gas contain = $\frac{1}{22.4}$ mole .

Now,

5.6L gas contain,

No. of mole = $\frac{1}{22.4}\times5.6 = 0.25$ mole

Moles= $\frac{\text{Weight}}{\text{Molecular weight}}$

0.25= $\frac{7.5}{\text{Molecular weight}}$

Molecular weight = 30

Thus, the gas is NO

135. Equal masses of methane and oxygen are introduced into a vessel at 27ºC. What fraction of the total pressure is due to oxygen?

(a) $\frac{1}{10}$ (b) $\frac{1}{2}$

(c) $\frac{1}{3}$ (d) $\frac{1}{4}$

A-P EAMCET 1995

Ans. (c) : Let masses of methane (CH_4) and oxygen = m

$$\therefore \text{ Mole fraction of } O_2 = \frac{n_1}{n_1+n_2}$$

$$= \frac{m/32}{m/32+m/16}$$

$$= \frac{m/32}{3m/32}$$

$$= 1/3$$

136. The volume of a given mass of a gas is directly proportional to its Kelvin temperature at constant pressure. The above statement is known as ....

(a) Boyle's law

(b) vant Hoff's law

(c) Charle's law

(d) Dalton's law of partial pressures

AP EAMCET (Engg.) 21.09.2020, Shift-II

Ans. (c) : The variation in a volume of a gas with temperature was first studies by Jacques Charles (1787) and known as Charles' law.

Charles' law states as, "The volume of the given mass of a gas is directly proportional to its absolute temperature at constant pressure.

137. The average kinetic energy of one molecule of an ideal gas at 27°C and 1 atm pressure is

(a) 900 cal k^{-1} mol^{-1}

(b) 6.21 × 10^{-21}JK^{-1} molecule^{-1}

(c) 336.7 JK^{-1} molecule^{-1}

(d) 3741. 3JK^{-1} mol^{-1}

AP EAMCET (Engg.)-2009

@apna_pdf

Ans. (b): Given,
Mole = 1, Temperature (T) = 27°C+273= 300K and
R = 8.314J/mole K

$$KE = \frac{3}{2}nRT \text{ or } \frac{3}{2}\times\frac{R}{N_A}T$$

$$KE = \frac{3}{2}\times\frac{8.314}{6.023\times10^{23}}\times300$$

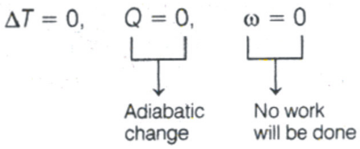
KE=6.21×10^{-21}J/K molecules

138. For an isothermal and free expansion of an ideal gas, which of the following is true ?
1. For an adiabatic change, heat (q) is non zero.
2. For an adiabatic change, heat (q) is zero.
3. For an isothermal reversible change, heat (q) is zero.
4. For an isothermal process, the temperature changes.

(a) 1	(b) 2
(c) 3	(d) 4

AP EAMCET (Engg.) 18.9.2020 Shift-I

Ans. (b) : For an isothermal and free expansion of an ideal gas,



So, the statement (2) is correct.

139. If two molecules of A and B having mass 100Kg 64 Kg and rate of diffusion of A is 12×10^{-3} then rate of diffusion of B will be ____

(a) 15×10^{-3}	(b) 64×10^{-3}
(c) 36×10^{-3}	(d) 10×10^{-3}

AP EAPCET 24.08.2021 Shift-II

Ans. (a) : Given that,
Mass of gas A = 100 kg
Mass of gas B = 64 kg
Rate of diffusion of A = 12×10^{-3}
Rate of diffusion of B = ?
So, we know that,

Rate of diffusion of A × $\sqrt{\text{Molar mass of A}}$ =

Rate of diffusion of B × $\sqrt{\text{Molar mass of B}}$

$12\times10^{-3}\times\sqrt{100}$ = Rate of diffusion of B × $\sqrt{64}$

$\frac{12\times10^{-3}\times10}{8}$ = Rate of diffusion of B

So, rate of diffusion of B = 15×10^{-3}

140. The density of an ideal gas can be given by—— where P,V,M,T and R respectively denote pressure Volume molar-mass Temperature and universal gas constant.

(a) $\frac{PM}{RT}$	(b) $\frac{PV}{RT}$
(c) $\frac{RT}{PM}$	(d) $\frac{RT}{PV}$

AP EAPCET 19-08-2021 Shift-I

Ans. (a) : From the ideal gas equation.
PV = nRT where – P = pressure
V = volume
N = no. of mole
R= Gas constant
T = Temperature

$\therefore \quad n = \frac{W}{M}$

Where W = weight of particle
M = molar mass
Putting the value of n in Equation (i) we get

$PV = \frac{W}{M}RT$

Or $PM = \frac{W}{V}RT \;(\therefore \tau = \frac{W}{V})$

$\therefore \tau = \frac{PM}{RT}$ Where τ = density of the gas.

141. How many liters of oxygen (at STP) are required for complete combustion of 39 g of liquid benzene?
(Atomic weights: C=12.O=16,H=1)

(a) 84	(b) 22.4
(c) 42	(d) 11.2

AP EAMCET (Engg.) 2001

Ans. (a) : $C_6H_6 + \frac{15}{2}O_2 \xrightarrow{\Delta} 6CO_2 + 3H_2O$

Molecular weight of benzene $(C_6H_6) = 78$

Moles of benzene = $\frac{\text{weight}}{\text{M.wt.}} = \frac{39}{78} = \frac{1}{2}$ moles

1 mole combustion of benzene required $\frac{15}{2}$ mole of oxygen gas

$\therefore \frac{1}{2}$ mole benzene required $\left(\frac{15}{2}\times\frac{1}{2} = \frac{15}{4}\right)$ mole of oxygen gas

As we know, mole = $\frac{\text{volume}}{22.4}$

Volume = Mole × 22. 4L

Volume of oxygen = $\frac{15}{4}\times22.4$L
= 84 L

142. What is the volume (in litres) of oxygen at STP required for complete combustion of 32 g of CH_4?
(Molecular weight of CH_4 is 16)

(a) 44.8	(b) 89.6
(c) 22.4	(d) 179.2

AP EAMCET (Engg.) 2001

Ans. (b) : On complete combustion, we get

$$CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$$

Weight of CH_4 = 34
M .wt. of CH_4 = 16

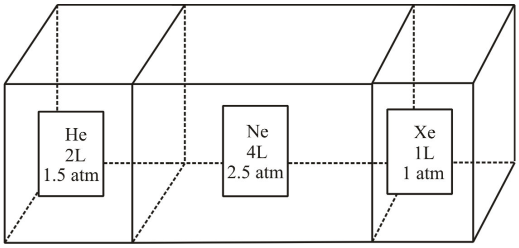
Moles of CH_4 = $\frac{\text{weight}}{\text{M.wt.}} = \frac{32}{16}$ = 2 moles

1 mole combustion of methane (CH_4) required 2 moles of oxygen at S T P.

@apna_pdf

$\therefore$ 2 mole methane requires 4 moles of oxygen.
Volume = Mole × 22 4 L
Volume of oxygen = 4 × 22.4
= 89.6 L

143. Consider the composite system. Which is held at 300K, shown in the figure. Assuming ideal gas behavior, calculate the total pressure if the barriers separating the compartments are removed. Assume that the volume of the barriers is negligible. (R=0.082 atmL/Mol.K)



(a) 1 atm (b) 2 atm
(c) 2.3 atm (d) 3.2 atm

AP EAPCET-6 Sep. 2021, Shift-II

Ans. (b) : The no, of moles can be calculated with the help of ideal gas equation.
i.e, PV= nRT

$$\text{So, } n_{He} = \frac{PV}{RT} = \frac{1.5\times2}{RT} = \frac{3}{RT} .....(1)$$

$$n_{Ne} = \frac{2.5\times4}{RT} = \frac{10}{RT} ......(2)$$

$$n_{Xe} = \frac{1\times1}{RT} = \frac{1}{RT} .....(3)$$

Total no. of moles present if barrier is removed.

$n = n_{He} + n_{Ne} + n_{Xe}$ …(3)

$$= \frac{3}{RT} + \frac{10}{RT} + \frac{1}{RT} = \frac{1}{RT}(3+10+1)$$

The total pressure is given by,

$$P = \frac{n_{Total} RT}{V}$$

$$= \frac{14 RT}{RT\times V}$$

$$= \frac{14}{7} = 2 \text{ atm.}$$

144. A certain mass of a gas occupies a volume of 2*l* at STP. To what temperature the gas must be heated to double its volume, keeping the pressure constant?

(a) 100 K (b) 273 K
(c) 273ºC (d) 546ºC

AP EAMCET (Engg.) -2007

Ans. (c) : Given,
At STP, Pressure = 1 atm
T_2 = 273 K
And volume, V_1 = 2 L
$V_2 = 2 V_1 = 4L$
From ideal gas equation,
P V = n R T
At constant pressure and same moles
Volume $\propto$ Temperature

Then,

$$\frac{V_1}{V_2} = \frac{T_1}{T_1}$$

$$T_2 = T_1 \times \frac{V_2}{V_1}$$

$$= 273 \times \frac{4}{2}$$

= 546 K
= 546–273
= 273^0 C

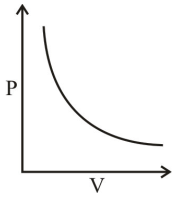
145. Which among the following are true for an irreversible isothermal expansion of an ideal gas?

(i) $W = -Q$ (ii) $\Delta U = 0$
(iii) $\Delta H \neq 0$ (iv) $\Delta T = 0$

(a) Only (i), (ii) & (iii)
(b) Only (i), (ii) & (iv)
(c) Only (ii), (iii) & (iv)
(d) Only (i), (ii) (iii) & (iv)

AP EAPCET 24.08.2021, Shift-I

Ans. (b) :



Since for an ideal gas the internal energy is proportional to temperature. It follows that there is no change in the internal energy of the gas during isothermal process. Then, the first law of thermodynamics then becomes.

$\Delta U = 0$
$\Delta T = 0$
$W = -Q$

146. Among the following. Van der Waal's constant 'a' would be maximum for ____.

(a) H_2 (b) O_2
(c) CH_4 (d) NH_3

AP EAPCET 24.08.2021, Shift-I

Ans. (d) : Van der Waal's constant 'a' is depend upon the magnitude of intermolecular attractive forces with the gas. The Vander Waal's force of attraction is more in NH_3.

147. When an ideal gas expands isothermally from 5 m^3 to 10 m^3 at 25 ^oC against a constant pressure of 10^7 $N.m^{-2}$, then the work done on the gas is__

(a) –100 MJ (b) –50 MJ
(c) –0.5 MJ (d) -10^5 MJ

AP EAPCET 20.08.2021 Shift-II

Ans. (b): Given that
Volume (ΔV) = 10–5 = $5m^3$
Pressure (P) = 10^7 $N.m^{-2}$
Temperature (T) = 25^oC
W = ?
$\therefore W = -P\Delta V$
$= -10^7 \times 5$
$= -50 \times 10^6$ J or –50 MJ

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148. What is the density of N_2 gas at 227°C and 5.00 atm pressure?
(R= 0.082 L atm K^{-1} mol^{-1})

(a) 1.40g/mL (b) 2.81g/mL
(c) 3.41g/mL (d) 0.29g/mL

Karnataka NEET 2013

Ans. (c) : $PV = nRT$

$$PV = \frac{w}{M}RT \left[n = \frac{\text{Weight of the gas taken}(w)}{\text{Mol. mass of gas}(M)}\right]$$

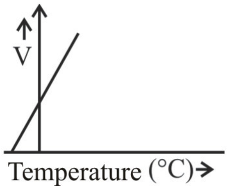
$$P = \frac{w}{M} \times \frac{RT}{V}$$

$$P = \frac{\rho RT}{M} \quad \left[\text{Density} = \frac{\text{Mass}}{\text{Volume}}\right]$$

$$\rho = \frac{PM}{RT}$$

$$= \frac{5 \times 28}{0.0821 \times 500} = 3.41 g/mL$$

149. The following graph illustrates



(a) Dalton's law (b) Charles' law
(c) Boyle's law (d) Gay-Lussac's law.

COMEDK 2017

Ans. (b) : Charles' law relates volume and temperature of a gas.

150. Containers A and B have same gases. Pressure, volume and temperature of A are all twice as that of B, then the ratio of number of molecules of A and B are

(a) 1:2 (b) 2:1
(c) 1:4 (d) 4:1

COMEDK 2018

Ans. (b) : $P_A V_A = n_A RT_A$ and $P_B V_B = n_B RT_B$

$$\frac{n_A}{n_B} = \frac{\frac{P_A V_A}{RT_A}}{\frac{P_B V_B}{RT_B}} = \frac{\frac{2P_B \times 2V_B}{2T_B}}{\frac{P_B \times V_B}{T_B}} = 2$$

Thus, number of molecules are also in the ratio 2:1.

151. In a flask of 'V' litres, 0.2 moles of O_2, 0.4 moles of N_2, 0.1 moles of NH_3 and 0.3 moles of He gases are present at 27°C. If total pressure exerted by these non-reacting gases is 1 atm, the partial pressure exerted by N_2 gas is

(a) 0.4 atm (b) 0.3 atm
(c) 0.2 atm (d) 0.1 atm

AP-EAMCET (Medical), 2008

Ans. (a) : Given data:

$n_{O_2} = 0.2$
$n_{N_2} = 0.4$
$n_{NH_3} = 0.1$
$n_{He} = 0.3$
$P_{Total} = 1$ atm

Partial pressure of Nitrogen $(p_{N_2}) = ?$

Now, $p_{N_2} = P_{Total} \times \chi_{N_2}$

$$p_{N_2} = 1 \times \frac{0.4}{0.2+0.4+0.1+0.3}$$

$$p_{N_2} = \frac{0.4}{1}$$

$$p_{N_2} = 0.4 atm$$

152. What are the conditions under which the relation between volume (V) an number of moles (n) of gas is plotted?
(P = pressure, T= temperature)

(a) Constant P and T (b) Constant T and V
(c) Constant P and V (d) Constant n and V

AP-EAMCET (Medical), 2001

Ans. (a) : According to Avogadro's law at constant pressure and temperature volume of a gas is directly proportional to number of moles of a gas.

153. What is the density (in $g.L^{-1}$) of CO_2 at 400 K and exerting a pressure of 0.0821 atm?
(R = 0.0821 L atm mol^{-1} K^{-1})

(a) 0.01 (b) 0.11
(c) 2.5 (d) 44

AP-EAMCET (Medical), 2002

Ans. (b) : Given,

T = 400 K
P = 0.0821 atm
R = 0.0821 L atm $mol^{-1}K^{-1}$
ρ = ? (g/L)

Now, from the ideal gas equation – we get

$$PV = nRT$$

or $$PV = \frac{w}{M}RT$$

or $$P = \frac{w}{M \times V}RT$$

or $$P = \frac{\rho}{M}RT$$

or $$\rho = \frac{PM}{RT} \quad [M_{CO_2} = 44]$$

or $$\rho = \frac{0.0821 \times 44}{0.0821 \times 400}$$

$$\rho = 0.11 g/L$$

154. Which of the following mixture form an ideal solution ?

(a) $CCl_4 + C_7H_8$
(b) $CHCl_3 + C_6H_6$
(c) $H_2O + CH_3OH$
(d) $n-C_6H_{14} + n-C_7H_{16}$

TS-EAMCET (Engg.), 06.08.2021

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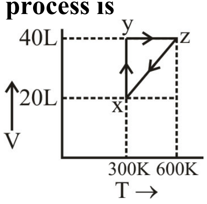
Ans. (d): An ideal solution obeys Raoult's law at all temperatures and pressures.
The solute-solute and solvent-solvent interactions are almost similar to solute-solvent interactions. No association or dissociation takes place. It does not form an azeotrope mixture.
Benzene + toluene
n-hexane + n-heptane
Ethyl bromide + ethyl iodide

155. The following graph indicates the system containing 1 mole of gas involving various steps. When it moves from z to x, the type of undergoing process is



(a) Cyclic (b) Isothermal
(c) Isochoric (d) Isobaric

TS-EAMCET (Engg.), 06.08.2021

Ans. (d): At X → Temperature (T_1) = 300K, Volume (V_1) = 20L, Pressure (P_1) = ?
At Z → Temperature (T_2) = 600K, Volume (V_2) = 40L, Pressure = P_2

$$\therefore \quad \frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$$

$$\frac{P_1}{P_2} = \frac{V_2 \times T_1}{T_2 \times V_1}$$

$$= \frac{40 \times 300}{600 \times 20}$$

$$\boxed{P_1 = P_2}$$

So, process is isobaric

156. A balloon filled with an air sample occupies 3 L volume at 35°C. On lowering the temperature to T, the volume decreases to 2.5L. The temperature T is?

(a) 16°C (b) –16°C
(c) 24°C (d) –20°C

TS-EAMCET (Engg.), 06.08.2021

Ans. (b): Given that, $V_1 = 3L$, $T_1 = 35 + 273 = 308K$
$V_2 = 2.5L$, $T_2 = ?$

According to Charle's law, $\frac{V_2}{V_1} = \frac{T_2}{T_1}$

$$T_2 = \frac{2.5 \times 308}{3}$$

$$T_2 = 256.67K$$

$$T_2 = -16.33°C$$

$$T_2 = 256.67 - 273$$

$$\boxed{T_2 = -16°C}$$

157. Which gas has a density of 1.24 g/L at 0°C and 1 atm pressure?

(a) O_2 (b) CH_4
(c) CO (d) CO_2

TS EAMCET 05.08.2021, Shift-I

Ans. (c) : By Ideal gas equations –

$$\because \quad PV = nRT$$

$$\text{or} \quad n = \frac{PV}{RT}$$

$$\text{or} \quad \frac{w}{M} = \frac{PV}{RT}$$

$$\text{since} \quad \frac{\rho}{M} = \frac{PV}{RT}$$

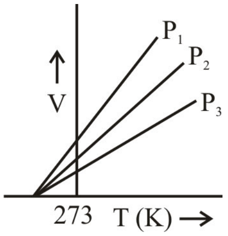
$$\text{or} \quad M = \frac{\rho RT}{P}$$

$$\text{or} \quad M = \frac{1.24 \times 0.0821 \times 273}{1}$$

$$M = 27.79 \simeq 28$$

Hence, 28 the atomic mass is CO.
So **(c)** is correct.

158. A plot of volume of the gas Versus T (K) is shown below : Which of the option is correct for the plot?



(a) $P_1 < P_2 < P_3$
(b) $P_3 < P_2 < P_1$
(c) $P_1 = P_2 \neq P_3$
(d) $P_1 = P_2 = P_3 = 0$ at 273 K

TS EAMCET 04.08.2021, Shift-I

Ans. (a) : According to Boyle's law state that the volume of gas at constant temperature varies inversely with the pressure exerted on it.

$$\boxed{V \propto \frac{1}{P}}$$

Hence, this plot indicate $P_1 < P_2 < P_3$.

159. Five moles of an ideal gas at 293 K is expanded isothermally from an initial pressure of 2.1 MPa to 1.3 MPa against at constant external pressure 4.3 MPa. The heat transferred in this process is——kJ mol^{-1}. (Rounded-off to the nearest integer)
[Use R = 8.314 J $mol^{-1}K^{-1}$]

JEE Main 25.02.2021, Shift-II

Ans. (3): Given:– No. of moles = 5
T = 293 k
P_1 = 2.1 MPa
P_2 = 1.3 MPa
P_{ext} = 4.3 MPa
We know that, for isothermal irreversible expansion,

$$W = -P_{ext}(\Delta V)$$

$$= -P_{ext}(V_2 - V_1) \quad \left\{ \begin{array}{l} \because PV = nRT \\ V = \frac{nRT}{P} \end{array} \right\}$$

@apna_pdf

$$= -4.3\left[\frac{5\times R\times 293}{1.3} - \frac{5\times R\times 293}{2.1}\right]$$

$$= -\frac{4.3\times 5\times 8.314\times 293\times 0.8}{1.3\times 2.1}$$

$$= -15.34\,\text{kJ}$$

For isothermal process, $\Delta U = 0$

From first law of thermodynamics

$Q = -w$

$Q = -(-15.34\text{kJ})$

$Q = 15.34$ kJ (for 5 moles)

$$\therefore\ Q/\text{mole} = \frac{15.35}{5} \approx 3\text{kJmol}^{-1}$$

160. The number of chlorine atoms in 20mL of chlorine gas at STP is ________ 10^{21}. (Round off to the Nearest Integer).
[Assume chlorine is an ideal gas at STP
$R=0.083$ L bar mol^{-1} K^{-1} , $N_A=6.023\times10^{23}$]

JEE Main 17.03.2021, Shift-II

Ans. (1) :
Given that, Volume of Cl_2= 20 mL
Gas constant (R)= 0.083 L bar $mol^{-1}K^{-1}$
Avogadro's no. $(N_A)=6.023\times10^{23}$
Now, from ideal gas equation-
PV=nRT

$$\text{or } PV = \frac{N}{6.023\times10^{23}}\times RT$$

$$\text{or } N = \frac{PV}{RT}\times 6.023\times10^{23}$$

$$N = \frac{1\times 20\times10^{-3}(L)\times 6.023\times10^{23}}{0.083(\text{Lbar mol}^{-1}K^{-1})\times 273(K)}$$

$N = 5.3\times10^{20}$

Cl atom $=2\times5.3\times 10^{20} = 1.02\times10^{21}\approx1\times10^{21}$.

161. 3.12g of oxygen is absorbed on 1.2 g of platinum metal. The volume of oxygen absorbed per gram of the absorbent at 1 atm and 300 K in L is _______. [R=0.0821 L atm $K^{-1}mol^{-1}$]

JEE Main 26.02.2021, Shift-I

Ans. (2) : Moles of O_2= $\frac{3.12\text{gm}}{32} = 0.0975$

$\therefore$ PV = nRT

$$\text{Volume of } O_2 = \frac{nRT}{P}$$

$$= \frac{0.0975\times0.082\times300}{1} = 2.4\text{L}$$

Therefore, volume of O_2 absorbed per gm of platinum

$$(Pt)= \frac{2.4}{1.2} = 2$$

162. A certain gas obeys $P(V_m - b)=RT$. The value of $\left(\frac{\partial Z}{\partial P}\right)_T$ is $\frac{xb}{RT}$.
The value of x is ________ .

JEE Main 26.02.2021, Shift-I

Ans. (1) : Given that,
P (V – b) = RT
PV – Pb= RT
Dividing RT both side, we get

$$\frac{PV}{RT} - \frac{Pb}{RT} = 1$$

$$\frac{PV}{RT} = 1 + \frac{Pb}{RT}$$

$$Z = 1 + \frac{Pb}{RT}\left(\because z = \frac{PV}{RT}\right)$$

$$\frac{dZ}{dP} = 0 + \frac{b}{RT}$$

Therefore,

$$\frac{b}{RT} = \frac{Xb}{RT}$$

X=1

Since, the value of X=1.

163. Assertion: At low pressure and high temperature, some gases behave as ideal gas.
Reason: At low temperature and high pressure, real gases behave as ideal gas.
(a) If both Assertion and Reason are correct and Reason is the correct explanation of Assertion.
(b) If both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.
(c) If Assertion is correct but Reason is incorrect.
(d) If both the Assertion and Reason are incorrect.

AIIMS 25 May 2019 (Evening)

Ans. (c): Real gases does not follow kinetic gas assumption, kinetic gas equation and gas law's.
According to kinetic gas assumption ideal gas has no intermolecular forces of attraction and volume occupied by then are negligible. But real gases have intermolecular forces of attraction and have some volume.
For real gas, Van der Waal's gas equation are

$$\left(P + \frac{an^2}{V^2}\right)(V - nb) = nRT$$

At low pressure and high temperature real gas behave as ideal gas equation. Because when pressure decreases volume increases than correction terms is negligible.
At low pressure, volume increases

$$\left(P + \frac{an^2}{V^2}\right)(V - nb) = nRT$$

Both $\frac{an^2}{V_2}$ and nb correction terms are neglected.

So, real gas follow ideal gas equation, PV = nRT

But at low temperature and high pressure real gases doesn't behave like ideal gas.

164. Assertion: The pressure of a fixed amount of an ideal gas is proportional to its temperature.
Reason: Frequency of collision and their impact both increase in proportion to the square root of temperature.

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(a) If both Assertion and Reason are correct and the Reason is the correct explanation of Assertion.
(b) If both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.
(c) If Assertion is correct but Reason is incorrect.
(d) If both the Assertion and Reason are incorrect.

AIIMS-27 May, 2018 (E)

Ans. (b): From ideal gas equation PV = nRT
According to gay Lussac's law, pressure is directly proportional to temperature at constant volume.
$P \propto T$
So, Assertion is correct.
Collision frequency is depends upon the root mean square velocity (U_{rms}) which is directly proportional to the square root of temperature.
$U_{rms} \propto \sqrt{T}$
SO, Reason is also correct but it is not correct explanation of assertion.

165. At what temperature, the rate of effusion of N_2 would be 1.625 times than that of SO_2 at 50°C?
(a) 110 K (b) 173 K
(c) 373 K (d) 273 K

BITSAT 2016

Ans.(c): $T_2 = 273 + 50 = 323k$

$$r \propto U \text{ and } U = \sqrt{\frac{3RT}{M}}$$

$$\therefore \frac{r_1}{r_2} = \sqrt{\frac{T_1M_2}{T_2M_1}} \text{ or}$$

$$\frac{r_{N_2}}{r_{SO_2}} = \sqrt{\frac{T_1 \times 64}{323 \times 28}} = 1.625$$

or $T_1 = 373$ K

166. Assertion: Gases do not liquefy above their critical temperature, even on applying high pressure.
Reason: Above critical temperature, the molecular speed is high and intermolecular attractions cannot hold the molecules together because they escape due to high speed.
(a) If both Assertion and Reason are correct and the Reason is the correct explanation of Assertion.
(b) If both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.
(c) If Assertion is correct but Reason is incorrect.
(d) If both the Assertion and Reason are incorrect.

AIIMS-2016

Ans. (a): The temperature below which gas can be liquefied by application of pressure is known as critical temperature. Above critical temperature gases do not liquefied even after applying high pressure because their molecular speed increases and intermolecular force of attraction cannot hold the molecules together

167. Assertion: At critical temperature liquid passes into gaseous state imperceptibly and continuously.
Reason: The density of liquid and gaseous phase is equal to critical temperature.
(a) If both Assertion and Reason are correct and the Reason is the correct explanation of Assertion.
(b) If both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.
(c) If Assertion is correct but Reason is incorrect.
(d) If both the Assertion and Reason are incorrect.

AIIMS-2017

Ans. (a): At critical temperature, density of liquid phase is equal to density of gaseous phase because of this liquid converted into gaseous state imperceptibly and continuously. Therefore, both assertion and reason are correct and reason is correct explosion of assertion

168. In van der Waal's equation at constant temperature of 300 K, a=1.4 atm Lt^2 mol^{-2}, V=100mL, n=1 mol, what is pressure of gas?
(a) 42 atm (b) 210 atm
(c) 500atm (d) 106 atm

AIIMS-26 May, 2018 (M)

Ans. (d): Given:- Temperature (T) = 300 K
a = 1. 4 atm Lt^2 mol^{-2}
V = 100 mL = 0. 1 L
N = 1 mole
Van der Waal's equation,

$$\left(P - \frac{an^2}{V^2}\right)(V) = nRT$$

on substituting values in above equation

$$\left(P - \frac{1.4 \times (1)^2}{(0.1)^2}\right)(0.1) = 1 \times 0.082 \times 300$$

P = 106 atm

169. The gas with the highest critical temperature is
(a) H_2 (b) He
(c) N_2 (d) CO_2

AIIMS-2014

Ans. (d) : Temperature below which gas can be liquefied by application of pressure is known as critical temperature (T_c). Critical temperature depends on the intermolecular force of attraction of molecules. Higher the attraction force greater the critical temperature.
CO_2 molecule is slightly polar so, it's critical temperature is highest.

170. X mL of H_2 gas effuses through a hole in a container in 5 seconds. The time taken for the effusion of the same volume of the gas specified below under identical condition is
(a) 10 seconds: He (b) 20 seconds: O_2
(c) 25 seconds: CO (d) 55 seconds: CO_2

AIIMS-2012

Ans. (b): Effusion is the property of flow of gaseous molecules from high concentration to low concentration from a pin hole with external pressure.

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According to Graham's law of diffusion,

Rate of diffusion / effusion $\propto \frac{1}{\sqrt{\text{M.wt.}}}$

$$\frac{r_{O_2}}{r_{H_2}} = \sqrt{\frac{(\text{M.wt.})_{H_2}}{(\text{M.wt.})_{O_2}}} \Rightarrow \frac{\frac{V_{O_2}}{t_{O_2}}}{\frac{V_{H_2}}{t_{H_2}}} = \sqrt{\frac{(\text{M.wt.})_{H_2}}{(\text{M.wt.})_{O_2}}}$$

$$\frac{\frac{V}{t_{O_2}}}{\frac{V}{5}} = \sqrt{\frac{2}{32}}$$

$$\frac{5}{t_{O_2}} = \sqrt{\frac{2}{16}} = \frac{1}{4}$$

time (T_{O_2}) = 5 × 4 =20 seconds

171. The rate of diffusion of SO_2,CO_2,PCl_3 and SO_3 are in the following order

(a) $PCl_3 > SO_3 > SO_2 > CO_2$

(b) $CO_2 > SO_2 > PCl_3 > SO_3$

(c) $SO_2 > SO_3 > PCl_3 > CO_2$

(d) $CO_2 > SO_2 > SO_3 > PCl_3$

AIIMS-2013

Ans. (d): Rate of diffusion (r_d) $\propto \frac{1}{\sqrt{\text{Molar mass}}}$

Molar mass of $SO_2 = 64$ g/mol

Molar mass of $SO_3 = 80$ g/mol

Molar mass of $CO_2 = 44$ g/mol

Molar mass of PCl_3 = 137.3 g/mol

Order of rate of diffusion is

$CO_2 > SO_2 > SO_3 > PCl_3$

172. Which equation shows correct from of Berthelot equation.

(a) $\left(P + \frac{a}{T(V+C)^2}\right)(V-b) = RT$

(b) $\left(P + \frac{a}{T(V-C)^2}\right)(V-b) = RT$

(c) $\left(P + \frac{a}{TV^2}\right)(V-b) = RT$

(d) $\left(P + \frac{a}{TV^2}\right)(V+b) = RT$

AIIMS-2000

Ans. (c): In Berthelot equation only pressure correction is changed from Van der Waal's equation while volume is same.

Berthelot equation,

$$\left(P + \frac{a}{TV^2}\right)(V-b) = RT$$

173. The transport of matter in the absence of bulk flow is known as:

(a) diffusion (b) transfusion

(c) translation (d) rotation

AIIMS-1999

Ans. (a): The property of spontaneous flow of gaseous molecules from high concentration to low concentration without external pressure is known as diffusion. In diffusion, membrane or bulks flow is absent molecules are diffused in small amount.

174. Van der Waal's equation;

$\left[P + \frac{a}{V^2}\right](V-b) = nRT$ is applicable for:

(a) ideal gas (b) non- ideal gas

(c) both (a) and (b) (d) none of these

AIIMS-1998

Ans. (b): Van der Waal's equation

$$\left[P + \frac{a}{V^2}\right](V-b) = nRT$$

is only applicable for non-ideal gas.

Non-ideal gases does not follow kinetic theory of gases or gas's law. Two major corrections are required for non-ideal gases.

(i) The intermolecular forces of attraction between molecules is not negligible.

(ii) The volume of molecule is not negligible in comparison of total volume of gas.

175. Among the following the maximum deviation from ideal gas behavior is expected from ___

(a) $He_{(g)}$ (b) $CH_{4(g)}$

(c) $NH_{3(g)}$ (d) $H_{2(g)}$

AP EAPCET 19-08-2021, Shift-II

Ans. (c) : The deviation from the ideal gas depends on the pressure and temperature. $NH_3$is most readily liquefiable gas out of given gases in the above.

Since, it has the strongest intermolecular attraction forces.

176. Helium gas at 1 atm and SO_2 at 2 atm pressure, temperature being the same, are released separately at the same moment into 1 m long evacuated tubes of equal diameters. If helium reaches the other end of the tube in t s, what distance, SO_2 would traverse in the same time interval in the other tube?

(a) 25 cm (b) 50 cm

(c) 60 cm (d) 75 cm

SRMJEEE – 2007

Ans. (b) :

Given, $P_{He} = 1\,\text{atm}, P_{SO_2} = 2\,\text{atm}, t_{He} = t_{SO_2} = t$

distance = 1m = 100 cm, $M_{SO_2} = 64, M_{He} = 21$

$$\therefore \frac{r_{He}}{r_{SO_2}} = \frac{\frac{100}{t_{He}}}{\frac{X}{t_{SO_2}}} = \frac{P_{He}}{P_{SO_2}}\sqrt{\frac{M_{SO_2}}{M_{He}}}$$

$$\therefore \frac{100}{t} \times \frac{t}{x} = \frac{1}{2}\sqrt{\frac{64}{4}}$$

$\Rightarrow$ x = 50 cm

177. At 1 atm pressure, 0.5 g of a gas has the volume of 0.1 L at 300 K, Gas constant R = 0.0821 L. atm K^{-1} mol^{-1}. Find the molar mass of the gas.

(a) 112 (b) 24.6

(c) 123.1 (d) 49.2

SRMJEEE – 2013

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Ans. (c) : Given, P = 1atm R = 0.0821 L.atmk^{-1} mol^{-1}

W = 0.5g M = ?

V = 0.1L

T = 300K

Now, From the ideal gas equation–

PV = nRT where – n = no. of moles

$$\text{or} \quad n = \frac{PV}{RT}$$

$$\text{or} \quad M = \frac{WRT}{PV}$$

$$M = \frac{0.5(g) \times 0.0821(L.atmk^{-1}mol^{-1}) \times 300(k)}{1(atm) \times (0.1)L}$$

M = 123.15g/mol

178. A gaseous mixture contains 2 moles of A, 3 moles of B. 5 moles of C and 10 moles of D contained in a vessel. If the gases are ideal and the partial pressure of C is 1.5 atm, then the partial pressure of B will be _____

(a) 1.5 atm (b) 0.6 atm

(c) 0.9 atm (d) 1.66 atm

AP- EAPCET- 07-09-2021, Shift-I

Ans. (c) : Given,

Mole of A = 2

Mole of B = 3

Mole of C = 5

Mole of D = 10

Partial pressure of C = 1.5 atm

Partial pressure of B = ?

$$\text{Partial pressure of C} = \frac{\text{Mole of C}}{\text{Total mole}} \times \text{Total pressure}$$

$$1.5 = \frac{5}{20} \times \text{Total pressure}$$

$$\boxed{\text{Total pressure} = 6\,\text{atm}}$$

$$\text{Now, Partial pressure of B} = \frac{\text{Mole of B}}{\text{Total mole}} \times \text{Total pressure}$$

$$= \frac{3}{20} \times 6 = 0.9\,\text{atm}$$

179. When 1 mole of CO_2(g) occupying volume 10L at 27°C is expanded under adiabatic condition, temperature falls to 150 K. Hence, final volume is

(a) 5 L (b) 20 L

(c) 40 L (d) 80 L

VITEEE-2013

Ans. (d) : For adiabatic condition –

$$\frac{T_2}{T_1} = \left(\frac{V_1}{V_2}\right)^{\gamma-1}$$

∵ CO_2 is triatomic gas

∴ $\gamma = 1.33$

Given, T_1 = 300 K, T_2 = 150 K, V_1 = 10 L, V_2 = ?

$$\left(\frac{150}{300}\right) = \left(\frac{10}{V_2}\right)^{1.33-1}$$

$$\left(\frac{1}{2}\right) = \left(\frac{10}{V_2}\right)^{0.33}$$

$$\left(\frac{1}{2}\right)^3 = \frac{10}{V_2}$$

V_2 = 10×8 = 80 Litre.

180. The pressure exerted by 6.0g of methane gas in a 0.03m^3 vessel at 129°C is (Atomic masses : C = 12.01, H = 1.01 and R = 8.314 JK^{-1} mol^{-1})

(a) 215216 Pa (b) 13409 Pa

(c) 41648 Pa (d) 31684 Pa

VITEEE- 2012

Ans. (c) : Given:–

Weight in gram of methane = 6.0 gram

Molecular weight of methane (CH_4) = 1 × 12 + 4 × 1

= 16 gram/mole

T = 129°C

= 129 + 273 = 402K

From, ideal gas equation,

$$PV = nRT \Rightarrow P = \frac{nRT}{V} = \frac{W}{M} \times \frac{RT}{V}$$

$$P = \frac{6}{16} \times \frac{8.314 \times 402}{0.03} = 41648\ \text{Pa}$$

181. A bubble of air underwater at temperature 15°C and the pressure 1.5 bar. If the bubble rises to the surface where the temperature is 25°C and the pressure is 1.0 bar, what will happen to the volume of the bubble?

(a) Volume will become greater by a factor of 1.6

(b) Volume will become greater by a factor of 1.1

(c) Volume will become smaller by a factor of 0.70

(d) Volume will become greater by a factor of 2.9

VITEEE- 2012

Ans. (a) : According to Ideal gas equation:-

$$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$$

$$\Rightarrow \frac{1.5 \times V_1}{288} = \frac{1.0 \times V_2}{298} \quad \left\{ \begin{array}{ll} \because T_1 = 15°C & \text{and } T_2 = 25°C \\ = 15 + 273 & = 25 + 273 \\ = 288\,K & = 298\,K \end{array} \right.$$

$$\Rightarrow \frac{V_1}{V_2} = \frac{1.0 \times 288}{298 \times 1.5}$$

$$V_2 = \frac{1.5 \times V_1 \times 298}{288}$$

$$\frac{V_2}{V_1} = \frac{447}{288}$$

$$\boxed{\frac{V_2}{V_1} = 1.55}$$

$V_2 = 1.55\ V_1$

i.e., volume of bubble will be 1.55 times of initial volume of bubble.

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182. When ideal gas expands in vacuum, the work done by the gas is equal to

(a) PV (b) RT

(c) 0 (d) nRT

VITEEE- 2006

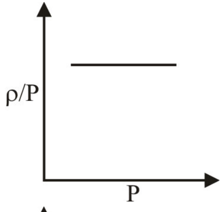
Ans. (c) : $W_{irr} = -P_{ext}\frac{R[P_1T_2 - P_2T_1]}{P_1P_2}$

During expansion in vaccum $P_{ext} = 0$

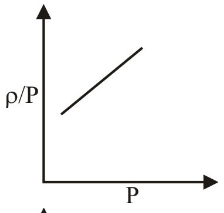
$\therefore$ work done = 0.

183. The ideal gas equation, PV = nRT, can be written in terms of density, ρ, and $\rho/P = \frac{M}{RT}$. The graph between ρ/P against P is given by

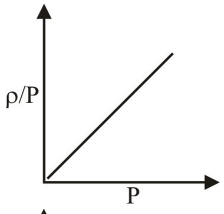
(a)



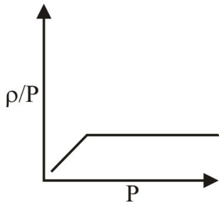
(b)



(c)



(d)



AMU-2013

Ans. (a) : From ideal gas equation,

PV = nRT

For 1 mole, PV = RT

Density (ρ) = $\frac{\text{Mass(M)}}{\text{Volume(V)}}$

Volume (V) = $\frac{\text{Mass(M)}}{\text{Density(P)}}$

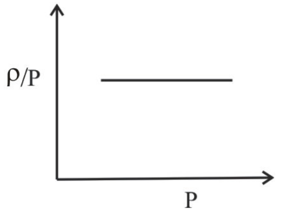
On substituting the value of volume (V) in ideal gas equation, we get

$$\frac{\rho}{P} = \frac{M}{RT}$$

$$\frac{\rho}{P} = \text{Constant}$$

$\rho \propto P$

Therefore,



184. One mole of an ideal gas expands at a constant temperature of 300 K from an initial volume of 10 liter to a final volume of 20 liter. The work done in expanding the gas is

(a) 750 Joule (b) 1726 Joule

(c) 1500 Joule (d) 3456 Joule

AMU-2011

Ans. (b) : Given :– T = 300 K

N = 1 mole

$V_1 = 10$ L

$V_2 = 20$ L

Work done in isothermal process,

$W = nRT \log_{10}\frac{V_2}{V_1}$

$= 1 \times 8.3 \times 300 \times 2.303 \log_{10}\frac{20}{10}$

= 1725.93 J ≈ 1726 J

185. The ratio of rates of diffusion of hydrogen chloride and ammonia gases is

(a) 1:1.46 (b) 1:2.92

(c) 1.46:1 (d) 1:0.73

AMU – 2010

Ans. (a) : r_1 = rate of diffusion of HCl

r_2 = Rate of diffusion of NH_3

M_1 = Molecular mass of HCl

M_2 = Molecular mass of NH_3

$$\frac{r_1}{r_2} = \sqrt{\frac{M_2}{M_1}} = \sqrt{\frac{17}{36.5}} = \sqrt{0.466} = 1 : 1.46$$

186. An ideal gas is undergoing from an initial volume, isothermal and adiabatic expansion from an initial volume, V_i and pressure, P_i to a common final volume of V_f, then

(a) $P_{adiabatic} < P_{isothermal} : V_{adiabatic} > V_{isothermal}$

(b) $P_{adiabatic} < P_{isothermal} : V_{adiabatic} < V_{isothermal}$

(c) $P_{adiabatic} > P_{isothermal} : V_{adiabatic} > V_{isothermal}$

(d) $P_{adiabatic} > P_{isothermal} : V_{adiabatic} < V_{isothermal}$

AMU–2006

Ans. (b) : We know that,

Slope of isothermal & adiabatic process are,

$$\left(\frac{dp}{dv}\right)_{iso} = \frac{-p}{v} \qquad \left(\frac{dp}{dv}\right)_{Ad} = -\gamma\frac{p}{v}$$

$$\therefore \quad \left(\frac{dp}{dv}\right)_{Ad} > \left(\frac{dp}{dv}\right)_{iso}$$

Case-I: Common volume V_f

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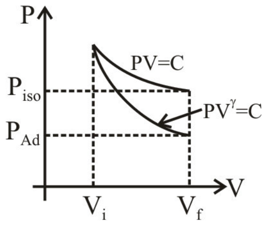
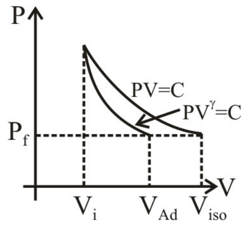
For expansion,



$\therefore \quad P_{iso} > P_{Ad}$

Case-II: Common pressure P_f

For expansion,



$\therefore \quad V_{iso} > V_{Ad}$

187. 7.5 g of gas occupies 5.6 L at STP. The gas is (atomic weights of C, N and O are 12, 14, 16, respectively)

(a) NO (b) N_2O
(c) CO (d) CO_2

Assam CEE-2020

Ans. (a) : One mole of Gas at STP occupies 22.4 L Thus, 5.6 L of Gas at STP contains 0.25 Moles

$$\text{No of moles} = \frac{\text{Wt.in grams}}{\text{Mol Wt}}$$

$$0.25 = \frac{7.5}{m}$$

$$\boxed{m = 30}$$

The Gas is NO.

188. Two litres of an ideal gas at a pressure of 10 atm expands isothermally into a vacuum until its total volume is ten litres During this process

(a) work is done; no heat is absorbed
(b) work is done; heat is emitted
(c) no work is done; heat is emitted
(d) no work is done; no heat is absorbed

Assam CEE-2019

Ans. (d) : For isothermal process,

$W = Q$

$\because$ For expansion of vacuum, $W = 0$

$\therefore \quad W = 0$

189. Gas equation PV = nRT is obeyed by ideal gas in

(a) adiabatic process (b) isothermal process
(c) both (a) and (b) (d) none of the above

BCECE-2007

Ans. (c) : Ideal gas in adiabatic and in isothermal process can obeyed gas equation PV = nRT

In isothermal process the temperature of the system is remain constant while in adiabatic process, no exchange of heat occurs between the system and the surrounding, So q = o

According to ideal gas equation the behavior of gases will be same at any specific condition. Therefore, the behavior of gas is also same in adiabatic and isothermal process so, there is no change in ideal gas equation in both the process.

190. If both oxygen and helium gases are at the same temperature, the rate diffusion of O_2 is very close to :

(a) 4 times that of He (b) 2 times that of He
(c) 0.35 times that of He (d) 8 times that of He

BCECE-2006

Ans. (c) : According to graham's law, rate of diffusion is inversely proportional to square root of molecular mass.

$$r_d \propto \frac{1}{\sqrt{\text{Molar mass}}}$$

$$\frac{(r_d)_{O_2}}{(r_d)_{H_e}} = \sqrt{\frac{(\text{M.Wt})_{H_e}}{(\text{M.Wt})_{O_2}}}$$

M. Wt. Of helium = 4

M. Wt. Of O_2 = 32

$$(r_d)_{O_2} = \sqrt{\frac{4}{32}} \times (r_d)_{H_2}$$

$$= 0.35 \times (r_d)_{H_2}$$

Rate of diffusion of O_2 is 0.35 time that of He.

191. 2g of O_2 at 27 °C and 760 mm of Hg pressure has volume :

(a) 1.4 L (b) 2.8 L
(c) 11.2 L (d) 22.4 L

BCECE-2005

Ans. (a) : Given : – mass of O_2 (M) = 2g

$T = 27^0C = 300$ K

P = 760 mm of Hg

$$\text{mole of } O_2 = \frac{\text{Mass of } O_2}{\text{Molecular mass of } O_2}$$

$$= \frac{2}{32} = \frac{1}{16}$$

Volume of O_2 at NTP = mole of O_2 × 22.4L

$$\text{Volume of } O_2 = \frac{1}{16} \times 22.4\text{L}$$

$$= 1.4 \text{ L}$$

192. A gas has a vapour density 11.2. The volume occupied by 1g of the gas at NTP is :

(a) 1 L (b) 11.2 L
(c) 22.4 L (d) 4 L

BCECE-2004

Ans. (a) : $\text{Vapour density} = \frac{\text{Molar mass}}{2}$

Molar mass = Vapour density × 2

= 11.2 × 2

= 22.4

$$\text{Moles} = \frac{\text{Weight}}{\text{Molar mass}}$$

$$\text{Mole} = \frac{1}{22.4}$$

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Volume of gas = mole × 22.4 L

$$= \frac{1}{22.4} \times 22.4\text{ L}$$

$$= 1\text{ L}$$

193. If the pressure and absolute temperature of 2L of carbon dioxide gas are doubled, the value of the gas would become

(a) 2L (b) 4L
(c) 5L (d) 7L

BCECE-2011

Ans. (a) : Given : – $P_1 = P$

$P_2 = 2P$

$T_1 = T$

$T_2 = 2T$

$V_1 = 2L$

Find V_2

Form ideal gas equation,

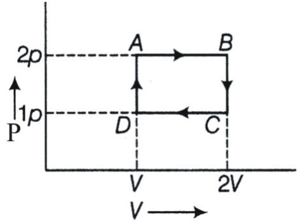
$PV = nRT$

$$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$$

$$V_2 = \frac{P \times 2L}{T} \times \frac{2T}{2P}$$

$V_2 = 2L$

194. An ideal mono-atomic gas follows the path ABCD. Then, the work done during the complete cycle is–



(a) zero (b) $-\frac{1}{2}PV$
(c) –PV (d) –2PV

BCECE-2015

Ans. (c) : Work done during the complete cycle is equal to area of the rectangle (A B C D). For clockwise cycle take negative sign and for anti – clockwise take positive sign.

Work done = – (Area of rectangle A B C D)

= –(length × breadth)

= – PV

195. A work is done on the system such that one mole of an ideal gas at 400K is compressed isothermally and reversibly to 1/10th of its original volume. The amount of (use R = 2 in cal) work done will be –

(a) 2.303 k-cal (b) 0.184 k-cal
(c) 1.84 k-cal (d) 4.60 k-cal

BCECE-2017

Ans. (c) : Work done for isothermal process is given by.

$$W = -\,nRT \ln \frac{V_2}{V_1}$$

$$= -\,2.303 \times nRT \log_{10} \frac{V_2}{V_1}$$

Given:–

T = 400 K

R = 2 cal

$$\frac{V_2}{V_1} = \frac{1}{10}$$

n = 1 mole

$$\therefore\ W = -\,1 \times 2 \times 400 \times 2.303 \log_{10} \frac{1}{10}$$

= 1.8424 k cal

= 1.84 k cal

196. Volume of an ideal gas is decreased by 5% at constant temperature such that there is an increase in pressure by x %. The increase in pressure (in%) will be :

(a) 5% (b) 4.7%
(c) 5.26% (d) 95%

BCECE-2017

Ans. (c) : Given : – If $V_1 = 100V$ then $V_2 = 95$ V

Because ΔV is decreased by 5%.

According to ideal gas equation.

$PV = nRT$

$P_1V_1 = P_2 V_2$

$$\frac{P_1}{P_2} = \frac{V_2}{V_1} = \frac{95V}{100V} = \frac{95}{100}$$

$P_1 = 95P$, $P_2 = 100P$

$$\text{Percentage change in pressure} = \left(\frac{P_2 - P_1}{P_1}\right) \times 100$$

$$= \left(\frac{100-95}{95}\right) \times 100$$

$$= \frac{5}{95} \times 100$$

= 5. 26 %

197. In a closed system, $A(s) \rightleftharpoons 2B(g) + 3C(g)$, if partial pressure of C is doubled, then partial pressure of B will be

(a) $2\sqrt{2}$ times the original value

(b) $\frac{1}{2}$ times the original value

(c) 2 times the original value

(d) $\frac{1}{2\sqrt{2}}$ times the original value

BITSAT 2016

Ans. (d) : $K_p = (P_B)^2 \times (P_C)^3$ -----(i)

Again, $(P_B)^2 \times (P_C)^3 = (P_{B_1})^2 \times (P_{C_1})^3$ ------(ii)

Given, $P_{C_1} = 2P_C$

From equation (i) and (ii) are equal,

$(P_B)^2 \times (P_C)^3 = (P_{B_1})^2 \times (2P_C)^3$

$(P_B)^2 \times (P_C)^3 = (P_{B_1})^2 \times 8(P_C)^3$

$$\boxed{P_{B_1} = \frac{P_B}{2\sqrt{2}}}$$

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198. The inversion temperature (T_i) for a gas is given by

(a) a/Rb (b) 2a/Rb

(c) $\frac{Rb}{a}$ (d) $\frac{2Rb}{a}$

BITSAT 2005

Ans. (b) : Gases become cooler during Joule Thomson's expansion only if they are below a certain temperature known as inversion temperature (T_i).

$$T_i = \frac{2a}{Rb}$$

199. The cooking time in a pressure cooker is less because :

(a) More heat is used
(b) High pressure cooks the food
(c) The boiling point of water increases in the cooker
(d) Heat is uniformly distributed

BITSAT 2009

Ans. (c) : In pressure cooker, pressure is high thus, the boiling point of water increases, resulting cooking time is less than other open pots.

200. One moles each of four ideal gases are kept as follows :

I. 1 L of gas (A) at 2 atm pressure
II. 2.5 L of gas (B) at 2 atm pressure
III. 1.25 L of gas (C) at 2 atm pressure
IV. 2.5 L of gas (D) at 2.5 atm pressure

Which of the above gases is kept at highest temperature?

(a) Gas (A) (b) Gas (B)
(c) Gas (C) (d) Gas (D)

BITSAT 2017

Ans. (d) : ∵ For ideal gas,

$$PV = nRT$$

$$\text{or } T = \frac{PV}{nR}$$

$\because$ n = 1 = constant
R = 0.083 = constant
$\therefore T \propto PV$

Thus,
The gas that shows highest product of P × V, has high temperature.
For,
(A) $P \times V = 1 \times 2 = 2$
(B) $P \times V = 2 \times 2.5 = 5$
(C) $P \times V = 2 \times 1.25 = 2.5$
(D) $P \times V = 2.5 \times 2.5 = 6.25$
Hence, gas (D) show highest temperature.

201. The temperature, at which a gas shows maximum ideal behaviour, is known as

(a) Boyle's temperature
(b) Inversion temperature
(c) Critical temperature
(d) Absolute temperature

CG PET -2009

Ans. (a) : The temperature at which a gas shows maximum ideal behavior for considerable range of pressure in known as Boyle's temperature.

202. For an ideal gas, number of moles per liter in terms of its pressure P, temperature T and gas constant R is

(a) $\frac{PT}{R}$ (b) PRT

(c) $\frac{P}{RT}$ (d) $\frac{RT}{P}$

[AIEEE 2002]

Ans. (c) : From ideal gas equation,

$$PV = nRT$$

Where P is Pressure
V is volume
N is no. of moles
R is gas constant
T is temperature

Number of moles per liter $\left(\frac{n}{V}\right)$ is

$$\frac{n}{V} = \frac{P}{RT}$$

203. At a given temperature T, gases Ne, Ar, Xe and Kr are found to deviate from ideal gas behaviour. Their equation of state is given as,

$$P = \frac{RT}{V-b} \text{ at T.}$$

Here, b is the Vander Waal's constant. Which gas will exhibit steepest increase in the plot of Z (compression factor) vs P?

(a) Xe (b) Ar
(c) Kr (d) Ne

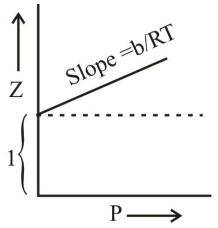
(JEE Main 2019, 9 April Shift-II)

Ans. (a) : From given equation,

$$P = \frac{RT}{V-b}$$

$$P(V-b) = RT$$

At high pressure Vander Waal's equation is converted into above equation
PV – Pb = RT
Dividing by RT on both side



$$\frac{PV}{RT} - \frac{Pb}{RT} = 1$$

$$Z = \frac{PV}{RT}$$

$$\therefore \quad Z = 1 + \frac{Pb}{RT}$$

y = mx + c
Z > 1 and
$Z \propto b$.

As the size of atom increases volume occupied by gas increases compressibility factor (z) also increases. Therefore, Xe has greater size and greater volume so, it will exhibit steepest increase in the plot of Z v/s P.

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204. For one mole of an ideal gas, which of these statements must be true?
(A) U and H each depends only on temperature.
(B) Compressibility factor Z is not equal to 1.
(C) $C_{p.m} - C_{v.m} = R$
(D) $dU = C_vdT$ for any process.
(a) (B), (C) and (d) (b) (A) and (C)
(c) (A), (C) and (D) (d) (C) and (D)

[JEE Main 2020, 4 Sep Shift-I]

Ans. (c) : For real gases,

$$U = f(T,V)$$
$$H = f(T,P)$$

But for ideal gas, $U = f(T)$
$$H = f(T)$$

Hence, U and H each depends only on temperature.
For ideal gas compressibility factor z is equal to 1.

$C_{PM} - C_{VM} = R$ and

$dU = C_VdT$ for any process is also correct for ideal gases.

205. A certain gas obeys $P(V_m–b) = RT$.
The value of $\left(\frac{\partial Z}{\partial P}\right)_T$ is $\frac{xb}{RT}$.
The value of x is…….
(Z=compressibility factor)

[JEE Main 2021, 26 Feb Shift-I]

Ans. (1) : From Vander Waal's equation

$$\left(P - \frac{an^2}{V^2_m}\right)(V_m - nb) = nRT$$

At high pressure,

$$P(V_m - nb) = nRT$$

For 1 mole,

$$P(V_m - b) = RT$$

PVm – Pb = RT
Dividing RT on both side

$$\frac{PV_m}{RT} - \frac{Pb}{RT} = 1$$

$$Z = \frac{PV_m}{RT}$$

$$Z = 1 + \frac{Pb}{RT}$$

$$\left(\frac{\partial Z}{\partial P}\right)_T = \frac{b}{RT} + 0$$

$$\therefore \frac{b}{RT} = \frac{xb}{RT}$$

$\therefore$ x = 1

206. A home owner uses $4.00×10^3$ m^3 of methane (CH_4) gas, (assume CH_4 is an ideal gas). In a Year to heat his home. Under the pressure of 1.0 atm and 300K, mass of gas used is $x×10^5$ g. The value of x is……. (Nearest integer)
(Given, R = 0.083 L atm K^{-1} mol^{-1})

[JEE Main 2021, 25 July Shift-I]

Ans. (26) : For ideal gas equation,

PV = nRT

$$n = \frac{PV}{RT}$$

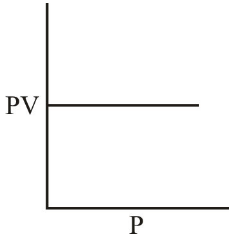
Given – P = 1 atm
$V = 4 \times 10^3\ m^3 = 4 \times 10^3 \times 1000$ L
T = 300 K
R = 0.083 L atm K^{-1} mol^{-1}

$$n = \frac{1 \times 4 \times 10^3 \times 1000}{300 \times 0.083}$$

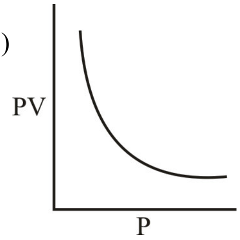
$n = 0.1606 \times 10^6$ mole
Mass = Mole × Molar mass
$= 0.1606 \times 10^6 \times 16$
$= 26 \times 10^5$ g
x = 26

207. Which one of the following is the correct PV vs P plot at constant temperature for an ideal gas? (P and V stand for pressure and volume of the gas respectively)

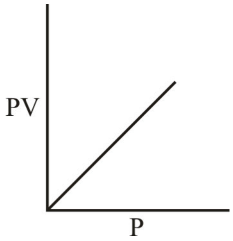
(a)



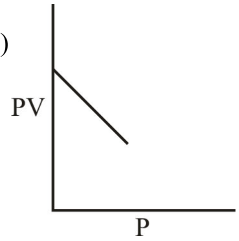
(b)



(c)



(d)



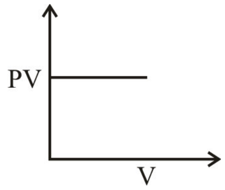
[JEE Main 2021, 31 Aug Shift-I]

Ans. (a) : From ideal gas equation.

PV = nRT
At constant temperature
PV = Constant

$$P \propto \frac{1}{V} \text{ (Boyle's law)}$$

Therefore, in PV v/s P plot at constant temperature for an ideal gas gives.



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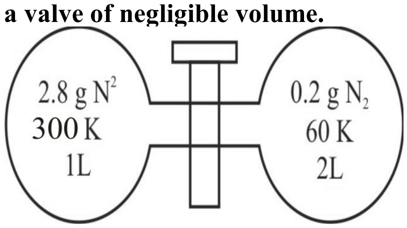
208. Two flasks I and II shown below are connected by a valve of negligible volume.



When the valve is opened, the final pressure of the system in bar is x×10^{-2}. The value of x is…………(Integer answer)
[Assume, Ideal gas, 1 bar = 10^5 Pa, molar mass of N_2 = 28.0 g mol^{-1}; R = 8.31 J mol^{-1} K^{-1}]
[JEE Main 2021, 27 Aug Shift-II]

Ans. (84) : Given:- $T_I = 300$ K, $T_{II} = 60$ K
$V_I = 1L$, $V_{II} = 2$ L
$M_I = 2.8$ g, $M_{II} = 0.2$ g

No. of moles in both Container when valve is closed = No. of moles on both container when valve is opend.

$$(n_I + n_{II})_{initial} = (n_I + n_{II})_{final}$$

Let us assume that the final temperature of system T (300 > T > 60)

Heat lost by N_2 in container I = $n_I c_m (300 - T)$

Heat gained by N_2 in container II = $n_{II} c_m (T - 60)$

Heat lost by N_2 in container I = Heat lost by N_2 in container II

$$n_I c_m (300 - T) = n_{II} c_m (T - 60)$$

Molar heat capacity for N_2 in both the container is same.

$$\left(\frac{2.8}{28}\right)(300 - T) = \left(\frac{0.2}{28}\right)(T - 60)$$

$$14(300 - T) = T - 60 \Rightarrow T = 284K$$

Let final pressure be P,

$$(n_I + n_{II})_{final} = \left(\frac{0.2+2.8}{28}\right) = \frac{3}{28} \text{ mol}$$

From ideal gas equation,

$$P(V_I + V_{II}) = (V_I + V_{II})_{final} RT$$

$$V_I + V_{II} = 3L = 3 \times 10^{-3} \text{ m}^3$$

$$P = \frac{3}{28} \times \frac{8.31 \times 280}{3 \times 10^{-3}} \text{Pa}$$

= 8.4 × 10^5 Pa
= 0.84 × 10^5 × 10^{-5} bar
= 0.84 bar = 84 × 10^{-2} bar
x = 84

209. The osmotic pressure of a solution containing 300 mg of a non-volatile, non-ionising, and non-associationg solute in 100 mL of water at 27 °C was found to be 1.23 atmosphere. The molar mass of the solute in g mol^{-1} is (R = 8.2 × 10^{-2} L atm K^{-1} mol^{-1})

(a) 40 (b) 120
(c) 60 (d) 180

J & K CET-(2016)

Ans. (c) : Osmotic pressure (π) of solution is

π = CRT

Where, C = Concentration of solution
R = gas constant
T = Temperature

$$C = \frac{\text{Mass}}{\text{Molar mass} \times \text{volume}} = \frac{m}{MV}$$

$$\pi = \frac{m}{MV} RT$$

$$1.23 = \frac{300 \times 10^{-3} \times 8.2 \times 10^{-2} \times 300}{M \times 100}$$

M = 60 g

210. Which of the following pair of gases will diffuse at the same rate through a porous plug?

(a) CO, NO_2 (b) NO, C_2H_6
(c) NO_2, CO_2 (d) NH_3, PH_3

J & K CET-(2011)

Ans. (b) : According to Graham's law,

$$\text{Rate of diffusion} \propto \frac{1}{\sqrt{\text{Molar mass}}}$$

Molar mass of compounds are,
CO = 28
NO_2 = 46
NO = 30
C_2H_6 = 2×12 + 6 × 1 = 30
CO_2 = 44, NH_3=17
PH_3 = 31

Therefore, rate of diffusion for NO and C_2H_6 is same because they have same molar mass.

211. If the ratio of the rates of diffusion of two gases A and B is 4 : 1. Then the ratio of their densities in the same order is

(a) 16 : 1 (b) 4 : 1
(c) 1 : 4 (d) 1 : 16

J & K CET-(2009)

Ans. (d) : According to Graham's law rate of diffusion(r_d) is inversely proportional to square root of density (ρ)

$$r_d \propto \frac{1}{\sqrt{\rho}}$$

$$\frac{(r_d)_A}{(r_d)_B} = \sqrt{\frac{\rho_B}{\rho_A}}$$

$$\frac{\rho_A}{\rho_B} = \left(\frac{(r_d)_B}{(r_d)_A}\right)^2 = \left(\frac{1}{4}\right)^2 = \frac{1}{16}$$

$$\rho_A : \rho_B = 1 : 16$$

212. Identify the pair of gases that have equal rates of diffusion

(a) CO, NO (b) N_2O, CO
(c) N_2O, CO_2 (d) CO_2, NO_2

J & K CET-(2008)

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Ans. (c) : Rate of diffusion (r_d) is inversely proportional to square root of molar mass (M.M)

$$r_d \propto \frac{1}{\sqrt{M.M}}$$

Rate of diffusion for two gases are equal when they have same molar mass. Molar mass of NO_2 and CO_2 are same that 44. So, there rate of diffusion is also equal.

213. A, B and C are ideal gases. Their molecular weights are 2, 4 and 28 respectively. The rate of diffusion of these gases follow the order

(a) C > A > B (b) C > B > A

(c) A = B = C (d) A > B > C

J & K CET-(2006)

Ans. (d) : According to Graham's law rate of diffusion is inversely proportional to molecular mass of gases.

$$r_d \propto \frac{1}{\sqrt{M.M}}$$

Hence, gases whose molecular mass is higher then its rate of diffusion lesser. The order of rate of diffusion is

A > B > C

214. The rate of diffusion of a gas is proportional to

(a) $P/\sqrt{d}$ (b) $\sqrt{P/d}$

(c) P/d (d) $\sqrt{P}/d$

J & K CET-(2004)

Ans. (a) : According to Graham's law, rate of diffusion (r_d) is inversely proportional to square root of density of gases.

$$r_d \propto \frac{1}{\sqrt{\text{density}}} = \frac{1}{\sqrt{d}}$$

At constant temperature, rate of diffusion is directly proportional to pressure (P) and inversely proportional to density (d)

$$r_d \propto \frac{P}{\sqrt{d}}$$

215. Molar volume of CO_2 is maximum at

(a) NTP (b) 0°C and 2.0 atm

(c) 127°C and 1atm (d) 273°C and 2.0 atm

J & K CET-(2004)

Ans. (c) : From ideal gas equation,

$$PV = nRT$$

$$V = \frac{nRT}{P}$$

For 1 mole

$$V = \frac{RT}{P}$$

$R = 0.0821 \text{ L bar } K^{-1} mol^{-1}$

(a) At, NTP, T = 273 K , P = 1 atm

$$V = \frac{0.0821 \times 273}{1} = 22.4 L$$

(b) T = 0^oC = 273 K , P = 2 atm

$$V = \frac{0.0821 \times 273}{2} = 11.4 L$$

(c) T = 127^o C = 400 K, P = 1 atm

$$V = \frac{0.0821 \times 400}{1} = 32.84 L$$

(d) T = 273^oC = 546 K, P = 2 atm

$$V = \frac{0.0821 \times 546}{2} = 22.4 L$$

Hence, molar volume of CO_2 is maximum at 127^oC and 1 atm.

216. Measurement of the dry gas from the volume of moist gas is based on

(a) Boyle's law

(b) Avogadro's law

(c) Gay Lussac's law

(d) Dalton's law of partial pressure

J & K CET-(2001)

Ans. (d) : Dalton's law of partial pressure helps in measurement of the dry gas from the volume of moist gas.

$$P_{(\text{dry gas})} = P_{(\text{moist gas})} - \text{Aqueous Tension}$$

217. The volume of a gas expands by 0.25 m^3 at a constant pressure of 10^3 Nm^{-2}. The workdone is equal to

(a) 2.5 erg (b) 250 joule

(c) 250 watt (d) 250 newton

J & K CET-(1999)

Ans. (b) : Work done = –PdV

Given, Change in volume (dV) = 0.25 m^3

Pressure (P) = 10^3 Nm^{-2}

$W = -10^3 \times 0.25$ Nm

= –250 Nm

= –250 Joule.

218. An ideal gas is found to obey an additional law P^2V= constant. The gas is initially at temperature T and volume V. When is expands to a volume 2V, the temperature becomes.

(a) T/2 (b) 2T

(c) $\sqrt{2}$ T (d) $T/\sqrt{2}$

J & K CET-(1999)

Ans. (c) : From ideal gas equation,

$$PV = nRT$$

$$P = \frac{nRT}{V}$$

When ideal gas follow additional law,

P^2V = constant

P(PV) = constant

Substituting the value of P and PV from above ideal gas equation,

$$\frac{nRT}{V}(nRT) = \text{constant}$$

$$\frac{(nRT)^2}{V} = \text{constant}$$

$$\frac{T^2}{V} = \text{constant}$$

$$\frac{(T_1)^2}{V_1} = \frac{(T_2)^2}{V_2}$$

$$T_2 = \sqrt{\frac{V_2}{V_1} \times (T_1)^2}$$

$$= \sqrt{\frac{2V}{V}} \times T$$

$$T_2 = \sqrt{2}\,T$$

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219. At constant pressure, what would be the percentage decreases in the density of an ideal gas for a 10% increase in the temperature?

(a) 10% (b) 9.1%
(c) 11% (d) 12.09%

J & K CET-(1998)

Ans. (b) : From ideal gas equation,

$$PV = nRT$$

$$PV = \frac{\text{mass (m)}}{\text{molar mass (M)}} RT$$

$$\text{density}(\rho) = \frac{m}{V} = \frac{PM}{RT}$$

$$\rho \propto \frac{1}{T}$$

It is given that, increase in temperature is 10%

Let T_1 is 100 T and $T_2 = 110$ T

$$\frac{\rho_1}{\rho_2} = \frac{T_2}{T_1} = \frac{110}{100}$$

$\rho_1 = 110\rho$, $\rho_2 = 100\rho$

$$\%\text{ change in density }(\rho) = \left(\frac{\rho_2 - \rho_1}{\rho_1}\right) \times 100$$

$$= \left(\frac{100\rho - 110\rho}{110\rho}\right) \times 100$$

$$= \frac{-10}{110} \times 100$$

$$= -9.09\% \approx -9.1\%$$

Where negative sign shows that on increasing temperature density decreases therefore percentage decrease in density is 9.1 %.

220. A flask containing air (open to atmosphere) is heated from 300 K to 500 K. The percentage of air escaped to the atmosphere is

(a) 66.6% (b) 16.6%
(c) 33.3% (d) 40%

J & K CET-(1999)

Ans. (d) : Given, $V_1 = V$

$T_1 = 300K$, $T_2 = 500K$

$V_2 = ?$

From ideal gas equation,

$$PV = nRT$$

At constant pressure, $V \propto T$

$$\frac{V}{T} = \text{constant}$$

$$\frac{V_1}{T_1} = \frac{V_2}{T_2}$$

$$V_2 = \frac{500}{300} V$$

$$= \frac{5}{3} V$$

$$\text{Percentage of air escaped} = \left(\frac{V_2 - V_1}{V_2}\right) \times 100$$

$$= \left(\frac{\frac{5}{3}V - V}{\frac{5}{3}V}\right) \times 100$$

$$= \frac{2V}{3} \times \frac{3}{5V} \times 100$$

$$= 40\%$$

221. A sample of methane gas occupying 0.50 m^3 volume is kept at 2.0×10^2 kPa pressure and 300 K temperature. The amount of methane will be

(a) 20 mol (b) 25 mol
(c) 30 mol (d) 40 mol.

J & K CET-(1998)

Ans. (d) : Given $V = 0.5m^3$, $P = 2\times10^2$ kPa$=2\times10^5$Pa , $T = 300K$

$n = ?$

From ideal gas equation,

$$PV = nRT$$

$$n = \frac{PV}{RT} = \frac{2\times10^5 \times 0.5}{300 \times 8.314}$$

$$= 40 \text{ mol}$$

222. Equal masses of SO_2 and O_2 are mixed in an empty container at 27°C. The total pressure exerted by the gaseous mixture is 1 atm. The partial pressure exerted by SO_2 gas is

(a) 0.20 atm (b) 0.33 atm
(c) 0.67 atm (d) 1 atm

J & K CET-(1997)

Ans. (b) :

Partial pressure of gas = Mole fraction × Total pressure

$$P = X \times P_T$$

mass of of SO_2 = mass of O_2 = w

$$\text{mole fraction of } SO_2 = \frac{w/64}{\frac{w}{64} + \frac{w}{32}} = \frac{1}{3}$$

$$P_{SO_2} = X_{SO_2} \times P_T$$

$$P_{SO_2} = \frac{1}{3} \times 1 \text{ atm} = 0.33 \text{ atm}$$

223. An ideal gas expands in volume from 1×10^{-3} m^3 to 1×10^{-2} m^3 at 300 K against a constant pressure of 1×10^5 Nm^{-2}. The work done is

(a) – 900 J (b) – 900 kJ
(c) 270 kJ (d) 900 kJ

JCECE - 2010

Ans. (a) : Work done due to change in volume against constant pressure.

$W = -P (V_2 - V_1)$

$= -1 \times 10^5 \text{ Nm}^{-2} (1 \times 10^{-2} - 1 \times 10^{-3})m^3$

$= -900$ Nm $= -900$ J (1 Nm = 1 J)

224. 1L oxygen gas at STP will weigh

(a) 1.43 g (b) 2.24 g
(c) 11.2 g (d) 22.4 g

JCECE - 2010

@apna_pdf

Ans. (a) : Given, volume of O_2 = 1L

$\because$ 22.4 L of O_2 at STP = 32 g

$$\therefore \quad 1 \text{ L of } O_2 \text{ at STP} = \frac{32}{22.4} \text{g} = 1.43 \text{ g}$$

225. At constant temperature, in a given mass of an ideal gas

(a) the ratio of pressure and volume always remains constant
(b) volume always remains constant
(c) pressure always remains constant
(d) the product of pressure and volume always remains constant

JCECE - 2011

Ans. (d) : At constant temperature, the product of pressure and volume of a given mass of an ideal gas is always constant. This is the statement of Boyle's law.

PV = constant (at T = constant)

226. For an ideal binary liquid solution with $p_x^0 > p_y^0$ in which relation between X_x (mole fraction of X in liquid phase) and Y_x (mole fraction of X in vapour phase) is correct, X_y and Y_y are mole fraction of Y in liquid and vapour phase respectively

(a) $X_x > Y_x$
(b) $X_x = Y_x$
(c) $\frac{X_x}{X_y} < \frac{Y_x}{Y_y}$
(d) X_x , Y_x, X_y and Y_y cannot be correlated

JIPMER-2015

Ans. (c) : Given :- $P_x^0 > P_y^0$

According to Raoult's law

$P_x = P_x^0 X_x = P_T V_x$ ....(i)

$P_y = P_y^0 X_y = P_T V_y$ ....(ii)

Where P_x^0 and P_y^0 are pressure in pure form of x and y respectively.

$$P_T = \frac{P_x^0 X_x}{Y_x}$$

$$P_T = \frac{P_y^0 X_y}{Y_y}$$

$$\therefore \quad \frac{P_x^0 X_x}{Y_x} = \frac{P_y^0 X_y}{Y_y}$$

$$\frac{P_x^0}{P_y^0} = \frac{X_y Y_x}{X_x Y_y}$$

$$\frac{P_x^0}{P_y^0} > 1 \Rightarrow \frac{X_y Y_x}{X_x Y_y} > 1$$

Therefore, $\frac{X_x}{X_y} < \frac{Y_x}{Y_y}$

227. 56 g of nitrogen and 96 g of oxygen are mixed isothermally and at a total pressure of 10 atm. The partial pressures of oxygen and nitrogen (in atm) are respectively

(a) 4, 6 (b) 5, 5
(c) 2. 8 (d) 6, 4

JIPMER-2011

Ans. (d) : Partial Pressure = Mole fraction × Total Pressure

$$\text{Mole fraction of oxygen } (X_O) = \frac{\frac{96}{16}}{\frac{96}{16}+\frac{56}{14}} = \frac{6}{10}$$

$$\text{Mole fraction of nitrogen } (X_N) = \frac{\frac{56}{14}}{\frac{56}{14}+\frac{96}{16}} = \frac{4}{10}$$

Partial pressure of Oxygen = $X_O \times P_T$

$$= \frac{6}{10} \times 10 = 6 \text{atm}$$

Partial pressure of nitrogen = $X_N \times P_T$

$$= \frac{4}{10} \times 10 = 4 \text{atm}$$

228. The volume of a gas measured at 27 °C and 1 atm pressure is 10L. To reduce the volume to 2L at 1 atm pressure, the temperature required is

(a) 60 K (b) 75 K
(c) 150 K (d) 225 K

JIPMER-2008

Ans. (a) : Given, $T_1 = 27^oC = 300K$, P_1 = 1 atm

V_1 = 10L, V_2 = 2L, P_2 = 1 atm , T_2 = ?

From ideal gas equation, PV = nRT

At constant pressure,

$$\frac{V}{T} = \text{constant}$$

Or
$$\frac{V_1}{T_1} = \frac{V_2}{T_2}$$

$$\frac{10}{300} = \frac{2}{T_2}$$

T_2 = 60 K

229. In an ideal gas equation which is constant?

(a) Temperature
(b) Pressure
(c) Volume
(d) Universal gas constant

JIPMER-2019

Ans. (d) : Ideal gas equation is PV = nRT

Where,

P is pressure,
V is Volume,
n is number of moles of gas,
T is temperature and
R is Universal gas constant.

P,V,T and n are variables i.e., its values is changed but R is constant for all gases in ideal gas equation.

@apna_pdf

230. What is the value of γ for mono atomic gas (ideal gas)?

(a) $\frac{7}{5}$ (b) $\frac{4}{3}$

(c) $\frac{5}{2}$ (d) None of these

JIPMER-2019

Ans. (d) : $\gamma = \frac{C_p}{C_v}$

$$C_v = \left(\frac{\delta U}{\delta T}\right), \quad C_p = C_v + R$$

For monoatomic gas, $U = \frac{3}{2}RT$

$$C_v = \frac{\delta}{\delta T}\left(\frac{3}{2}RT\right) = \frac{3}{2}R$$

$$C_p = \frac{3}{2}R + R = \frac{5}{2}R$$

Now, $\gamma = \frac{C_p}{C_v} = \frac{(5/2)R}{(3/2)R} = \frac{5}{3}$

231. 11.2 L of gas at STP weight 14g. The gas would be

(a) H_2 (b) CO

(c) B_2H_6 (d) All of these

JIPMER-2016

Ans. (b) : $\text{Moles} = \frac{\text{volume}}{22.4\,L}$ at STP and NTP

$$= \frac{11.2\,L}{22.4\,L} = 0.5\,\text{mol}$$

$$\text{Mole} = \frac{\text{weight}}{\text{Molar mass}}$$

$$\text{Molar} = \frac{\text{weight}}{\text{mole}}$$

$$= \frac{14}{0.5} = 28$$

Then, CO having molar mass 28.

232. At 27°C, one mole of an ideal gas is compressed isothermally and reversibly from a pressure of 2atm to 10atm.

Choose the correct option from the following

(a) Change in internal energy is positive

(b) Heat is negative

(c) Work done is – 965.84 cal

(d) All are incorrect

JIPMER-2016

Ans. (b) : For isothermal process,

$$\Delta u = 0$$

Work done, $w = -2.303nRT \log_{10}\frac{P_1}{P_2}$

n = 1 mole , T = 27°C = 300 K

$P_1 = 2$ atm , $P_2 = 10$ atm , $R = 2\text{ Cal K}^{-1}\text{ mol}^{-1}$

$w = -2.303 \times 1 \times 2 \times 300 \log_{10}\frac{2}{10}$

$= +965.84$ cal

According to the first law of thermodynamics,

$q = \Delta U - W = 0 - 965.84$ cal

$q = -965.84$ cal

∴ Heat is negative.

233. Temperature of a gas is t K. What would be the temperature at which volume and pressure, both will reduced to half of the initial values?

(a) t/2 (b) t/4

(c) t/3 (d) t/8

JIPMER-2016

Ans. (b) : Given $T_1 = tK$, $P_1 = p$, $V_1 = v$, $P_2 = \frac{p}{2}$,

$V_2 = \frac{v}{2}$, $T_2 = ?$

From ideal gas equation,

$$PV = nRT$$

$$\frac{PV}{T} = \text{constant}$$

$$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$$

$$\frac{pv}{t} = \frac{p/2 \times v/2}{T_2}$$

$$T_2 = \frac{t}{4}K$$

234. For an ideal gas, compressibility factor is

(a) 0 (b) 1

(c) –1 (d) +2

Karnataka-CET-2018

Ans. (b) : Deviation of real gases from ideal gas behaviour is mathematically denoted by compressibility factor (z).

For ideal gas.

$$PV = nRT$$

$$\frac{PV}{nRT} = 1$$

$$z = \frac{PV}{nRT} = 1$$

Compressibility factor (z) = 1 for ideal gas.

235. In which one of the following, does the given amount of chlorine exert the least pressure in a vessel of capacity 1 dm^3 at 273 K?

(a) 0.03555 g (b) 0.071g

(c) 6.023×10^{21} molecules (d) 0.02 mol

KARNATAKA-CET, 2010

Ans. (a) : Ideal gas equation is

$$PV = nRT$$

When V and T are same,

$$P \propto n$$

Thus, when number of moles, i.e., n is least, it will exert least pressure.

(a) $n = \frac{\text{wt}}{\text{mol.wt}} = \frac{0.0355}{35.5} = 1\times10^{-3}$ mole

(b) $n = \frac{0.071}{35.5} = 2\times10^{-3}$ mol

@apna_pdf

(c) $n = \dfrac{\text{number of molecules}}{N_A}$

$$= \frac{6.023\times10^{21}}{6.023\times10^{23}} = 0.01\,\text{mol}$$

Thus, 0.0355 g chlorine have the least no. of moles that's why this will exert the least pressure.

236. For one mole of an ideal gas, increasing the temperature from 10°C to 20°C.

(a) increases the average kinetic energy by two times

(b) increases the rms velocity by $\sqrt{2}$ times

(c) increases the rms velocity by two times

(d) increases both the average kinetic energy and rms velocity, but not significantly

KARNATAKA-CET, 2010

Ans. (d) : Given, $T_1 = 273 + 10 = 283$ K

$T_2 = 273 + 20 = 293$ K

Average Kinetic energy $(KE) = \dfrac{3}{2}KT$

$$\frac{(KE_1)}{(KE_2)} = \frac{283}{293} = 0.96$$

Root mean square (rms) velocity,

$$v_{rms} = \sqrt{\frac{3RT}{M}}$$

$$\frac{v_{(rms)_1}}{v_{(rms)2}} = \sqrt{\frac{T_1}{T_2}}$$

$$= \sqrt{\frac{283}{293}} = 0.98$$

Thus, both average kinetic energy and root mean square velocity increase but not significantly when temperature is increased from 10°C to 20°C.

237. A gas deviates from ideal behavior at a high pressure because its molecules

(a) attract one another

(b) show the Tyndall effect

(c) have kinetic energy

(d) are bound by covalent bonds

KARNATAKA-CET, 2008

Ans. (a) : At high pressure, the volume is decreased appreciably, so the attractive forces become large and the molecules are crowded together. Thus, pressure correction is necessary and the gas deviates more from ideal behaviour.

238. When the absolute temperature of ideal gas is doubled and pressure is halved the volume of gas

(a) will be half at original volume

(b) will be 4 times the original volume

(c) will be 2 times the original volume

(d) will be 1/4th times the original volume

Kerala-CEE-29.08.2021
Karnataka-CET-2021
Kerala-CEE-2005

Ans. (b) : Given that, $T_2 = 2T$, $P_2 = 0.5P$, $V_2 = ?$

$T_1 = T$, $P_1 = P$, $V_1 = V$

By using ideal gas equation–

$$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$$

$$\therefore \quad \frac{PV}{T} = \frac{0.5P\times V_2}{2T}$$

$$V = \frac{0.5\times V_2}{2}$$

$$2V = \frac{1}{2}\times V_2$$

$$\boxed{4V = V_2}$$

or $\quad V_2 = 4V$

239. When a sample of gas is compressed at constant temperature from 15 atm to 60 atm, its volume changes from 76 cm³ to 20.50 m³. Which of the following statements are possible explanations of this behavior?

1. The gas behaves non-ideally

2. The gas dimerises

3. The gas is adsorbed into the vassel walls

(a) 1, 2 and 3 (b) 1 and 2 only

(c) 2 and 3 only (d) 1 only

(e) 3 only

Kerala-CEE-2009

Ans. (d) : The given sample of gas have;

$P_1 = 15$ atm

$P_2 = 60$ atm

$V_1 = 76\text{ cm}^3 = 76\times10^{-6}\text{ m}^3$

$V_2 = 20.50\text{ m}^3$

From ideal gas equation,

$PV = nRT$

At constant temperature,

$PV = \text{Constant}$

$\Rightarrow \quad P_1V_1 = P_2V_2 = \text{Constant}$

Now, $\quad P_1V_1 = 15\times76\times10^{-6}\text{ m}^3$

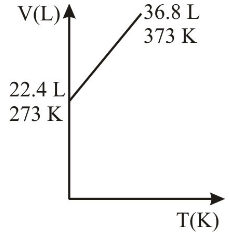
$P_2P_2 = 60\times20.50\text{ m}^3$

Here, $\quad P_1V_1 \neq P_2V_2$

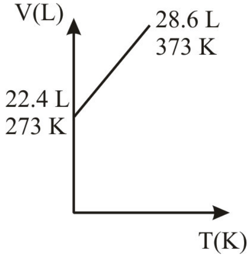
∴ The gas behaves non-ideally.

240. Which one of the following volume (V) temperature (T) plots represents the behavior of one mole of an ideal gas at one atmospheric pressure?

(a)



(b)



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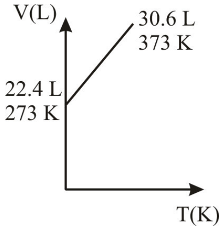
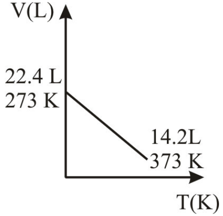
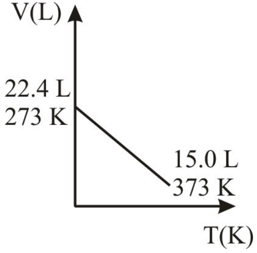
(c)



(d)



(e)



Kerala-CEE-2007

Ans. (c) : At STP, 1 mole of gas occupies 22.4 L volume at 1 atm pressure and 273 K temperature.

From ideal gas equation

$$PV = nRT$$

If n = 1 mole and at constant pressure

$$\frac{V}{T} = \text{constant}$$

$$\frac{V_1}{T_1} = \frac{V_2}{T_2}$$

$V_1 = 22.4$ L $\qquad T_1 = 273$ K

$V_2 = 30.6$ L $\qquad T_2 = ?$

Then, $T_2 = \frac{30.6 \times 273}{22.4} \approx 373K$

According to Charle's law $V \propto T$

$\therefore$ Slope of V vs. T is linear.

241. To what temperature must a neon gas sample be heated to double its pressure, if the initial volume of gas at 75ºC is decreased by 15.0%?

(a) 319º C (b) 592º C
(c) 128º C (d) 60º C
(e) 90º C

Kerala-CEE-2005

Ans. (a) : Given, $T_1 = 75°C = 348$ K

$P_1 = P \quad P_2 = 2P$

Let, $V_1 = 100$ ml then $V_2 = 85$ mL

$T_2 = ?$

From ideal gas equation,

$$\frac{PV}{T} = \text{constant}$$

$$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$$

$$T_2 = \frac{2P \times 85 \times 348}{P \times 100} = 591.6K \approx 319°C$$

242. Two vessels of volumes 16.4 L and 5 L contains two ideal gases of molecular existence at the respective temperature of 27 °C and 227 °C and exert 1.5 and 4.1 atm. respectively. The ratio of the number of molecules of the former to that to the later is

(a) 2 (b) 1
(c) $\frac{1}{2}$ (d) $\frac{1}{3}$
(e) 3

Kerala-CEE-2013

Ans. (a) :

	I vessel	II vessel
Volume	$V_I = 16.4L$	$V_{II} = 5$ L
Temperature	$T_I = 27^oC = 300K$	$T_{II} = 227^o = 500$ K
Pressure	$P_I = 1.5$ atm	$P_{II} = 4.1$ atm

From ideal gas equation.

$$PV = nRT \quad \Rightarrow n = \frac{PV}{RT}$$

$$\frac{n_I}{n_{II}} = \frac{P_IV_I}{T_I} \times \frac{T_{II}}{P_{II}V_{II}}$$

$$= \frac{1.5 \times 16.4}{300} \times \frac{500}{4.1 \times 5}$$

$$\frac{n_I}{n_{II}} = 2$$

243. When 4 g of an ideal gas A is introduced into an evacuated flask kept at 25 °C, the pressure is found to be one atmosphere. If 6 g of another ideal gas B is then added to the same flask, the pressure becomes 2 atm at the same temperature. The ratio of molecular weight (M_A: M_B) of the two gases would be

(a) 1 : 2 (b) 2 : 1
(c) 2 : 3 (d) 3 : 2
(e) 1 : 4

Kerala-CEE-2013

Ans. (c) : Given, $W_A = 4g \qquad W_B = 6g$

$P_1 = 1atm \qquad P_2 = 2$ atm

Number of moles of A = $\frac{4}{M_A}$

Number of moles of B = $\frac{6}{M_B}$

Total number of moles (A + B) = $\frac{4}{M_A} + \frac{6}{M_B}$

From ideal gas equation, at constant temperature and volume-

$$\frac{P}{n} = \text{constant}$$

$$\frac{P_1}{n_A} = \frac{P_2}{n_T} \qquad \Rightarrow \frac{1}{\frac{4}{M_A}} = \frac{2}{\frac{4}{M_A} + \frac{6}{M_B}}$$

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$$\frac{4}{M_A}+\frac{6}{M_B}=\frac{8}{M_A}\Rightarrow\frac{8}{M_A}-\frac{4}{M_A}=\frac{6}{M_B}$$

$$\frac{4}{M_A}=\frac{6}{M_B}\qquad\Rightarrow\frac{M_A}{M_B}=\frac{4}{6}=\frac{2}{3}$$

$M_A : M_B = 2 : 3$

244. If two moles of an ideal gas at 500 K occupies a volume of 41 L, the pressure of the gas is (R = 0.082 L atm K^{-1} mol^{-1})

(a) 2 atm (b) 3 atm
(c) 4 atm (d) 5 atm
(e) 1 atm

Kerala-CEE-2014

Ans. (a) : Given:- n = 2 mole, T= 500 K, V = 41 L, R = 0.082 L atm K^{-1} mol^{-1} P = ?
From ideal gas equation,

$$PV = nRT \Rightarrow P = \frac{nRT}{V} = \frac{2\times0.082\times500}{41}$$

P = 2 atm

245. Mixing of N_2 and H_2 from an ideal gas mixture at room temperature in a container. For this process, which of the following statement is true?

(a) $\Delta H = 0, \Delta S_{Surrounding} = 0, \Delta S_{System} = 0$ and $\Delta G = -ve$
(b) $\Delta H = 0, \Delta S_{Surrounding} = 0, \Delta S_{System} > 0$ and $\Delta G = -ve$
(c) $\Delta H >= 0$, $\Delta S_{Surrounding} = 0$, $\Delta S_{System} > 0$ and $\Delta G = -ve$
(d) $\Delta H < 0$, $\Delta S_{Surrounding} > 0$, $\Delta S_{System} < 0$ and $\Delta G = -ve$
(e) $\Delta H = 0, \Delta S_{Surrounding} = 0, \Delta S_{System} < 0$ and $\Delta G = -ve$

Kerala-CEE-2017

Ans. (d) : Mixing of N_2 and H_2 is an exothermic reaction so–
$\Delta H = -ve$
Favourable condition – Low temperature
And, $\Delta n = 2 - 4 = -2$
Since, $\Delta S_{(uni.)} = \Delta S_{(surrounding)} + \Delta S_{(system)}$
And for ΔG to be negative (–ve) i.e. it is spontaneous at room temperature.
$\therefore$ $\Delta H < 0$
$\Delta S_{(surrounding)} > 0$
$\Delta S_{(system)} < 0$
$\Delta S_{(uni.)} > 0$

246. Pressure of ideal and real gases at 0K are

(a) > 0 and 0 (b) < 0 and 0
(c) 0 and 0 (d) > 0 and > 0
(e) 0 and > 0

Kerala-CEE-2017

Ans. (e) : We know the compressibility factor–

$$Z = \frac{PV}{nRT}$$

Z = 1 for ideal gas
$\therefore$ PV = nRT
At 0 K temperature (T = 0)
PV = 0
P = 0
For real gas, Z > 1 which means it is less compressible than ideal gas At 0 K temperature.
P > 0 for real gas.

247. An ideal gas "A" having volume of 1L at 27ºC is kept in a container having movable piston and adiabatic walls in ambient condition. If 1.33 L amt of energy is supplied inside the system, find out the final temperature of the system?

(a) 399 K (b) 499 K
(c) 599 K (d) 299 K
(e) 450 K

Kerala-CEE-2019

Ans. (a) : Given V_1 = 1 litre, T_1 = 27 + 273 = 300K
V_2 = 1.33 litre, T_2 = ?
∵ Piston is movable and having adiabatic walls
∴ Pressure is constant

At constant pressure, $\frac{V_1}{T_1} = \frac{V_2}{T_2}$

$\Rightarrow \quad \frac{1}{300} = \frac{1.33}{T_2}$

$\Rightarrow \quad T_2 = 1.33 \times 300 = 399$ K.

248. Two moles of an ideal gas are allowed to expand from a volume of 10 dm^3 to 2 m^3 at 300 K against a pressure of 101.325 kPa. Calculate the work done

(a) –201.6 kJ (b) 13.22 kJ
(c) –810.6 J (d) –18.96 kJ

MHT CET-2018

Ans. (a) : Given, n = 2 T = 300 K
P = 101.325 kPa, $V_1 = 10\ dm^3 = 0.01\ m^3$
$V_2 = 2\ m^3$
W = ?
Work done (W) = –PΔV
$= -101.325 \times 10^3\ (2 - 0.01)$
$= -101.325 \times 10^3 \times 1.99$
= –201.63 kJ

249. 4 L-atm is equal to

(a) 40.50 cal (b) 78.75 cal
(c) 95.23 cal (d) 96 cal

MHT CET-2010

Ans. (d) : Given, Energy = 4L- atm
Find energy in cal.
The value of R = 2 cal K^{-1} mol^{-1}
or R = 0.0821 L atm K^{-1} mol^{-1}

$$\text{Energy (cal)} = \frac{\text{Energy}(L-atm)\times R\,(cal)}{R_{(L-atm)}}$$

$$= \frac{4\times2}{0.0821} = 96\,cal$$

250. For an ideal gas, the heat of reaction at constant pressure and constant volume are related as

(a) H + E = pV (b) E = H + pΔV
(c) $q_p = q_v + \Delta nRT$ (d) None of these

MHT CET-2007

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Ans. (c) : From 1st law of thermodynamics

$$\Delta u = q + w = q - P\Delta V$$

At constant volume, $\Delta V = 0$ then

$$w = 0$$

$\therefore$ $\Delta u = q_v$ (heat absorbed at constant volume

At constant pressure,

$$\Delta U = q_p - P\Delta V$$

$$q_P = (u_2 + PV_2) - (u_1 + PV_1)$$

$$H = U + PV$$

$$q_P = \Delta H$$

Where q_p is heat absorbed at constant pressure.

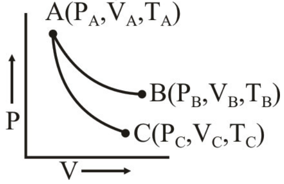
As we know that,

$$\Delta H = \Delta U + \Delta n_g RT$$

Put the value of ΔH and Δu in above equation,

$$q_P = q_V + \Delta n_g RT$$

251. Reversible expansion of an ideal gas under isothermal and adiabatic conditions are as shown on in the figure.



AB $\rightarrow$ Isothermal expansion

AC $\rightarrow$ Adiabatic expansion

Which of the following options is not correct?

(a) $\Delta S_{isothermal} > \Delta S_{adiabatic}$

(b) $T_A = T_B$

(c) $W_{isothermal} > W_{adiabatic}$

(d) $T_c > T_A$

NEET-Odisha 2019

Ans. (d) : In adiabatic expansion q = 0

In isothermal expansion T = constant

Hence, $T_A = T_B$

Work done in isothermal expansion is greater that work done in adiabatic expansion

$\therefore$ $W_{isothermal} > W_{adiabatic}$

In case of adiabatic expansion, cooling effect is observed. Therefore, $T_C < T_A$

Hence, option (d) is not correct.

252. When a deviation more in the behaviour of a gas from the ideal gas equation PV = nRT?

(a) At high temperature and low pressure

(b) At low temperature and high pressure

(c) At high temperature and high pressure

(d) At low temperature and low pressure

NEET-1993

Ans. (b) : Real gas shows deviation from ideal gas behaviour. Ideal gases have no intermolecular force of attraction between molecules and volume occupied by them are negligible. But real gases having intermolecular force of attraction between molecules and its volume is not neglected. At high temperature and low pressure real gas behaves like ideal gas because at low pressure intermolecular force of attraction between molecules are neglected. At high pressure and low temperature real gases shows maximum deviation from ideal gas behaviour because at high pressure, molecules experienced large intermolecular force of attraction.

253. A gas is said to behave like an ideal gas when the relation PV/T = constant. When do you expect a real gas to behave like an ideal gas?

(a) When the temperature is low.

(b) When both the temperature and pressure are low

(c) When both the temperature and pressure are high

(d) When the temperature is high and pressure is low.

NEET-1991

Ans. (d) : For real gas, van der Waal's equation is,

$$\left(P + \frac{an^2}{V^2}\right)(V - nb) = nRT$$

At high temperature and low pressure real gas behaves like ideal gas because at low pressure, volume increases. Due to this both correction terms of van der Waal's equation is negligible because intermolecular force of attraction is neglected on increasing volume.

Then at low pressure and high temperature van der Waal's equation converted into ideal gas equation.

$$PV = nRT$$

254. A gas such as carbon monoxide would be most likely to obey the ideal gas law at

(a) low temperature and high pressures

(b) high temperature and high pressures

(c) low temperature and low pressure

(d) high temperature and low pressure

NEET-2013

Ans. (d) : At high temperature and low pressure real gas behaves like ideal gas because at low pressure, volume increases. Due to this intermolecular, force of attraction between gas molecules is negligible and both correction terms of van der Waal's equation is also neglected. Hence, real gas follow kinetic theory of gases at low pressure and high temperature. Carbon monoxide is real gas but at high temperature and low pressure it behave like ideal gas.

255. Maximum deviation from ideal gas is expected from

(a) $CH_{4(g)}$ (b) $NH_{3(g)}$

(c) $H_{2(g)}$ (d) $N_{2(g)}$

NEET-2013

Ans. (b) : NH_3 show maximum deviation from ideal gas. In ideal gases no intermolecular force of attraction present. But in case of NH_3, it shows maximum force of attraction because of hydrogen bonding. That's why, NH_3 shows maximum deviation from ideal gas.

256. Which is not true in case of an ideal gas?

(a) It cannot be converted into a liquid

(b) There is no interaction between the molecules.

(c) All molecules of the gas move with same speed.

(d) At a given temperature, PV is proportional to the amount of the gas

NEET-1992

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Ans. (c) : According to kinetic theory of gases there is no interaction between ideal gas molecules. Gas molecules collide with each other and move in different directions i.e. random motion. Due to the collision, molecules show different speed in different directions.
According to ideal gas equation

$$PV = nRT$$

At constant temperature, $PV \propto n$. Ideal gases cannot be liquefied.

257. Under what conditions will a pure sample of an ideal gas not only exhibit a pressure of 1 atm but also a concentration of 1 mole litre^{-1}? (R = 0.082 liter atm mol^{-1} deg^{-1})

(a) At STP
(b) When V = 22.4 litres
(c) When T =12 K
(d) Impossible under any condition

NEET-1993

Ans. (c) : From ideal gas equation

$$PV = nRT$$

$$P = \frac{n}{V}RT \qquad \left(\frac{n}{v} = \text{concentration}\right)$$

$$P = CRT$$

$$T = \frac{P}{CR}$$

$$T = \frac{1}{1 \times 0.082}$$

$$T = 12\text{ K}$$

258. The correct value of the gas constant 'R' is close to

(a) 0.082 litre-atmosphere K
(b) 0.082 litre-atmosphere K^{-1} mol^{-1}
(c) 0.082 litre-atmosphere^{-1} K mol^{-1}
(d) 0.082 litre^{-1} atmosphere^{-1} K mol

NEET-1992

Ans. (b) : From ideal gas equation

$$PV = nRT$$

$$R = \frac{PV}{nT}$$

For 1 mole of gas at STP, T=273K, P = 1 atm, V = 22.4L

$$R = \frac{1\text{atm} \times 22.4\text{L}}{1\text{mole} \times 273\text{K}}$$

$$= 0.0821\text{ L atm K}^{-1}\text{ mol}^{-1}$$

259. Select one correct statement. In the gas equation, PV = nRT

(a) n is the number of molecular of a gas
(b) V denotes volume of one mole of the gas
(c) n moles of the gas have a volume V
(d) P is the pressure of the gas when only one mole of gas is present

NEET-1992

Ans. (c) : According to ideal gas equation ,

$$PV = nRT$$

Where, P is pressure exerted by n moles of gas
V is Volume occupied by n moles of gas.
n is the number of moles of a gas
So, option (c) is correct, n moles of the gas have volume V.

260. At constant temperature, in a given mass of an ideal gas

(a) the ratio of pressure and volume always remains constant
(b) volume always remains constant
(c) pressure always remains constant
(d) the product of pressure and volume always remains constant

NEET-1991

Ans. (d) : From ideal gas equation,

$$PV = nRT$$

At constant temperature, and mass

$$PV = \text{constant}$$

$$P \propto \frac{1}{V} \qquad \text{(Boyle's law)}$$

261. If P, V, M, T and R are pressure, volume, molar mass, temperature and gas constant respectively, then for an ideal gas, the density is given by

(a) $\frac{RT}{PM}$ (b) $\frac{P}{RT}$
(c) $\frac{M}{V}$ (d) $\frac{PM}{RT}$

NEET-1989

Ans. (d) : From ideal gas equation

$$PV = nRT$$

$$\text{Density}(\rho) = \frac{\text{Mass}(m)}{\text{Volume}(V)}$$

And, $$\text{mole} = \frac{\text{mass}(m)}{\text{molar mass}(M)}$$

$\therefore$ $$PV = \frac{m}{M}RT$$

$$\rho = \frac{m}{V} = \frac{PM}{RT}$$

262. At 0 °C, a balloon is expanded with an ideal gas up to 490 mL which is the $\frac{7}{8}$th of its maximum expansion volume. Now, if the temperature is being gradually raised, predict at what temperature it will burst.

(a) 29 °C (b) 30 °C
(c) 39 °C (d) 312 °C

Tripura JEE-2022

Ans. (c): Given:- $T_1 = 0°C = 273K$, $V_1 = 490mL$

Volume V_1 is $\frac{7}{8}$th of its maximum expansion

Volume i.e. V_2. Then

$$\frac{V_1}{V_2} = \frac{7}{8} \qquad \Rightarrow V_2 = 490 \times \frac{8}{7}$$

$$T_2 = ? \qquad V_2 = 560\,\text{mL}$$

From ideal gas equation at constant pressure

$$\frac{V}{T} = \text{constant}$$

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$$\frac{V_1}{T_1}=\frac{V_2}{T_2}$$

$$T_2=V_2\times\frac{T_1}{V_1}=560\times\frac{273}{490}$$

$$T_2=312\text{K}=39°\text{C}$$

263. Under adiabatic process, one mole of an ideal gas is compressed to its $\frac{1}{5}$th volume at 350 K temperature. Determine the final temperature [C_v=12.55JK^{-1}mol^{-1}].

(a) 738.5 K (b) 1011.5 K
(c) 1284.5 K (d) 1750 K

Tripura JEE-2019

Ans. (b) : Given : $\frac{V_2}{V_1}=\frac{1}{5}$

T_1 = 350K , n = 1 , Cv = 12.55 JK^{-1} mol^{-1}, T_2 = ?

$C_p - C_v = R \Rightarrow C_p = R + C_v$

C_p = 12.55 + 8.314 = 20.864 JK^{-1} mol^{-1}

For adiabatic and reversible compression,

$$TV^{\gamma-1}=\text{constant}$$

$$\gamma=\frac{Cp}{Cv}=\frac{20.864}{12.55}=1.66$$

$$T_1V_1^{\gamma-1}=T_2V_1^{\gamma-1}$$

$$\frac{T_2}{T_1}=\left(\frac{V_1}{V_2}\right)^{\gamma-1}=(5)^{1.66-1}$$

$$\frac{T_2}{350}=(5)^{0.66}$$

$$T_2=350\times(5)^{0.66}\quad=1011.5\text{K}$$

264. 5 moles of a gas in a closed vessel was heated from 300 K to 600 K. The pressure of the gas is doubled. The number of moles of the gas at 600 K is

(a) 5 (b) 2.5
(c) 10 (d) 20

UP CPMT-2013

Ans. (a) : Given, n_1 = 5 moles, T_1 = 300 K, T_2 = 600 K
P_1 = P, P_2 = 2P, n_2 = ?

From gas equation,

$$PV = nRT$$

$$P_1V_1 = n_1RT_1$$

$$PV_1 = n_1RT_1 \quad \text{........(i)}$$

$$P_2V_2 = n_2RT_2 \quad \text{.......(ii)}$$

$$2PV_2 = n_2RT_2$$

$$\therefore V_1 = V_1$$

Dividing eq^n. (i) by (ii)

$$\frac{PV_1=n_1RT_1}{2PV_1=n_2RT_2}$$

$$\frac{1}{2}=\frac{n_1T_1}{n_2T_2}$$

$$\frac{1}{2}=\frac{5\times300}{n_2\times600}$$

$$n_2=\frac{5\times2\times300}{600}$$

$$\boxed{n_2=5}$$

or $$n_1=\frac{PV}{RT}$$

$$\therefore\quad 5=\frac{P\times V}{R\times300}$$

$$n_2=\frac{2P\times V}{R\times600}$$

$\therefore$ n_2 = 5 mol

265. Which of the following expression is true regarding gas laws? (w = weight; M = molecular mass)

(a) $\frac{T_1}{T_2}=\frac{M_1w_2}{M_2w_1}$ (b) $\frac{T_1}{T_2}=\frac{M_2w_1}{M_1w_2}$

(c) $\frac{T_1}{T_2}=\frac{M_1w_1}{M_2w_2}$ (d) $\frac{T_1}{T_2}=\frac{M_1w_1}{M_2w_2}$

UP CPMT-2010

Ans. (a): Ideal gas equation is,

$$PV = nRT$$

$$T\propto\frac{1}{n}$$

Where, number of moles (n) = $\frac{\text{weight}\,(w)}{\text{mol.mass}\,(M)}$

$$\Rightarrow\ \frac{T_1}{T_2}=\frac{n_2}{n_1}=\frac{w_2\times M_1}{M_2\times w_1}$$

266. A certain mass of the oxygen gas ocupies 7 L volume under a presure of 380 mm Hg. The volume of the same mass of the gas at standard pressure, with temperature remaining constant, shall be

(a) 26.60 L (b) 54.28 L
(c) 3.5 L (d) 7 L

UP CPMT-2009

Ans. (c): Given, V_1 = 7 L, P_1 = 380 mm Hg

We know standard pressure = 760 mm Hg = P_2

At constant temperature,

$$p_1V_1=p_2V_2$$

$$380\times7=760\times V_2$$

$$\therefore\quad V_2=\frac{380\times7}{760}$$

$$=3.5\text{L}$$

267. Graph between P and V at constant temperature is

(a) straight
(b) curved increasing
(c) straight line with slope
(d) None of the above

UP CPMT-2007

Ans. (d) : According to Boyle's law, for a fixed amount of a gas at constant temperature, the gas volume is inversely proportional to the gas pressure.

$$P\propto\frac{1}{V}$$

$$PV = \text{constant}$$

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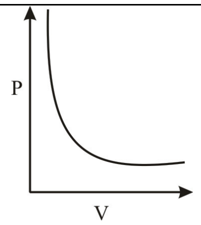

Graph between P and V at constant temperature is called isotherm and is an equilateral hyperbola.

268. Rate of diffusion of NH_3 is twice that of X. What is the molecular mass of X?

(a) 68 (b) 48

(c) 12 (d) 8

UP CPMT-2007

Ans. (a) : According to Graham law,

$$\frac{r_1}{r_2}=\sqrt{\frac{d_2}{d_1}}=\sqrt{\frac{M_2}{M_1}}$$

Rate of diffusion, $r_X=\left(\frac{r_{NH_3}}{2}\right)$ given

Molecular mass of NH_3=17

Molecular mass of X, (M_x)=?

By Graham's law of diffusion,

$$\frac{r_{NH_3}}{r_X}=\sqrt{\frac{M_X}{M_{NH_3}}} \text{or } 2=\sqrt{\frac{M_X}{M_{NH_3}}}$$

$$4\times M_{NH_3}=M_X \Rightarrow M_X=4\times17=68$$

269. If two molecules of A and B having mass 100 kg and 64 kg and rate of diffusion of A is 12×10^{-3}, then what will be the rate of diffusion of B?

(a) 15×10^{-3} (b) 64×10^{-3}

(c) 5×10^{-3} (d) 46×10^{-3}

UP CPMT-2007

Ans. (a) : According to Graham's law of diffusion, At constant pressure and temperature, the rate of diffusion of a gas is inversely proportional to the square root of its vapour density.

Rate of diffusion (r) $\propto\frac{1}{\sqrt{d}}$

Molecular weight (M) = 2×vapour density

$$\frac{r_1}{r_2}=\sqrt{\frac{M_2}{M_1}}$$

$$M_A=\left(\frac{100}{2}\right)\text{kg/molecule}$$

$$M_B=\left(\frac{64}{2}\right)\text{kg/molecule}$$

$r_A=12\times10^{-3}$ and r_B=?

$$\frac{r_A}{r_B}=\sqrt{\frac{d_B}{d_A}}=\sqrt{\frac{M_B}{M_A}}$$

$$\frac{12\times10^{-3}}{r_B}=\sqrt{\frac{64/2}{100/2}}=\sqrt{\frac{64}{100}}=\frac{8}{10}$$

$$r_B=\frac{12\times10^{-3}\times10}{8}$$

$$=15\times10^{-3}$$

270. If a mixture of CO and N_2 in equal amount have total 1 atm pressure, find out partial pressure of N_2 in mixture.

(a) 1 atm (b) 0.50 atm

(c) 2 atm (d) 3 atm

UP CPMT-2006

Ans.(b): According to Dalton law of partial pressure

total pressure (P) = 1

P = XP

$$P_{N_2}=X_{N_2}P$$

$$X_{N_2}=\frac{n_{N_2}}{n_{N_2}+n_{Co}}$$

Molecular Mass (N_2) = 28 g/mol

Molecular Mass (CO) = 28 g/mol

$$X_{N_2}=\frac{\frac{W}{28}}{\frac{W}{28}+\frac{W}{28}}$$

$$X_{N_2}=\frac{\frac{W}{28}}{\frac{W+W}{28}}$$

$$X_{N_2}=\frac{\frac{W}{28}}{\frac{2W}{28}}$$

$$X_{N_2}=\frac{28W}{28\times2W}$$

$$X_{N_2}=\frac{1}{2}$$

$$P_{N_2}=X_{N_2}P$$

$$P_{N_2}=\frac{1}{2}\times1$$

$$\boxed{P_{N_2}=0.5\text{atm}}$$

271. The compressibility factor of an ideal gas is

(a) 1 (b) 2

(c) 4 (d) 0

UP CPMT-2003

Ans. (a) Compressibility factor (z) = $\frac{PV}{nRT}$

$\because$ for ideal gas PV= nRT

$\therefore$ compressibility factor (Z)= 1

272. For an ideal gas, Joule-Thomson coefficient is

(a) zero

(b) negative

(c) positive

(d) depend on molecular weight

UP CPMT-2001

Ans. (a) : Joule-Thomson effect: When a real gas is allowed to expand adiabatically from region of high pressure to region of low pressure through a fine hole, it cools (except H_2 which warms up). The actual change in temperature on expansion of gas is expressed in terms of Joule-Thomson coefficient (μ).

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$$\mu = \left(\frac{\partial T}{\partial P}\right)_H$$

It is temperature change in degrees by a drop of one atmospheric pressure when the gas expands under constant enthalpy. Its value is zero for ideal gas because ideal gas has no or negligible van dar Waals' forces of attraction.

273. Which one of the following is not correct for an ideal solution?

(a) It must obey Raoult's law
(b) $\Delta H = 0$
(c) $\Delta C = 0$
(d) $\Delta H = \Delta V \neq 0$

UPTU/UPSEE-2005

Ans.(d): Ideal gases must obey Raoult's law which state when two volatile liquids are mixed to prepare a solution then vapour pressure of a particular liquid in solution is directly proportional to its mole fraction.

In ideal mixing.

Δ H mix = 0

Δ V mix = 0

274. Van der Waals' real gas, acts as an ideal gas at which condition?

(a) High temperature, low pressure
(b) Low temperature, high pressure
(c) High temperature, high pressure
(d) Low temperature, low pressure

UPTU/UPSEE-2015
BCECE-2012
NEET-2002

Ans. (a) : At low pressure and high temperature real gas behaves like ideal gas. Ideal gas having no intermolecular forces of attraction between molecules. Therefore at low pressure, intermolecular force of attraction of real gas is neglected. Hence at low pressure and high temperature real gas behave like ideal gas.

Vander waal's equation

$$\left(P + \frac{an^2}{V^2}\right)(V - nb) = nRT$$

At low pressure and high temperature,

$$P >> \frac{an^2}{V} \quad \text{and} \quad V >> nb$$

Then PV = nRT

i.e., real gas behaves as ideal gas.

275. Avogadro's law is valid for

(a) all gases
(b) ideal gas
(c) Van der Waals gas
(d) real gas

WB-JEE-30.04.2022

Ans. (b) : Avogadro's law is used to determine the molecular formula of gaseous molecules. Avogadro's law is only applicable for ideal gases. At low pressure and high temperature Avogadro's law is applicable to real gas.

276. Equal weights of CH_4 and H_2 are mixed in an empty container at 25°C the fraction of the total pressure exerted by H_2 is

(a) 1/9
(b) 1/2
(c) 8/9
(d) 16/17

WB-JEE-2012

Ans. (c) : Weight of CH_4 (w) = Weigh of H_2 (w)

Molar Mass of CH_4 = 16

Molar Mass of H_2 = 2

$$\text{Mole fraction of } H_2 = \frac{W/2}{\frac{W}{2} + \frac{W}{16}} = \frac{8}{9}$$

Partial pressure = Mole fraction × Total pressure

$$\text{Fraction of the total pressure} = \frac{\text{Partial pressure}}{\text{Total pressure}}$$

$$= \text{Mole fraction}$$

∴ Fraction of the total pressure

$$\text{exerted by } H_2 = X_{H_2} = \frac{8}{9}$$

277. Mixing of two different ideal gases under isothermal reversible condition will lead to

(a) increase Gibbs free energy of the system
(b) no change of entropy of the system
(c) increase of entropy of the system
(d) increase of enthalpy of the system

WB-JEE-2013

Ans. (c) : Mixing of two different ideal gas under isothermal reversible condition are

$$\Delta H_{mix.} = 0, \Delta V_{mix.} = 0, \Delta U_{mix.} = 0$$

$$\Delta S_{mix} = \text{Positive}$$

$$\Delta Y_{mix} = \text{negative}$$

Hence, entropy of mixture increases
enthalpy of mixture decreases.

278. For one mole of an ideal gas, the slope of V vs. T curve at constant pressure of 2 atm is X L mol^{-1} K^{-1}. The value of the ideal universal gas constant 'R' in terms of X is

(a) X L atm mol^{-1} K^{-1}
(b) $\frac{X}{2}$ L atm mol^{-1} K^{-1}
(c) 2X L atm mol^{-1} K^{-1}
(d) 2X atm L^{-1} mol^{-1} K^{-1}

WB-JEE-2014

Ans. (c) : From ideal gas equation

PV = nRT

For n = 1

PV = RT

At constant pressure

$$\frac{V}{T} = \frac{R}{P} = \text{constant}$$

If graph is plotted for V vs T then slope of the V vs T curve is $\frac{R}{P}$

$$\text{Slope} = \frac{R}{P} = X \text{ L mol}^{-1} \text{ K}^{-1}$$

But, P = 2 atm

Then R = Slop × P

= 2X L mol^{-1} K^{-1}

279. At a certain temperature the time required for the complete diffusion of 200 mL of H_2 gas is 30 min. The time required for the complete diffusion of 50 mL of O_2 gas at the same temperature will be

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(a) 60 min (b) 30 min
(c) 45 min (d) 15 min

WB-JEE-2014

Ans. (b) : According to Graham's law of diffusion, rate of diffusion $(r_d) = \frac{\text{Volume}}{\text{time}}$

$$\gamma_d \propto \frac{1}{\sqrt{\text{Molar mass}}}$$

$$= \frac{(r_d)H_2}{(r_d)O_2} = \frac{V_{H_2}/t_{H_2}}{V_{O_2}/t_{O_2}} = \sqrt{\frac{(M.M)_{O_2}}{(M.M)_{H_2}}}$$

But given, $V_{H_2} = 200\text{ mL}$, $t_{H_2} = 30\text{min}$

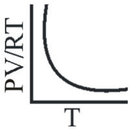
$V_{O_2} = 50\text{ mL}$, $t_{O_2} = ?$

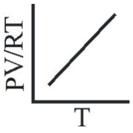
$$\frac{\frac{200}{30}}{\frac{50}{t_{O_2}}} = \sqrt{\frac{32}{2}}$$

$$\frac{200 \times t_{O_2}}{50 \times 30} = \sqrt{16} = 4$$

$$t_{O_2} = \frac{30 \times 4}{4} = 30\text{min.}$$

280. For an ideal gas, a plot of PV/RT versus T will look like

(a)


(b)


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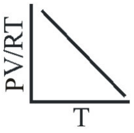

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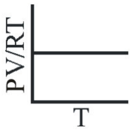


A-P EAMCET 1995

Ans. (d) : According to ideal gas equation

PV = nRT

$\frac{PV}{RT} = \text{Constant}$

$\therefore \frac{PV}{RT}$ remains constant with respect to T.

281. At STP, the density of a gas (molecular weight 45) in g/L is

(a) 2 (b) 22.4
(c) 11.2 (d) 1000

A-P EAMCET 1996

Ans. (a) : Given that, Molecular mass = 45

We know that

$$\text{Density} = \frac{\text{Weight}(\text{mass})}{\text{Volume}}$$

$$= \frac{45}{22.4} = 2\text{g}/\text{L}$$

3. Real Gases

282. Real gases show ideal behaviour at

(a) high pressure and high temperature
(b) low pressure and high temperature
(c) low pressure and low temperature
(d) high pressure and low temperature

A-P EAMCET 1996

Ans. (b) : For real gases equation,

$$\left(P + \frac{a}{V^2}\right)(V - b) = RT$$

Real gas behaves like ideal gas at high temperature and low pressure.

Then, $P \gg \frac{a}{V^2}$ and $V \gg b$

Hence, the equation becomes

PV = RT

i.e. the gases behave as ideal gas equation (ideally)

283. The rms velocity of an ideal gas at 300K is 12240 cms^{-1}, what is the most probable velocity at that temperature?

(a) 10000 cm s^{-1} (b) 11280 cm s^{-1}
(c) 13250 cm s^{-1} (d) 12240 cm s^{-1}

A-P EAMCET 2000

Ans. (a) : Given that,

$V_{rms} = 12240\text{ cms}^{-1}$

$$V_{rms} = \sqrt{\frac{3RT}{M}}$$

$$V_{mp} = \sqrt{\frac{2RT}{M}}$$

$$\frac{V_{rms}}{V_{mp}} = \sqrt{\frac{3}{2}}$$

$$\frac{V_{rms}^2}{V_{mp}^2} = \frac{3}{2}$$

$$V_{mp} = \sqrt{\frac{2 \times (12240)^2}{3}}$$

$$\boxed{V_{mp} \approx 10000\,\text{cm}\,\text{s}^{-1}}$$

284. A gaseous mixture of three gases A, B and C has a pressure of 10 atm. The total number of moles of all the gases is 10. If the partial pressures of A and B are 3.0 and 1.0 atm respectively and if 'C' has mol. Wt. of 2.0, what is the weight of 'C' in grams present in the mixture?

(a) 6 (b) 3
(c) 12 (d) 8

AP EAMCET (Medical) -1998

Ans. (c): Given that,

Total pressure of gases A, B and C = 10 atm.

Total number of moles $(n_A + n_B + n_C) = 10$

Partial pressure of A $(P_A) = 3$ atm.

Partial pressure of B $(P_B) = 1$ atm.

@apna_pdf

Molecular weight of C = 2.0

Now,

Partial pressure of A (P_A) = Total pressure × mole fraction of gas A

or $P_A = 10 \times \frac{n_A}{\text{Total moles}}$

or $3 = 10 \times \frac{n_A}{10}$

or $n_A = 3$

Similarly, for gas B–

$P_B = \text{Total pressure} \times \frac{n_B}{10}$

or $1 = 10 \times \frac{n_B}{10}$

or $n_B = 1$

$\because$ $n_A + n_B + n_C = 10$

or $3 + 1 + n_C = 10$

or $n_C = 6$

$\because$ $\text{Mole} = \frac{\text{Weight of solute}}{\text{Molecular weight}}$

$\therefore$ $6 = \frac{w_C}{2}$

or $w_C = 12$ g

285. Among the following gases, the order of liquefiability is

a) SO_2
b) CO_2
c) CH_4
d) NH_3

(a) $CH_4 > CO_2 > NH_3 > SO_2$
(b) $NH_3 > SO_2 > CH_4 > CO_2$
(c) $CO_2 > NH_3 > SO_2 > CH_4$
(d) $SO_2 > NH_3 > CO_2 > CH_4$

TS EAMCET 10.08.2021, Shift-II

Ans.(d): We know that greater the force of intermolecular attraction, easier is its liquefication therefore order of liquefication is

$SO_2 > NH_3 > CO_2 > CH_4$

286. The compressibility factor (Z) of a gas is < 1 at STP. Therefore

(a) $V_m < 22.4L$
(b) $V_m = 44.8L$
(c) $V_m > 22.4L$
(d) $V_m = 11.2L$

TS EAMCET 10.08.2021, Shift-II

Ans. (a) : Compression factor $Z = \frac{V_{real}}{V_{ideal}}$

Now $Z < 1$

Then $V_{real} < V_{ideal}$

So, the gas will have a volume < 22.4 litre or

Vm < 22.4 L.

287. A real gas would be most likely to obey the ideal gas laws at ———

(a) low temperature and low pressure
(b) high temperature and low pressure
(c) high temperature and high pressure
(d) low temperature and high pressures

AP EAPCET 25.08.2021, Shift-II

Ans. (b) : A real gas would be most likely to obey the ideal gas laws at high temperature and low pressure.

Ideal gas equation –

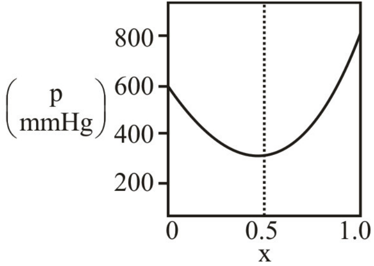
$$\boxed{PV = nRT}$$

Real gas equation

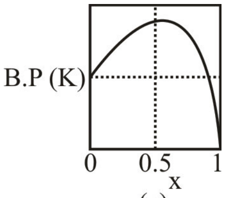
$$\boxed{\left(P + \frac{an^2}{V^2}\right)(V - nb) = nRT}$$

Where n = no. of moles.

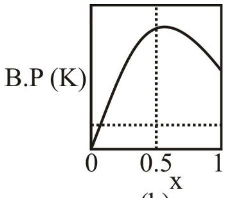
288. The vapour pressure of a non-ideal two component solution is given below



Identify the correct T-X curve for the same mixture.



(a)



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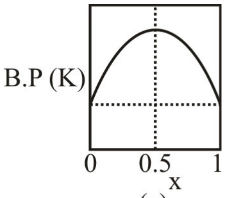

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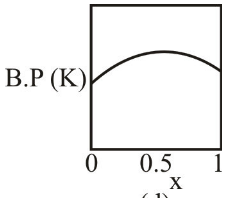


(d)

TS EAMCET-2017

Ans. (a) : The vapour pressure of a non-ideal component solution. The correct T-X curve of the same mixture.

Hence option (a) is correct.

289. Which among the following statements is/are incorrect regarding real gases?

(i) Their compressibility factor is never equal to unity ($Z \neq 1$)
(ii) The deviations from ideal behavior are less at low pressures and high temperatures
(iii) Intermolecular forces among gas molecules are equal to zero
(iv) The obey Vander Waals equation PV = nRT

(a) (i), (ii), (iv) only
(b) (ii), (iv only
(c) (ii) only
(d) (iii), (iv) only

AP EAPCET 20.08.2021 Shift-I

Ans. (d) :

Van der Waal equation $\left(P + \frac{an^2}{V^2}\right)$ (V – nb) = nRT

Where n = no. of moles.

@apna_pdf

Real gas obey's Van der Waal equation and intermolecular forces among gas molecules are not equal to zero. Ideal gas equation

$$PV = nRT$$

290. Which of the following sets consists of gases with the same rate of diffusion at identical temperature and pressure?

(a) H_2, D_2, He	(b) CO_2, NO_2, C_3H_8
(c) CO_2, N_2O, C_3H_8	(d) N_2, CO_2, C_2H_4

SRMJEEE – 2013

Ans. (c) : As we know, the diffusion of gas depends upon the molecular mass. i.e $\frac{r_1}{r_2} = \sqrt{\frac{M_2}{M_1}}$.

CO_2, N_2O and C_3H_8 have same molecular mass i.e 44. Hence, the rate of diffusion will be similar at identical temperature and pressure.

291. Assertion (A) van der Waals' forces are responsible for chemisorptions.
Reason (R) High temperature is fovourable for chemisorptions.
The correct answer is

(a) (A) is false, but (R) is true
(b) Both (A) and (R) are correct and (R) is the correct explanation of A
(c) Both (A) and (R) are correct and (R) is not the correct explanation of (A)
(d) (A) is true, but (R) is false

AP-EAMCET (Engg.) - 2014

Ans. (a) : Van der Waal's forces are responsible for chemisorptions, force that lead to formation of a chemical bond (covalent bond) are responsible for chemisorptions. **High temperature** is favorable for chemisorptions. Hence, statement of assertion (A) is false but the statement of reason is true.

292. What is the ratio of kinetic energies of 3g of hydrogen and 4g of oxygen at T(K) ?

(a) 12 : 1	(b) 6 : 1
(c) 1 : 6	(d) 24 : 1

AP-EAMCET (Engg.)-2005

Ans. (a) : At same temperature-

$$\frac{K_{E_1}}{K_{E_2}} = \frac{n_1}{n_2}$$

No. of moles of hydrogen $= \frac{3}{2} = 1.5$ moles

Number of moles of oxygen $= \frac{4}{32} = 0.125$ moles

Thus,

$$\frac{K_{E_1}}{K_{E_2}} = \frac{1.5}{0.125}$$

or $$\frac{K_{E_1}}{K_{E_2}} = 12:1$$

293. A low pressure, the van der Waal's equation is reduced to

(a) $Z = \frac{PV_m}{RT} = 1 - \frac{a}{VRT}$

(b) $Z = \frac{PV_m}{RT} = 1 + \frac{b}{RT}P$

(c) $PV_m = RT$

(d) $Z = \frac{PV_m}{RT} = 1 - \frac{a}{RT}$

VITEEE-2019

Ans. (a) : Van der Waal's equation-

$$\left[p + \frac{a}{V^2}\right](V - b) = RT$$

$$PV - Pb + \frac{a}{V} - \frac{ab}{V^2} = RT$$

$$PV = RT + Pb - \frac{a}{V} + \frac{ab}{V^2}$$

Given, at low pressure Pb = O

$$PV = RT - \frac{a}{V} + \frac{ab}{V^2}$$

$$\frac{PV}{RT} = 1 - \frac{a}{VRT} + \frac{ab}{V^2RT}$$

$$Z = \frac{PV_m}{RT} = 1 - \frac{a}{VRT} \qquad \left(\because Z = \frac{PV_m}{RT}\right)$$

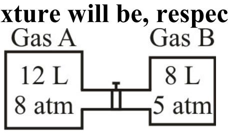
294. It V is the volume of one molecule of gas under given conditions, the van der Waal's constant b is

(a) 4V	(b) $\frac{4V}{N_0}$
(c) $\frac{N_0}{4V}$	(d) $4VN_0$

BITSAT 2018

Ans. (d) : Van der Waals's constant b = 4 times the actual volume of 1 mole molecules.
B is equal to 4× the volume of molecules is one mole of a gas (N_o molecules)
Volumes of one molecule = V
Volume of N_o molecule = V N_o
Hence b = $4VN_o$

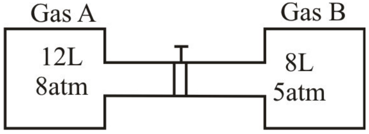
295. Two vessels containing gases A and B are interconnected as shown in the figure. The stopper is opened, the gases are allowed to mix homogeneously. The partial pressures of A and B in the mixture will be, respectively



(a) 8 and 5 atm	(b) 9.6 and 4 atm
(c) 4.8 and 2 atm	(d) 6.4 and 4 atm

CG PET -2009

Ans. (c) : Given that,



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$V_A = 12$ L $\quad V_B = 8$ L

$P_A = 8$ atm $\quad P_B = 5$ atm

We know

$Pv = nRT$

Now,

Moles of A, $n_A = \frac{P_A V_A}{RT} = \frac{12 \times 8}{RT} = \frac{96}{RT}$

Moles of B, $n_B = \frac{P_B V_B}{RT} = \frac{8 \times 5}{RT} = \frac{40}{RT}$

Moles fraction of A,(X_A) = $\frac{\text{Mole of A}}{\text{Total Mole}} = \frac{\frac{96}{RT}}{\frac{96+40}{RT}} = \frac{96}{136}$

Moles fraction of B,(X_B) =

$$\frac{\text{Mole of B}}{\text{Total Mole}} = \frac{\frac{40}{RT}}{\frac{96+40}{RT}} = \frac{40}{136}$$

Total pressure X total volume = (n_A+n_B)× RT

$P \times (12+8) = \frac{1}{RT}(96+40)RT$

Total Pressure (P)= 6.8 atm

Partial Pressure =Total Pressure × mole fraction

Partial pressure of A = Total pressure ×X_A

$= 6.8 \times \frac{96}{136} = 4.8\text{atm}$

Partial pressure of B = $6.8 \times \frac{40}{136} = 2\,\text{atm}$

296. In Van der Waals' equation of state of the gas law, the constant 'b' is a measure of

(a) Intermolecular repulsions

(b) Intermolecular attraction

(c) Volume occupied by the molecules

(d) Intermolecular collisions per unit volume

[AIEEE 2004]

Ans. (c) : Van der Waal's Equation

$$\left(P + \frac{an^2}{V^2}\right)(v - nb) = nRT$$

Where a = Van der Waal's constant that measure attractive force between the molecules.

b = Volume occupied by the molecule.

297. The compressibility factor for a real gas at high pressure is

(a) $1 + \frac{RT}{pb}$ $\qquad$ (b) 1

(c) $1 + \frac{pb}{RT}$ $\qquad$ (d) $1 - \frac{pb}{RT}$

AIEEE-2012

Ans. (c) : Compressibility factor (z):- It is the factor which decides the extent of deviation of real gases from the ideal gas behavior.

As we know $\left(p + \frac{a}{v^2}\right)(v - b) = RT$

When pressure is high $p >> \frac{a}{V^2}$

$\left(p + \frac{a}{V^2}\right) \approx P$

$p(v - b) = RT$

$pV - pb = RT$

$pV = RT + pb$

$\frac{pV}{RT} = 1 + \frac{pb}{RT}$

$\boxed{Z = 1 + \frac{pb}{RT}}$

Z > 1 at high pressure

298. a and b are van der Waals' constants for gases. Chlorine is more easily liquefied than ethane because

(a) a and b for Cl_2 > a and b for C_2H_6

(b) a and b for Cl_2 < a and b for C_2H_6

(c) a for Cl_2 > a for C_2H_6 but b for Cl_2 > b for C_2H_6

(d) a for Cl_2 > a for C_2H_6 but b for Cl_2 < b for C_2H_6

[AIEEE 2011]

Ans. (d) : In a Van der Waal's gas equation, the constant a gives the idea of the magnitude of attractive forces between the molecules of the gas while b is the measure of effective volume occupied by the gas molecules or effective size of gas molecules.

Greater the value of 'a' larger the attractive intermolecular force between the gas molecules. It means, the gases with higher value of a and lower value of b are more liquefiable.

Hence, Cl_2 is more easily liquefied than ethane.

So, a for Cl_2> a for C_2H_6 but b for Cl_2 < b for C_2H_6

299. If Z is a compressibility factor, van der Waals' equation at low pressure can be written as

(a) $Z = 1 + \frac{RT}{pb}$ $\qquad$ (b) $Z = 1 - \frac{a}{VRT}$

(c) $Z = 1 - \frac{pb}{RT}$ $\qquad$ (d) $Z = 1 + \frac{pb}{RT}$

[JEE Main 2014]

Ans. (b) : From Van der Waal's equation

$$\left(p + \frac{a}{V^2}\right)(V - b) = RT$$

At low pressure, V decreases. Tuus, $\frac{a}{V^2}$ increases.

So, b can be neglected.

$\left(p + \frac{a}{V^2}\right)V = RT$, $pV + \frac{a}{V} = RT$

$\frac{pV}{RT} + \frac{a}{VRT} = 1$, $\boxed{\frac{pV}{RT} = 1 - \frac{a}{VRT}}$

$\boxed{Z = 1 - \frac{a}{VRT}}$

Where Z = compressibility factor

@apna_pdf

300. Consider the following table.

Gas	a/(k Pa dm^6)	b/(dm^3 mol^{-1})
A	642.32	0.05196
B	155.21	0.04136
C	431.91	0.05196
D	155.21	0.4382

a and b are van der Waals' constants. The correct statement about the gases is

(a) Gas C will occupy lesser volume than gas A; gas B will be lesser compressible than gas D.
(b) Gas C will occupy more volume than gas A; gas B will be more compressible than gas D.
(c) Gas C will occupy more volume than gas A; gas B will be lesser compressible than gas D
(d) Gas C will occupy more volume than gas A; gas B will be lesser compressible than gas D

[JEE Main 2019, 10 April Shift-I]

Ans. (b) : As we know from the Van der Waal's gas equation. The value of a gives the idea of the magnitude of attractive force and value of b give the idea of effective volume occupied by the gas molecules.

From the above given table.

It is clear that, gas A and C have same value of b but different value of a. It means gas having higher value of 'a' have more force of attraction.

So occupy less volume because molecules are more closer.

Gas B and D have same value of 'a' but different value of 'b' so gas having laser value of b will be more compressible.

301. The behavior of real gas approaches ideal behavior at

(a) low temperature, low pressure
(b) high temperature, high pressure
(c) low temperature, high pressure
(d) high temperature, low pressure

COMEDK 2016

Ans. (d) : Real gases are found to obey the gas laws fairly well at low pressure and high temperature.

302. A mixture of one mole each of H_2, He and O_2 each are enclosed in a cylinder of volume, V at temperature T. If the partial pressure of H_2 is 2 atm, the total pressure of the gasses in the cylinder is

(a) 14 atm (b) 38 atm
(c) 22 atm (d) 6 atm

[JEE Main 2020, 3 Sep Shift-II]

Ans. (d) : Given that,

Mole of H_2, He, O_2= 1

Partial Pressure of H_2=2 atm

As we know

$\boxed{\text{Partial pressure} = \text{Total Pressure} \times \text{Mole Fraction}}$

For mole fraction of H_2

$$X_{H_2} = \frac{\text{Mole of } H_2}{\text{Mole of } H_2 + \text{Mole of He} + \text{Mole of } O_2}$$

$$X_{H_2} = \frac{1}{1+1+1} = \frac{1}{3}$$

Then,

$$2 = \frac{1}{3} \times \text{Total Pressure}$$

Total pressure = 6 atm

303. The unit of the Van der Waals' gas equation parameter 'a in

$$p\left(\frac{an^2}{V^2}\right)(V-nb) = nRT \text{ is}$$

(a) kg ms^{-2} (b) dm^3 mol^{-1}
(c) kg ms^{-1} (d) atm dm^6 mol^{-2}

[JEE Main 2021, 27 Aug Shift-I]

Ans. (d) : Van der Waal's gas Equation

$$\left(p + \frac{an^2}{V^2}\right)(V-nb) = nRT$$

$$\frac{an^2}{V^2} = \text{atm}$$

$$a = \text{atm} \times \frac{\text{dm}^6}{\text{mol}^2}$$

a = atm dm^6 mole^{-2}

304. The behavior of real gas approaches ideal behavior at

(a) low temperature, low pressure
(b) high temperature, high pressure
(c) low temperature, high pressure
(d) high temperature, low pressure

J & K CET-(2013, 2003, 2000)

Ans. (d) : At high temperature and low pressure, the real gas most closely approaches the behavior of an ideal gas because at high temperature gas molecules have less potential energy and high kinetic energy due to this intermolecular force is less.

This reason makes them ideal.

305. The Van der waals constants for four gases P, Q, R and S are 4.17, 3.59, 6.71 and 3.8 atm. L^2 mol^{-2} Therefore, the ascending order of their liquefaction is

(a) $R < P < S < Q$ (b) $Q < S < R < P$
(c) $Q < S < P < R$ (d) $R < P < Q < S$

J & K CET-(2009)

Ans. (c) : As we know, from Van der Waal's gas equation, greater the value of 'a' larger the attractive intermolecular force between the gas molecules. It means, the gas with higher value of 'a' and lower value of b are more liquefiable.

Then, $Q(3.59) < S(3.8) < P(4.17) < R(6.71)$

306. The units of van der Waals constants a and b respectively are

(a) L atm^2 mol^{-1} and mol L^{-1}
(b) L atm mol^2 and mol L.
(c) L^2 atm mol^{-2} and mol^{-1} L.
(d) L^{-2} atm^{-1} mol^{-1} and L mol^{-2}

J & K CET-(2008)

Ans. (c) : We know Van der Waal's gas equation

$$\left(p + \frac{a}{V^2}\right)(V-b) = RT$$

$$\frac{a}{V^2} = \text{atm}$$

a = L^{2}atm mol^{-2}

and

b =L/mol

b= L mol^{-1}

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307. Which one among the following, is the van der waals equation, describing the behavior of one mole of a real gas over wide ranges of temperature and pressure?

(a) $\left(P+\frac{a}{V^2}\right)(V-b)=RT$

(b) $\left(P-\frac{a}{V^2}\right)(V-b)=RT$

(c) $\left(P+\frac{a}{V^2}\right)(V-b)=\frac{R}{T}$

(d) $\left(P+\frac{a}{V^2}\right)(V+b)=RT$

J & K CET-(2007)

Ans. (a) : We know Van der Waal's gas equation

$$\left(p+\frac{a}{V^2}\right)(V-b)=RT$$

Where,

p = Pressure

V = Molar volume of the gas

T = Temperature

R =Universal gas constant

And a, b are the constant

308. The Van der Waals' equation for a real gas is given by the formula $\left(P+\frac{n^2a}{V^2}\right)(V-nb)=nRT$ Where P, V, T and n are the pressure, volume, temperature and the number of moles of the gas. Which one is the correct interpretation for the parameter a?

(a) The parameter a accounts for the finite size of the molecule, not included temperature in the ideal gas law

(b) The parameter a accounts for the shape of gas phase molecules

(c) The parameter a accounts for intermolecular interaction's present in the molecule

(d) The parameter a has no physical significance and van der Waals' introduced it as a numerical correction factor only

JCECE - 2005

Ans. (c) : From the Van der Waal's gas equation

$$\left(p+\frac{n^2a}{V^2}\right)(V-nb)=nRT$$

Where,

p = pressure

V = volume

n = number of moles

T = temperature

R = ideal gas constant

The constant 'a' is the measure of the magnitude of intermolecular attractive forces between the particles.

b = measures the volume of a gas molecule.

309. In Van der Waals' equation of state of the gas law, the constant 'b' is a measure of

(a) intermolecular repulsions

(b) intermolecular attractions

(c) volume occupied by the molecules

(d) intermolecular collisions per unit volume

JCECE – 2008

Manipal-2016

JCECE - 2010

Ans. (c) : In Van der Waal's gas equation, the constant a and b measure.

a = It is measure the magnitude of intermolecular attractive forcers between them.

b = It is measure the volume of gas molecule.

$$\boxed{\left(p+\frac{a}{V^2}\right)(V-b)=RT}$$

310. Consider the van der Waals constants, a and b, for the following gases,

Gas	Ar	Ne	Kr	Xe
a/(atm dm^6 mol^{-2})	1.3	0.2	5.1	4.1
b(10^{-2} dm^3 mol^{-1})	3.2	1.7	1.0	5.0

Which gas is expected to have the highest critical temperature?

(a) Kr (b) Ne

(c) Xe (d) Ar

[JEE Main 2019, 9 April Shift-I]

AIIMS 25 May 2019 (Morning)

Ans. (a): Critical Temperature:- It is temperature at which a substance exist in a liquid form.

We know

$$\text{Critical temperature } (T_c)=\frac{8a}{27Rb}----(i)$$

For Ar, a = 1.3 and b = 3.2

From equation (i)

$$T_{c(Ar)}=\frac{8}{27R}\left(\frac{1.3}{3.2}\right)$$

For Ne, a =0.2, b=1.7

$$T_{c(Ne)}=\frac{8}{27R}\left(\frac{0.2}{1.7}\right)$$

For Kr , a = 5.1, b=1

$$T_{c(Kr)}=\frac{8}{27R}\left(\frac{5.1}{.1}\right)$$

For Xe , a = 4.1, b=5.0

$$T_{c(Xe)}=\frac{8}{27R}\left(\frac{4.1}{5}\right)$$

It is clear from the above expression. Kr has a highest critical temperature value.

$\therefore T_c$ has order – Kr > Xe > Ar > Ne

311. If a gas expands at constant temperature, it indicates that

(a) kinetic energy of molecules decreases

(b) pressure of the gas increases

(c) kinetic energy of molecules remains same

(d) number of the molecules of gas increases

JCECE - 2013

@apna_pdf

Ans. (c) : A gas expands at a constant temperature it indicate that the kinetic energy of molecules remains the same.

$KE = \frac{3}{2}RT$ or $KE \propto T$

Here, the temperature of gas remains constant. Hence, kinetic energy of molecules remains the same.

312. The compressibility of a gas is less than unity at STP, therefore

(a) $V_m > 22.4$ L
(b) $V_m < 22.4$ L
(c) $V_m = 22.4$ L
(d) $V_m = 44.8$ L

JIPMER-2017

Ans. (b) : We know that,

Compressibility factor $(Z) = \frac{PV}{nRT}$

Given, compressibility factor less than 1 at STP.

Then

$$Z<1$$

$$Z = \frac{PV}{nRT} < 1$$

As we know

At STP, P = 1 atm, T=273K, R= 0.08210 L atm k^{-1}

Then,

$$V < \frac{nRT}{P} = \frac{0.821 \times 273 \times 1}{1}$$

V< 22.4L

313. A certain sample of gas has a volume of 0.2L measured at 1 atm pressure and 0°C. At the same pressure but 273°C, its volume will be:

(a) 0.4 L
(b) 0.8 L
(c) 27.8 L
(d) 55.6 L

JIPMER-2006

Ans. (a) : Given that,

V_1= 0.2L V_2= ?
P_1=1 atm P_2 = 1 atm
T = 0ºC = 273K T = 273ºC +273 = 546 K

When pressure is constant, Ideal gas equation

$$\frac{V_1}{T_1} = \frac{V_2}{T_2}$$

$$V_2 = \frac{T_2 \times V_1}{T_1}$$

$$V_2 = \frac{0.2 \times 546}{273}$$

V_2= 0.42L

314. a/V^2 given in Van der Waal's equation is for

(a) internal pressure
(b) inter molecular attraction
(c) both (1) and (2)
(d) temperature correction

JIPMER-2005

Ans. (b) : Van der Waals equation

$$\underbrace{\left(P + \frac{an^2}{V^2}\right)}_{\substack{\downarrow \\ \text{Pressure} \\ \text{correction}}} \underbrace{(V - nb)}_{\substack{\downarrow \\ \text{Volume} \\ \text{Correction}}} = nRT$$

Here $\frac{a}{V^2}$ showes intermolecular attraction.

Where a = Van der Waals constant for gases.

315. The pressure of real gases is less than that of ideal gas because of

(a) increases in the kinetic energy of the molecules
(b) increases in the number of collisions
(c) Intermolecular attraction
(d) finite size of particles

Karnataka-CET-2017

Ans. (c) : The pressure of the gas is developed due to the wall collision of the gas molecules. But due to intermolecular attraction the colliding molecules will experience an inward pull.

Therefore, the pressure exerted by the molecules in real gas will be less than the ideal gas. Since ideal gas have no intermolecular attraction.

316. The statement that is not correct is

(a) Compressibility factor measure the deviation of real gas from ideal behaviour
(b) Van der Waals constant 'a' measure extent of intermolecular attractive forces for real gases
(c) Critical temperature is the lowest temperature at which liquefaction of a gas first occurs
(d) Boyle point depends on the nature of real gas

Karnataka-CET-2014

Ans. (c) : • Compressibility factor measure the deviation of real gas from ideal gas behavior

$$\boxed{Z = \frac{PV}{nRT}}$$

- Van der Walls constant 'a' measure extent of intermolecular attractive forces for real gases.
- Critical temperate is the highest temperature at which liquefaction of a gas first occurs.
- Boyle's temperature is the temperature at which real gas obeys the gas laws over an appreciable range of pressure is called Boyle point.

317. The correct arrangement for the ions in the increasing order of their radii is

(a) Na^+, Cl^-, Ca^{2+}
(b) Ca^{2+}, K^+, S^{2-}
(c) Na^+, Al^{3+}, Be^{2+}
(d) Cl^-, F^-, S^{2-}

Karnataka-CET-2014

Ans. (b) : Atomic Radii:- It is radius of atom. This is the distance between an atom's nucleus and outer electron shell.

Increasing order of radii

Ca^{2+}, K^+, S^{2-}

318. 25g of each of the following gasses are taken at 27°C and 600 mm pressure. Which of these will have the least volume?

(a) HCl
(b) HBr
(c) HI
(d) HF

Karnataka-CET-2011

Ans. (c) : Given that,

Mass (M)=25g

Temperature (T) = 27ºC = 273+27=300K

Pressure = 600mm

We know

@apna_pdf

$$PV = nRT \Rightarrow \frac{m}{M}RT ----(i)$$

Where M = Molecular Mass

M= Mass

Note:- Pressure, Temperature and gas constant same for all

For HCl

M = 1+35 =36 g/mol

From eq^n (i)

$$P \times V = \frac{25}{36} \times RT$$

$$V = \frac{25}{36} \times \frac{RT}{P}$$

Similarly, for HBr

M = 1+79 =80

$$V = \frac{25}{80} \times \frac{RT}{P}$$

For HI

M = 1+126 = 127

$$V = \frac{25}{127} \times \frac{RT}{P}$$

For HF

M = 1+18 =19

$$V = \frac{25}{19} \times \frac{RT}{P}$$

From the above expressions, It is clear that HI has the least volume.

319. Gases X, Y, Z, P and Q have the van der Waals' constants a and b (in CGS units) as shown below:

	X	**Y**	**Z**	**P**	**Q**
a	**6**	**6**	**20**	**0.05**	**30**
b	**0.025**	**0.15**	**0.1**	**0.02**	**0.2**

The gas with the highest critical temperature is:

(a) P (b) Q

(c) Y (d) Z

(e) X

Kerala-CEE-2006

Ans. (b) : As we know

$$\text{Critical temperature } (T_c) = \frac{8a}{27Rb}$$

Note:- $\frac{8}{27Rb}$ is constant for all

For

a = 6, b = 0.025

$$T_c = \frac{8 \times 6}{27R(0.025)} = \frac{6000}{25}\left(\frac{8}{27R}\right)$$

For Y

a = 6, b = 0.15

$$T_c = \frac{6}{.15}\left(\frac{8}{27R}\right) = \frac{600}{15}\left(\frac{8}{27R}\right)$$

For Z

a = 20, b = 0.1

$$T_c = \frac{20}{.1}\left(\frac{8}{27R}\right) = \frac{200}{1}\left(\frac{8}{27R}\right)$$

For = P

a = 0.05, b = 0.02

$$T_c = \frac{0.05}{0.02}\left(\frac{8}{27R}\right) = \frac{5}{2}\left(\frac{8}{27R}\right)$$

For = Q

a = 30, b = 0. 2

$$T_c = \frac{30}{0.2}\left(\frac{8}{27R}\right) = \frac{300}{2}\left(\frac{8}{27R}\right)$$

It is clear from the above expression gas x has the highest critical temperature.

Note:- official answer given by commission 'b'.

320. The gas with the highest critical temperature is

(a) H_2 (b) He

(c) N_2 (d) O_2

(e) CO_2

Kerala-CEE-2012

Ans. (e) :

Gas	**Critical Temperature**
H_2	33.2k
O_2	154.3k
He	5.2k
CO_2	304.2k
N_2	126.2k

It is clear from the above table that CO_2 gas has maximum critical temperature 304.2K.

321. The type of attractive forces that operate between gaseous HCl molecules is

(a) dipole-dipole forces

(b) dispersion forces

(c) ion-dipole forces

(d) dipole-induced dipole forces

(e) electrostatic forces

Kerala-CEE-2020

Ans. (a) : Hydrogen chloride has dipole moment because hydrogen has a slight positive charge and Cl atom has slight negative charge and due to attractive forces between unlike charges HCl molecule has dipole-dipole forces. So, option (a) is correct.

322. In van der Waals' equation of state for a non-ideal gas, the term that accounts for intermolecular forces is

(a) V– b (b) $(RT)^{-1}$

(c) $\left(P + \frac{a}{V^2}\right)$ (d) RT

NEET-1990

Ans. (c) : Van der Waal's gas equation

$$\left(P + \frac{a}{V^2}\right)(V - b) = RT$$

$\left(P + \frac{a}{V^2}\right)$ = It shows intermolecular forces.

323. Given van der Waals' constant for NH_3, H_2, O_2 and CO_2 are respectively 4.17, 0.244, 1.36 and 3.59, which one of the following gases is most easily liquefied?

(a) NH_3 (b) H_2

(c) O_2 (d) CO_2

NEET-2018

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Ans. (a) : The gas which has highest Van der Waal's gas constant value those gas liquefied first.

As we know

Critical temperature (T_c) $\propto$ Van der Waal's gas constant.

Given that,

$NH_3 = 4.17$

$H_2 = 0.244$

$O_2 = 1.36$

$CO_2 = 3.59$

It is clear from the above value, NH_3 will liquefied first.

324. For real gases van der Waals' equation is written as $\left[P+\frac{an^2}{V^2}\right](V-nb)=nRT$ where a and b are van der waals' constants. Two sets of gases are

(I) O_2, CO_2, H_2 and He

(II) CH_4, O_2 and H_2

The gases given in set-I in increasing order of b and gases given in set-II in decreasing order of a, are arranged below. Select the correct order from the following :

(a) (I) $He < H_2 < CO_2 < O_2$ (II) $CH_4 > H_2 > O_2$

(b) (I) $O_2 < He < H_2 < CO_2$ (II) $H_2 > O_2 > CH_4$

(c) (I) $H_2 < He < O_2 < CO_2$ (II) $CH_4 > O_2 > H_2$

(d) (I) $H_2 < O_2 < He < CO_2$ (II) $O_2 > CH_4 > H_2$

NEET-2012

Ans. (b) : $\left(P+\frac{an^2}{V^2}\right)(V-nb)=nRT$

Here 'a' shows intermolecular attraction force and b shows excess volume.

As we know

$b \propto r^3$

Where r^3 is atomic radius. It means, the compound which has more radius then their value of b is more.

(I) O_2, Co_2, H_2 and He

$Co_2 > O_2 > H_2 > He$

(II) CH_4, O_2 and H_2

It is clear that Van der Waal's force of

$CH_4 > O_2 > H_2$

325. Which of the following equation is not correct?

(a) $\left(p+\frac{an^2}{V^2}\right)(V-b)=nRT$

(b) $\left(p+\frac{a}{V^2}\right)(V-b)=RT$

(c) $\left(p+\frac{an^2}{V^2}\right)(V-nb)=nRT$

(d) $p=\frac{RT}{(V-b)}-\frac{a}{V^2}$

UP CPMT-2014

Ans. (a) : Van der Waals' equation is

$$\left(p+\frac{an^2}{V^2}\right)(V-nb)=nRT$$

For 1 mol, n=1

$$\left(p+\frac{a}{V^2}\right)(V-b)=RT$$

or $$p=\frac{RT}{(V-b)}-\frac{a}{V^2}$$

326. At low pressure and high temperature, the van der waal's equation is finally reduced (simplified) to

(a) $\left(p+\frac{a}{V_m^2}\right)(V_m-b)=RT$

(b) $p(V_m-b)=RT$

(c) $\left(p+\frac{a}{V_m^2}\right)V_m=RT$

(d) $pV_m=RT$

UPTU/UPSEE-2017

Ans. (d) : As we know, at low pressure and high temperature gas behave as ideal gas.

So, The ideal gas equation

$\boxed{PV_m=RT}$

327. A Van der Waals' gas may behave ideally when

(a) the volume is very low

(b) the temperature is very high

(c) the pressure is very low

(d) the temperature, pressure and volume all are very high

WB-JEE-2013

Ans. (c) : Van der Waal's gas behave as ideal gas at low pressure and very high temperature. At these conditions there will be large intermolecular distance between gas molecules so negligible intermolecular force.

328. The compressibility factor (Z) of one mole of a van der Waals' gas of negligible 'a' value is

(a) 1

(b) $\frac{bp}{RT}$

(c) $1+\frac{bp}{RT}$

(d) $1-\frac{bp}{RT}$

WB-JEE-2014

Ans. (c) : We know Van der Waal's gas equation

$$\left(P+\frac{n^2a}{V^2}\right)(V-nb)=nRT$$

For 1 mole (i.e. n =1)

$$\left(P+\frac{a}{V^2}\right)(V-b)=RT$$

If a is negligible

$$P+\frac{a}{V^2}\simeq P$$

$P(V-b)=RT$, $PV-Pb=RT$

$$\frac{PV}{RT}-\frac{Pb}{RT}=1$$

$$\boxed{\frac{PV}{RT}=1+\frac{Pb}{RT}}$$

@apna_pdf

329. Four gases P, Q, R and S have almost same values of 'b' but their 'a' values (a, b are van del waals' constants) are in the order Q < R < S < P. At a particular temperature among the four gases, the most easily liquefiable one is

(a) P (b) Q

(c) R (d) S

WB-JEE-2014

Ans. (a) : If the values of b is same for all the gases. Then, the gas which has high value of a then those gas will be liquefied first.

Given, Q < R < S < P

From the above, it is clear that P liquefied first among them.

330. For a van der Waals' gas, the term $\left(\frac{ab}{V^2}\right)$ represents some

(a) pressure (b) energy

(c) critical density (d) molar mass

WB-JEE-2019

Ans. (b) : Given,

$$\frac{ab}{V^2}$$

We know,

$$a = \text{atm}L^2\,\text{mol}^{-2}$$

$$b = \text{L mol}^{-1}$$

$$V = \left(\frac{L}{\text{mol}}\right)^2 = L^2\text{mol}^{-2}$$

Then

$$\frac{ab}{V^2} = \frac{\text{atm. }L^2\text{mol}^{-2} \times \text{L mol}^{-1}}{L^2\text{mol}^{-2}}$$

$$= \text{atm L mole}^{-1}$$

$$= \frac{\text{atm. L}}{\text{Mole}}$$

This represent unit of energy.

4. Kinetics Molecular Theory of Gases and Molecular Collisions

331. The factor by which the kinetic energy of 8 g of H_2 at 27ºC is greater than the kinetic energy of 8g of O_2 at the same temperature, is

(a) 4 (b) 8

(c) 16 (d) 32

A-P EAMCET 1991

Ans. (c) : We know that,

$$\text{Kinetic energy (K.E.)} = \frac{3}{2}nRT$$

Where R = constant

$T_1 = 27ºC = 27 + 273 = 300$ K

$T_2 = 300$ K

$$\therefore \frac{K.E_1}{K.E_2} = \frac{n_1 \times T_1}{n_2 \times T_2}$$

$$\frac{K.E_1}{K.E_2} = \frac{4 \times 300}{\frac{1}{4} \times 300}$$

$$\frac{K.E_1}{K.E_2} = 16$$

332. Assertion (A) : At 300 K, kinetic energy of 16 g of methane is equal to the kinetic energy of 32 g of oxygen.

Reason (R) : At constant temperature, kinetic energy of one mole of all gases is equal.

(a) Both (A) and (R) are true and (R) is the correct explanation of (A)

(b) Both (A) and (R) are true and (R) is not the correct explanation of (A)

(c) (A) is true but (R) is not true

(d) (A) is not true but (R) is true

A-P EAMCET 2004

Ans. (a) : Kinetic energy for 'n' moles of gas is given as–

$$K.E. = \frac{3}{2}nRT$$

Where, R = Universal gas constant.

T = Temperature

$\therefore$ $E \propto T$

Thus, at constant temperature kinetic energy of one mole of any gas is equal.

333. What is temperature at which the kinetic energy of 0.3 moles of helium is equal to the kinetic energy of 0.4 moles of argon at 400 K?

(a) 400 K (b) 873 K

(c) 533 K (d) 300 K

A-P EAMCET 2008

Ans. (c) : Given that,

No. of moles of helium = 0.3 moles

No. of moles of argon = 0.4 moles

We know that, $K.E. = \frac{3}{2}nRT$

According to the question,

K.E. of helium = K.E. of argon

$$\frac{3}{2} \times 0.3 \times R \times T = \frac{3}{2} \times 0.4 \times R \times 400$$

$$\text{or} \quad T = \frac{0.4 \times 400}{0.3} = 533K$$

334. If the kinetic energy in J, of CH_4 (molar mass = 16 g mol^{-1}) at T(K) is X, the kinetic energy in J, of O_2 (molar mass = 32 g mol^{-1}) at the same temperature is

(a) X (b) 2X

(c) X^2 (d) $\frac{X}{2}$

TS-EAMCET-2016

Ans. (a) : The expression of kinetic energy is–

$$K.E. = \frac{3}{2}\frac{R}{N_A} \cdot T$$

Where, R = Gas constant

N_A = Avogadro's number

T = Absolute temperature

@apna_pdf

It is clear that from above equation, the K.E. is depend upon the temperature of the molecule. CH_4 molecule has X kinetic energy at T then O_2 is also have X kinetic energy at the same temperature. Hence, the correct option is (a).

335. A gaseous mixture of 3 gases A, B and C has a pressure 10 atm. The total number of moles are 10. If partial pressure of gases A and B are 3 atm and 1 atm respectively and if molar mass of gas C is 2. Calculate the weight of C in the mixture.

(a) 12 g (b) 24 g
(c) 8 g (d) 2 g

AP EAMCET (Engg.) 17.09.2020 Shift-I

Ans. (a) : Given: P = 10 atm

Total numbers of moles. $n_A + n_B + n_c = 10$

$P_a = 3$atm, $P_B = 1$ atm

$\therefore\ P_A = X_A \times P_{total}$

$$= \frac{n_A}{n_A + n_B + n_c} \times 10 = \frac{n_A}{10} \times 10 = 3$$

Similary,

$P_B = X_B \times P_{total}$

$$1 = \frac{n_B}{n_A + n_B + n_C} \times 10$$

So $n_B = 1$

$\therefore\ n_c = 10 - (3 + 1) = 6$

Weight of C = 6 × 2 = 12g

336. Which of the following statement is/are true

(a) The pressure of a fixed amount of an ideal gas is proportional to its temperature only
(b) Frequency of collisions increases in proportion to the square root of temperature
(c) The value of van der Waal's constant 'a' is smaller for ammonia than for nitrogen
(d) If a gas is expanded at constant temperature, the kinetic energy of the molecules decrease

TS EAMCET-2017

Ans. (b) : Frequency of collisions increases in proportion to the square root of temperature.

337. Electrons with a kinetic energy of 6.023 × 10^4 J/mol are evolved from the surface of a metal, when it is exposed to radiation of wavelength of 600 nm. The minimum amount of energy required to remove an electron from the metal atom is

(a) 2.3125×10^{-19} J (b) 3×10^{-19} J
(c) 6.02×10^{-19} J (d) 6.62×10^{-19} J

AP EAMCET (Engg.)-2009

Ans. (a): Given

$\lambda = 600\text{nm} = 6\times10^{-7}$m

$m_e = 9.109\times10^{-31}$ kg

Kinetic energy of 1 mole = 6.023×10^4 J/mole

1 mole atom contain = 6.023×10^{23} atom

$$\text{Kinetic energy of 1 atom} = \frac{\text{KE of 1mole}}{\text{No. of atom in1 mole}}$$

$$= \frac{6.023\times10^4}{6.023\times10^{23}}$$

$= 1.0\times10^{-19}$ Jule

As we know

$$\frac{1}{2}mv^2 = \frac{hc}{\lambda} - h\nu_0$$

Where $h\nu_0$ = Minimum energy required for remove an electron

h = Plank constant= 6.626×10^{-34}

c = Speed of light = 3×10^8

$$\frac{1}{2}mv^2 = \text{KE of atom}$$

$$h\nu_0 = \frac{hc}{\lambda} - \frac{1}{2}mv^2$$

$$h\nu_0 = \frac{6.626\times10^{-34}\times3\times10^8}{6\times10^{-7}} - 1\times10^{-19}$$

$$h\nu_0 = 3.313\times10^{19} - 1\times10^{-19}$$

$$h\nu_0 = 2.313\times10^{-19}\,\text{Jule}$$

338. The Kinetic energy of one mole of any gas depends upon ______

(a) pressure of the gas
(b) volume of the gas
(c) nature of the gas
(d) absolute temperature of the gas

AP EAPCET 24.08.2021, Shift-I

Ans. (d) : The expression of kinetic energy can be written as –

$$E_K = \frac{3}{2}\eta RT$$

For n = 1 mol

$$\therefore\quad E_K = \frac{3}{2}RT \text{ where R = Gas constant}$$

The given equation shows T = Absolute temperature thus kinetic energy is directly proportional to the absolute temperature of the gas molecule.

339. Three flasks of equal volumes contain CH_4, CO_2 & Cl_2 gases respectively. They will contain equal number of molecules if_______

(a) The mass of all the gases is same
(b) The mass of the gases is same but Temperature is different
(c) Temperature & Pressure of all the flasks are same
(d) Temperature, Pressure & Masses same in the flasks

AP EAPCET 20.08.2021 Shift-II

Ans. (c): Three flasks of equal volume contain CH_4, CO_2 and Cl_2 gases of equal number of molecule if temperature and pressure of all flasks are same.

340. The mole fraction of dioxygen in a neon-dioxygen mixture is 0.18. If the total pressure of the mixture is 25 bar, the partial pressure, of neon in the mixture would be

(a) 25.18 bar (b) 25.82 bar
(c) 4.5 bar (d) 20.5 bar

COMEDK 2014

Ans. (d) : Given P_{total}= 25 bar, $x_{O_2} = 0.18$

$\therefore x_{Ne} = 1 - 0.18 = 0.82$

$P_{Ne} = x_{Ne} \times P_{total} = 0.82 \times 25 = 20.5\text{bar}$

@apna_pdf

341. The kinetic energy of 4 moles of nitrogen gas at 127°C is….. cals. $\left(\mathbf{R = 2cal\ mol^{-1}K^{-1}}\right)$

(a) 4400 (b) 3200
(c) 4800 (d) 1524

AP-EAMCET (Medical), 2003

Ans. (c) : The expression of kinetic energy for a gas is–

$$E_k = \frac{3}{2}nRT$$

Where- E_k = Kinetic energy
n = Number of moles
R= Gas constant
T = Temperature (in K)

Given data: n = 4
T = 127 + 273 = 400K
E_k = ?
R = 2 cal $mol^{-1}K^{-1}$

Now, $E = \frac{3}{2} \times 4 \times 2 \times 400$

E = 4800 calorie.

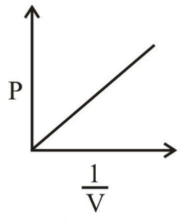
342. Assertion: The graph between $PV/s\frac{1}{V}$ is a straight line.

Reason: For adiabatic process $P \propto \frac{1}{V}$.

(a) If both Assertion and Reason are correct and Reason is the correct explanation of Assertion.
(b) If both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.
(c) If Assertion is correct but Reason is incorrect.
(d) If both the Assertion and Reason are incorrect.

AIIMS 25 May 2019 (Morning)

Ans. (c): From Boyle's law $P \propto \frac{1}{V}$ and graph between the P and $\frac{1}{V}$ is straight line.



And, For adiabatic process

$Pr^{\gamma} = C$

$P = \frac{C}{V^{\gamma}}$

$P \propto \frac{1}{V^{\gamma}}$

Hence, assertion is correct while reason is incorrect.

343. Assertion: Compressibility factor (Z) for non-ideal gases can be greater than 1.
Reason: Non- ideal gases always exert higher pressure than expected.

(a) If both Assertion and Reason are correct and the Reason is the correct explanation of Assertion.
(b) If both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.
(c) If Assertion is correct but Reason is incorrect.
(d) If both the Assertion and Reason are incorrect.

AIIMS-26 May, 2018 (E)
AIIMS-2015

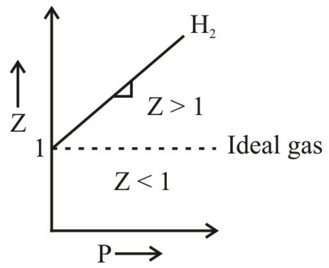
Ans. (d): Compressibility factor can be less than 1 or more than 1 depending upon the nature of the non ideal gas.

344. Assertion: Compressibility factor for hydrogen varies with pressure with positive slope at all pressures.
Reason : Even at low pressure, repulsive forces dominate hydrogen gas.

(a) If both Assertion and Reason are correct and the Reason is a correct explanation of the Assertion.
(b) If both Assertion and Reason are correct but Reason is not a correct explanation of the Assertion.
(c) If the Assertion is correct but Reason is incorrect.
(d) If both the Assertion and Reason are incorrect.
(e) If the Assertion is incorrect but the Reason is correct.

AIIMS-2005

Ans. (a):



Compressibility factor for hydrogen (H) varies with pressure with positive slope at all pressure. As we can see from the graph this statement is true and even at low pressure repulsive force dominate in hydrogen gas.

Hence, option (a) is correct

345. Assertion: The molecules of the dissolved gas present in a liquid gain kinetic energy as temperature is raised.
Reason: Gases tends to be more soluble in liquids as the temperature is raised.

(a) If both Assertion and Reason are correct and the Reason is the correct explanation of Assertion.
(b) If both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.
(c) If Assertion is correct but Reason is incorrect.
(d) If both the Assertion and Reason are incorrect.

AIIMS-2009

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Ans. (c): When dissolved gas molecule present in liquid, If we raised the temperature of the gas molecule kinetic energy increases and they escape from the liquid.

Hence, Molecule of gas will not be soluble in liquid when increased the temperature

So, Assertion is correct but reason is incorrect.

346. Assertion: Gases do not settle to the bottom of container.

Reason : Gases have high kinetic energy.

(a) If both Assertion and Reason are correct and the Reason is a correct explanation of the Assertion.

(b) If both Assertion and Reason are correct but Reason is not a correct explanation of the Assertion.

(c) If the Assertion is correct but Reason is incorrect.

(d) If both the Assertion and Reason are incorrect.

(e) If the Assertion is incorrect but the Reason is correct.

AIIMS-1997

Ans. (a): Gases do not settle down to the bottom of the container because their intermolecular force of attraction is very low. So they can move very fast in any specified region because of it they has high kinetic energy.

347. At critical state, the compressibility factor (Z) for a real gas is equal to

(a) $\frac{3}{8}$ (b) $\frac{8}{3}$

(c) $\frac{4}{3}$ (d) $\frac{3}{4}$

AIIMS-26 May, 2018 (M)

Ans. (a): We know compressibility factor (z)

$$\boxed{Z = \frac{PV}{RT}} \text{——— (i)}$$

At critical point

$$P = \frac{a}{27b^2}$$

$$V = 3b$$

And

$$T = \frac{8a}{27Rb}$$

Putting these all value in equation (i)

$$Z = \frac{\frac{a}{27b^2} \times 3b}{R \times \frac{8a}{27Rb}}$$

$$Z = \frac{3}{8}$$

348. Dominance of strong repulsive forces among the molecules of the gas (Z=compressibility factor

(a) Depends on Z and indicated by Z=1

(b) Depends on Z and indicated by Z>1

(c) Depends on Z and indicated by Z<1

(d) Is independent of Z.

AIIMS-2006

Ans. (b): If Z > 1

It means, gas is less compressible than ideal gas i.e. if we compress the gas, the decrease in volume is less than expected. This is because of the dominance of strong repulsive forces between the molecules preventing them to come closer.

349. The compressibility factor of an ideal gas is:

(a) 0 (b) 2

(c) 1 (d) 4

AIIMS-1997

Ans. (c): The deviation of real gases from ideal behaviour is measured in terms of a ratio of PV to nRT. This is termed as compressibility factor (Z)

$$Z = \frac{PV}{nRT}$$

For ideal gas PV = nRT, hence the compressibility factor, Z = 1 at all temperature and pressure.

350. The ratio of rates of diffusion of gases X and Y is 1 : 5 and that of Y and Z is 1 : 6. The ratio of rates of diffusion of Z and X is

(a) 1 : 30 (b) 1 : 6

(c) 30 : 1 (d) 6 : 1

AP-EAMCET (Engg.) - 2014

Ans. (c) : According to Graham's law of diffusion.

$$\frac{r_X}{r_Y} = \frac{1}{5} \text{\_\_\_\_\_(I)}$$

$$\frac{r_Y}{r_Z} = \frac{1}{6} \text{\_\_\_\_\_(II)}$$

Multiply equation (I) and (II) we get

$$\frac{r_X}{r_Z} = \frac{1}{5} \times \frac{1}{6} = \frac{1}{30}$$

or $\frac{r_Z}{r_X} = \frac{30}{1}$

or $r_Z : r_X = 30 : 1$

351. Which one of the following is the kinetic energy of a gaseous mixture containing 3g of hydrogen and 80 g of oxygen at temperature T(K)?

(a) 3RT (b) 6RT

(c) 4RT (d) 8RT

AP-EAMCET – 2016

Ans. (b) : Number of moles of hydrogen

$$= \frac{\text{mass of } H_2}{\text{M. weight of } H_2}$$

$$= \frac{3}{2} = 1.5$$

Number of moles of oxygen = $= \frac{80}{32} = 2.5$

$\therefore$ Total number of moles in gaseous mixture of hydrogen and oxygen = 1.5 + 2.5 = 4

Therefore, K.E. = $\frac{3}{2}$nRT

$$= \frac{3}{2} \times 4 \times RT$$

$$= 6RT$$

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352. At T (K), the ratio of kinetic energies of 4 g of H_2(g) and 8 g of O_2 (g) is

(a) 1: 4 (b) 4: 1

(c) 2: 1 (d) 8: 1

AP-EAMCET (Engg.) 2013

Ans. (d) :
We know that K.E. = 3/2 nRT

∵ 4 gm of H_2 gas has 2 moles of H_2.

and 8 gm of O_2 gas has 1/4 moles of O_2.
Hence, ratio of K.E of H_2 and O_2

$$K.E_{H_2} : K.E_{O_2} = 2 : \frac{1}{4} = 8 : 1$$

353. The average kinetic energy of one molecule of an ideal gas at 27°C and 1 atm pressure is

(a) 900 cal $K^{-1}mol^{-1}$

(b) 6.21×10^{-21} JK^{-1} $molecule^{-1}$

(c) 336.7 JK^{-1} $molecules^{-1}$

(d) 3741.3 JK^{-1} mol^{-1}

VITEEE- 2009

Ans. (b) : Average kinetic energy per molecule

$$= \frac{3}{2}kT$$

$$\text{or } = \frac{3}{2}\frac{R}{N_0}T = \frac{3}{2} \times \frac{8.314}{6.023 \times 10^{23}} \times 300$$

$$= 6.21 \times 10^{-21}\ JK^{-1}\ molecule^{-1}$$

354. Above the Boyle temperature, the compressibility factor of the real gases, Z is

(a) 1 (b) < 1

(c) > 1 (d) ≤ 1

AMU-2013

Ans. (c) : Boyle's Temperature:- It is the temperature at which the real gas behaves as an ideal gas over a wide range of pressure is known as Boyle temperature. At this temperature the attractive and repulsive forces acting on the gas particle are balance.
Above the Boyle temperature (Z > 1), the real gases show positive deviation from ideality and Z value are greater than 0 (Z > 1).

355. The kinetic energy of one mole of a gas is

(a) $\frac{3}{2}KT$ (b) $\frac{1}{2}KT$

(c) $\frac{3}{2}RT$ (d) $\frac{1}{2}RT$

AMU 2002

Ans. (c) : According to the Kinetic theory of gases, the mathematical expression of Kinetic energy for one mole is:

$$K.E. = \frac{3}{2}RT$$

Where R = Gas constant (8.314J $mol^{-1}K$)
T = Temperature (measured in Kelvin).

356. 4.4 g of a gas at STP occupies a volume of 2.24 L, the gas is

(a) O_2 (b) CO

(c) CO_2 (d) NO_2

Assam CEE-2014

Ans. (c) : $\left.\begin{array}{l}\text{Given mass} = 4.4\text{g} \\ \text{Volume} = 2.24\text{ L}\end{array}\right] \text{at STP}$

$$\text{No. of Moles} = \frac{\text{Mass}}{\text{Molecular Mass}} \text{ or } \frac{\text{Volume}}{22.4}$$

Let molecular mass is x

$$\frac{4.4}{x} = \frac{2.24}{22.4}$$

$$x = \frac{4.4}{0.1}$$

$$\boxed{x = 44}$$

Molecular Mass = 44
$CO_2 = 12 + 32 = 44$
$O_2 = 16 + 16 = 32$
$CO = 12 + 16 = 28$
$NO_2 = 14 + 32 = 46$
Hence, CO_2 is correct option.

357. Magnitude of kinetic energy in an orbit is equal to :

(a) half of the potential energy

(b) twice of the potential energy

(c) one fourth of the potential energy

(d) none of the above

BCECE-2005

Ans. (a) : Kinetic energy of e^- moving in an orbit

$$K.E = \frac{Z\varepsilon^2}{8\pi\varepsilon r}$$

And

$$P.E = \frac{-2e^2}{4\pi\varepsilon r}$$

$$P.E = -2KE$$

$$\boxed{KE = \frac{-1}{2}P.E}$$

358. When hydrogen molecules decomposed into it's atoms which conditions gives maximum yield of H atoms?

(a) High temperature and low pressure

(b) Low temperature and high pressure

(c) High temperature and high pressure

(d) Low temperature and low pressure

BCECE-2008

Ans. (a) : $H_2 \rightleftharpoons 2H - \text{Heat}$

According to Le Chatelier's principle-
Increase the rate of forward reaction, temperature should be increased and pressure should be decreased.

359. The velocity of a moving electron having 4.55×10^{-25}J of kinetic energy is

(a) 10^3 ms^{-1} (b) 10^5 cms^{-1}

(c) 10^2 ms^{-1} (d) 10^4 cms^{-1}

CG PET- 2015

Ans. (a) : Given,
Mass of electron = 9.1×10^{-31} kg
Kinetic energy of electron (K.E.) = 4.55×10^{-25}
We know

$$K.E. = \frac{1}{2}MV^2$$

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$$4.55 \times 10^{-25} = \frac{1}{2} 9.1 \times 10^{-31} \times V^2$$

$$V^2 = \frac{4.55 \times 10^{-25} \times 2}{9.1 \times 10^{-31}}$$

$$V^2 = \frac{9.1 \times 10^6}{9.1}$$

$$V^2 = 10^6$$

$$\boxed{V = 10^3 \text{m/sec}}$$

360. According to the kinetic theory of gases, in an ideal gas, between two successive collisions a gas molecule travels

(a) In a circular path
(b) In a wavy path
(c) In a straight line path
(d) With an accelerated velocity

[AIEEE 2003]

Ans. (c) : As we know, assumption of kinetic energy theory of gases. The gas molecules are in constant, rapic, straight line motion (It means that gas molecules have kinetic energy $KE = \frac{1}{2}MV^2$).

361. As the temperature is raised from 20ºC to 40ºC the average kinetic energy of neon atoms changes by a factor of which of the following?

(a) $1/2$
(b) $\sqrt{313/293}$
(c) 313/293
(d) 2

[AIEEE 2004]

Ans. (c) : Given,

$T_1 = 20°C + 273 = 293K$

$T_2 = 40°C + 273 = 313K$

We know average kinetic energy

Then, $E = \frac{3}{2}KT$

$$E1 = \frac{3}{2}K(293) \text{———} (i)$$

$$E1 = \frac{3}{2}K(313) \text{———} (ii)$$

Equation (ii / i)

$$\frac{E_2}{E_1} = \frac{\frac{3}{2}K(313)}{\frac{3}{2}K(293)}$$

$$\boxed{\frac{E_2}{E_1} = \frac{313}{293}}$$

362. Which of the following is not the postulate of the kinetic theory gases?

(a) Gas molecules are in an permanent state of random motion.
(b) Pressure of gas is due to molecular impacts on the walls.
(c) The molecules are perfectly elastic.
(d) The molecular collisions are elastic.

J & K CET-(2013)

Ans. (c) : Postulate of the kinetic theory of gases.

(i) Gas molecules are in a permanent state of random motion
(ii) The collisions between molecules are completely elastic (i.e. when molecules collide, there is no exchange of energy)
(iii) Pressure of gas is due to molecular impact on the walls.
(iv) Each molecules in a gas has different velocity

363. According to kinetic theory of gases

(a) the absolute temperature is a measure of kinetic energy of molecules
(b) molecules attract each other
(c) energy is lost during molecular collision
(d) molecules possess appreciable volume

J & K CET-(2001)

Ans. (a) : According to kinetic theory of gases the absolute temperature is a measure of kinetic energy of molecules.

364. Which one of the following statement is not an assumption of the kinetic theory of gases?

(a) There are attractive forces between the particles.
(b) The particles of a gas are in a state of continuous motion.
(c) The actual volume of molecules is negligible compared to the empty space between them.
(d) At any particular time, different particles in a gas have the same kinetic energy.

J & K CET-(1997)

Ans. (a) : Assumption in Kinetic Theory of Gases

(1) Molecules obey Newton's Laws of motion
(2) The particles of a gas are in a state of continuous motion
(3) The actual volume of molecules is negligible compared the empty space between them.
(4) At any particular time, different particles in a gas have the same kinetic energy.
(5) The molecules of gas have no attraction or repulsion for each other.

365. The density of a gas is 1.964 g dm^{-3} at 273 K and 76 cm Hg. The gas is

(a) CH_4
(b) C_2H_6
(c) CO_2
(d) Xe

JCECE - 2009

Ans. (c) : Given,

Density (ρ) = 1.964 g/dm^{-3} = 1.964 × 10^{-3} g/cc

Pressure (P) = 76 cm = 760 mm Hg = 1 atm

Universal Gas Constant (R) = 0.08212 atm/k mol

= 88.1 cc atm/k mol

Temperature (T) = 273 K

We know, from Ideal Gas equation

$$PV = nRT$$

$$PV = \frac{m}{M}RT$$

$$\frac{PV}{m} = \frac{RT}{M}$$

$$P\frac{1}{\rho} = \frac{RT}{M}$$

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$$M = \frac{\rho RT}{P} \text{ ———(i)}$$

Putting all value

$$M = \frac{1.964\times10^{-3}\times82.1\times273}{1}$$

$$M = 44$$

Hence, from the above given option CO_2 has molecules weight 44.

366. For three gases A,B and C, the values of their critical temperatures (T_C) are such that $T_C(A) > T_C(B) > T_C(C)$ assuming identical value of 'b'. Which gas can be most easily liquefied?

(a) A (b) B

(c) C (d) All at same temperature

JCECE - 2016

Ans. (a) : Relation used

$$T_C = \frac{8a}{27Rb}$$

where, a and b are van der Waals' constant. Keeping value of b constant, we have,

$$T_C \propto a$$

As we know, more be the value of 'a', more easily we can liquefied the gas.

Hence, more be the value of T_C, more easily that gas will be liquefied i.e. A.

367. Which of the following ideal gases has higher value of average kinetic energy per mole at given temperature — N_2, CO_2, O_2?

(a) N_2

(b) CO_2

(c) O_2

(d) All have equal value of KE

JCECE - 2016

Ans. (d) : Average kinetic energy per mole of gas is independent of nature of gas and is as,

$$KE_{av} = \frac{3}{2}RT(\text{per mole})$$

and $KE_{av} \propto T$

Since, T = constant

thus, value of KE also same for all gases.

368. The average kinetic energy of an ideal gas per molecule in SI units at 25°C will be

(a) 6.17×10^{-21} kJ (b) 6.17×10^{-21}J

(c) 6.17×10^{-20}J (d) 6.16×10^{-20}J

JIPMER-2013, NEET-1996

Ans. (b) : kinetic energy of an ideal gas is,

$$\text{Average KE} = \frac{3}{2}kT$$

Boltzmann constant is given as k

The temperature is represented as T.

The value of Boltzmann constant is

1.38×10^{-23}J/K

$$\text{Average KE} = \frac{3}{2}kT$$

$$= \frac{3}{2}\times1.38\times10^{-23}\times300\text{J} = 6.17\times10^{-21}\text{ J.}$$

369. The kinetic energy of a gas molecule is .... temperature.

(a) independent of

(b) directly proportional to

(c) inversely proportional to

(d) directly proportional to square root of

Manipal-2019

Ans. (b) As we know, the average kinetic energy of gas

$$\text{K.E (E)} = \frac{3}{2}kT$$

$$E \propto T$$

Here kinetic energy proportional to Temperature.

370. What is the kinetic energy of 1 g of O_2 at 47°C?

(a) 2.17×10^2 J (b) 2.24×10^2 J

(c) 1.24×10^2 J (d) None of these

Manipal-2017

Ans. (c) : Given, Temperature (T) = 47°C + 273 = 320K K

Mass = 1 g

Molecular weight of O_2 = 32 g/mol

$$\text{Mole} = \frac{\text{Mass}}{\text{Molecular weight}}$$

$$\text{Mole} = \frac{1}{32}$$

As we know, K.E. of n mole

$$= \frac{3}{2}\times(nRT)$$

$$= \frac{3\times\frac{1}{32}\times8.314\times320}{2}$$

$$= 1.24 \times 10^2 \text{ Joule.}$$

371. Internal energy and pressure of a gas per unit volume are related as

(a) $P = \frac{2}{3}E$ (b) $P = \frac{3}{2}E$

(c) $P = \frac{1}{2}E$ (d) $P = 2E$

NEET-1993

Ans. (a) : We know,

$$\text{Kinetic Energy of Gas} = \frac{3}{2}nRT \text{ ——(i) (for n moles)}$$

$$\text{and} \quad PV = nRT \text{ ———(ii)}$$

From (i) and (ii)

$$\text{K.E.} = \frac{3}{2}PV$$

Here, in question given for unit volume (i.e. V = 1)

$$P = \frac{2}{3}E$$

372. A closed flask contains water in all its three states solid, liquid and vapour at 0°C. In this situation, the average kinetic energy of water molecules will be

(a) the greatest in all the three states

(b) the greatest in vapour state

(c) the greatest in the liquid state

(d) the greatest in the solid state

NEET-1992

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Ans. (b) : As we know, the intermolecular attraction force between the molecule is more as compare to gas and liquid has intermolecular attraction force in between solid and gas.
Hence, Particle has maximum collision in gas because it has maximum velocity.
As we know, K.E. is the function of temperature. So, maximum kinetic energy is in vapour state.

373. The energy absorbed by each molecule (A_2) of a substance is 4.4×10^{-19} J and bond energy per molecule is 4.0×10^{-19} J. The kinetic energy of the molecule per atom will be

(a) 2.2×10^{-19} J (b) 2.0×10^{-19} J
(c) 4.0×10^{-19} J (d) 2.0×10^{-20} J

NEET-2009

Ans. (d) : Given, molecule is diatomic (A_2) = 2 atom
Energy is absorbed by each molecule = 4.4×10^{-19} Joule
Bond energy absorbed by per molecule = 4×10^{-19} Joule

$$\text{K.E.} = \text{Energy absorbed} - \text{Bond Energy}$$
$$\text{K.E.} = 4.4 \times 10^{-19} - 4 \times 10^{-19}$$
$$= 0.4 \times 10^{-19} \text{ Joule}$$

$$\text{Energy absorbed by per atom} = \frac{\text{K.E.}}{2}$$
$$= \frac{0.4\times10^{-19}}{2}$$
$$= 0.2 \times 10^{-19} \text{ Joule}$$
$$= 2 \times 10^{-20} \text{ Joule}$$

374. If a gas expands at constant temperature, it indicates that

(a) Kinetic energy of molecules remains the same
(b) Number of the molecules of gas increase
(c) Kinetic energy of molecules decreases
(d) Pressure of the gas increases

NEET-2008

Ans. (a) : As we know,

$$\text{K.E.} = \frac{3}{2}\text{KT} \qquad \text{Where K} = \text{nR}$$

Here,

$$\text{K.E.} \propto \text{T}$$

Given, temperature is constant hence Kinetic energy s also constant. Then Kinetic energy of molecules remain the same.

375. Average molar kinetic energy of CO and N_2 at same temperature is

(a) $KE_1 = KE_2$
(b) $KE_1 > KE_2$
(c) $KE_1 < KE_2$
(d) can't say anything. Both volumes are not given

NEET-2000

Ans. (a) : Given,
CO and N_2
Molecular mass of CO = 12 + 16 = 28 g/mol
Molecular mass of N_2 = 14 + 14 = 28 g/mol

$$\text{Moles} = \frac{\text{mass}}{\text{molecular mass}}$$

$$(\text{Moles})_{\text{CO}} = \frac{\text{mass}}{28}$$

$$(\text{Moles})_{\text{N2}} = \frac{\text{mass}}{28}$$

$$\text{K.E.} = \frac{3}{2}\text{nRT}$$

As we seen above, number of mole are same and R and T is also same as given question-
Hence,

$$(\text{K.E.})_{\text{CO}} = (\text{K.E.})_{\text{N}_2}$$

376. 50 mL of hydrogen diffuses out through a small hole of a vessel, in 20 minutes. The time taken by 40 mL of oxygen to diffuse out is

(a) 32 minutes (b) 64 minutes
(c) 8 minutes (d) 12 minutes

NEET-1994
J & K CET-(2003)

Ans. (B) : Rate of diffusion of Hydrogen (H_2) = $\frac{50}{20}$ = 2.5 and Rate of diffusion of Oxygen (O_2) = $\frac{40}{t}$

According to Graham's law of diffusion,

$$\frac{r_{O_2}}{r_{H_2}} = \sqrt{\frac{M_{H_2}}{M_{O_2}}}$$

Where M = molecular mass
$H_2 = 2$
$O_2 = 32$

$$\frac{\frac{40}{t}}{2.5} = \sqrt{\frac{2}{32}} = \sqrt{\frac{1}{16}} = \frac{1}{4}$$

$$\frac{40}{t} = \frac{1}{4} \times 2.5 \Rightarrow t = \frac{40\times4\times10}{25} = 64\,\text{min}$$

377. Which one of the following is the correct order of interactions?

(a) Covalent < Hydrogen bonding < Van der Waal's < Dipole-dipole
(b) Van der Waal's < Hydrogen bonding < Dipole-dipole < Covalent
(c) Van der Waal's < Dipole-dipole < Hydrogen bonding < Covalent
(d) Dipole-dipole < Van der Waal's < Hydrogen bonding < Covalent

NEET-1993

Ans:(b)

No.	Force	Aries Due to	Nature of force
1.	Van der Wall's	Temporary Dipole moment between atom	Weakest
2.	Dipole	2 atom having Dipole moment	less strong
3.	Covalent Bond	Sharing of Electron	Strongest
4.	Hydrogen Bond	attraction of forces that occurs between two atoms of two different molecules	less weak

Hence,
Vander Wall's < Hydrogen Bonding < Dipole - dipole < Covalent

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378. Calculate the total pressure in a 10.0 L cylinder which contains 0.4 g helium, 1.6 g oxygen and 1.4 g nitrogen at $27^\circ C$.

(a) 0.492 atm (b) 49.2 atm
(c) 4.92 atm (d) 0.0492 atm

UPTU/UPSEE-2006

Ans. (a) : Given,

V = 10.0L
Mass of Helium (He) = 0.4 g
Mass of Oxygen (O) = 1.6 g
and Mass of Nitrogen (N_2) = 1.4 g
Temperature = 27°C + 273 = 300 K.

We know,
Universal Gas constant (R) = 0.082L atm mol^{-1} k^{-1}
Then,

$$\text{Moles of He} = \frac{\text{Mass}}{\text{Molecular mass}} = \frac{0.4}{4} = 0.1$$

$$\text{Moles of O} = \frac{1.6}{32} = 0.05$$

$$\text{Moles of } N_2 = \frac{1.4}{28} = 0.05$$

Total moles in 10.0L cylinder at 27°C

= 0.1 + 0.05 + 0.05
= 0.2 mol

We know,

$$PV = nRT$$

$$P = \frac{nRT}{V} = \frac{0.2 \times 0.082 \times 300}{10}$$

P = 0.492 atm

379. Equal weights of ethane and hydrogen are mixed in an empty container at 25 °C. The fraction of total pressure exerted by hydrogen is

(a) 1 : 2 (b) 1 : 1
(c) 1 : 16 (d) 15 : 16

WB-JEE-2018

Ans. (d) : Let x gm. of each gas is mixed.

$$\text{mole of ethane } (C_2H_6) = \frac{x}{30}$$

$$\text{mole of hydrogen } (H_2) = \frac{x}{2}$$

$$\text{mole of fraction of } H_2 = \frac{x/2}{\frac{x}{30} + \frac{x}{2}} = \frac{15}{16}$$

5. Molecular Speeds

380. The r.m.s. velocity of a gas at a particular temperature is found to be 12240 cm.sec^{-1}. What is its most probable velocity (in cm.sec^{-1}) at the same temperature?

(a) 10^5 (b) 10^4
(c) 11280 (d) 1128

AP-EAMCET (Med.)-1999

Ans. (b) : Given data: V_{rms} = 12240 cm.sec^{-1}

$$V_{rms} = \sqrt{\frac{3RT}{M}} \quad -\text{(I)}$$

$$\text{and } V_{mp} = \sqrt{\frac{2RT}{M}} \quad -\text{(II)}$$

Dividing the equation (I) from (II) – we get

$$\frac{V_{rms}}{V_{mp}} = \sqrt{\frac{3RT}{M}} \times \sqrt{\frac{M}{2RT}}$$

$$\text{or} \quad \frac{12240}{V_{mp}} = \sqrt{\frac{3}{2}}$$

$$\text{or} \quad V_{mp} \approx 10^4 \text{ cm.sec}^{-1}$$

381. The rms velocity of an ideal gas at 27ºC is 0.3 m/s. Its rms velocity at 927ºC (in m/s) is

(a) 3.0 (b) 2.4
(c) 0.9 (d) 0.6

A-P EAMCET 1991

Ans. (d) : $V_{rms} = \sqrt{\frac{3RT}{M}}$

$V_{rms(1)} = 0.3$
T_1 = 27ºC = 27 + 273 = 300 K
$V_{rms(2)}$ = ?
T_2 = 927º C = 927 + 273 = 1200

$$\frac{V_{rms_1}}{V_{rms_2}} = \sqrt{\frac{T_1}{T_2}}$$

$$\frac{0.3}{V_{rms(2)}} = 0.3 \times 2 = 0.6 \text{ ms}^{-1}$$

382. The rate of diffusion of a gas in a diffusion tube is $\frac{1}{2\sqrt{7}}$. Molecular weight of the gas (in g mol^{-1})

(a) 12 (b) 28
(c) 24 (d) 44

A-P EAMCET 1992

Ans. (b) : Given that,

Rate of diffusion of a gas in a diffusion tube (r) = $\frac{1}{2\sqrt{7}}$

Molecular weight (M) = ?

Graham's law states that the rate of diffusion or effusion of a gas is inversely proportional to the square root of its molecular weight.

$$\therefore \quad r = \frac{1}{\sqrt{M}}$$

squaring both side, we get

$$r^2 = \frac{1}{M}$$

$$\left(\frac{1}{2\sqrt{7}}\right)^2 = \frac{1}{M}$$

$$M = \left(2\sqrt{7}\right)^2 = 4 \times 7$$

or M = 28 g mol^{-1}

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383. At 27ºC, the ratio of root mean square velocities of ozone to oxygen is

(a) $\sqrt{\frac{3}{5}}$ (b) $\sqrt{\frac{4}{5}}$

(c) $\sqrt{\frac{2}{3}}$ (d) 0.25

A-P EAMCET 1992

Ans. (c) : We know that,

$$V_{rms} = \sqrt{\frac{3RT}{M}}$$

Where, R = Gas constant
T = Temperature
M = Molar mass of gas

$$\frac{V_{rms}(O_3)}{V_{rms}(O_2)} = \sqrt{\frac{3RT/M.(\text{weight of } O_3)}{3RT/M.(\text{weight of } O_2)}}$$

$$\frac{V_{rms}(O_3)}{V_{rms}(O_2)} = \sqrt{\frac{32}{48}} = \sqrt{\frac{2}{3}}$$

384. The root mean square velocity of a gas is doubled when the temperature is

(a) reduced to half
(b) reduced to one-fourth
(c) increased four times
(d) increased two times

AP – EAMCET - (Medical)-1997
A-P EAMCET 1996

Ans. (c) : $U_{rms} = \sqrt{\frac{3RT}{M}}$

Where, R = Gas constant
T = Temperature
M = Molar mass

$\because$ $U_{rms} \propto \sqrt{T}$

Then, $\frac{U_{rms_1}}{U_{rms_2}} = \sqrt{\frac{T_1}{T_2}}$

Squaring both side we get

$$\left(\frac{1}{2}\right)^2 = \frac{T_1}{T_2}$$

$$\frac{1}{4} = \frac{T_1}{T_2}$$

or $\boxed{T_2 = 4T_1}$

385. The rms velocity of CO_2 at a temperature, T (in Kelvin) is x cm s^{-1}. At what temperature (in Kelvin), the rms velocity of nitrous oxide would be 4x cm s^{-1} ? (Atomic weights of C, N and O are respectively 12, 14 and 16)

(a) 16 T (b) 2 T
(c) 4 T (d) 32 T

A-P EAMCET (Engg.)-2001

Ans. (a) : Given that,

$$V_{rms}(CO_2) = x = \sqrt{\frac{3RT_{CO_2}}{M_{CO_2}}} \quad .....(i)$$

$$V_{rms}(N_2O) = 4x = \sqrt{\frac{3RT_{N_2O}}{M_{N_2O}}} \quad .....(ii)$$

$\therefore$ Molecular weight of CO_2 = 44
and molecular weight of N_2O = 44
Dividing equation (i) from (ii) we get.

$$\frac{x}{4x} = \sqrt{\frac{T_{CO_2}}{M_{CO_2}} \times \frac{M_{N_2O}}{T_{N_2O}}}$$

Square both side, we get

$$\frac{x^2}{16x^2} = \frac{T_{CO_2}}{44} \times \frac{44}{T_{N_2O}}$$

$$T_{N_2O} = 16\,T_{CO_2}$$

Hence, the option (a) is correct.

386. If gas contains only three molecules that move with velocities of 100, 200, 500 ms^{-1}. What is the rms velocity of that gas in ms^{-1}?

(a) $100\frac{\sqrt{8}}{3}$ (b) $100\sqrt{30}$

(c) $100\sqrt{10}$ (d) $\frac{800}{3}$

A-P EAMCET 2003

Ans. (c) : Given that,
$V_1 = 100\ ms^{-1}$, $V_2 = 200\ ms^{-1}$, $V_3 = 500\ ms^{-1}$ and n = 3

$$\text{rms velocity (V)} = \sqrt{\frac{V_1^2 + V_2^2 + V_3^2}{n}}$$

$$= \sqrt{\frac{(100)^2 + (200)^2 + (500)^2}{3}}$$

$$= \sqrt{1,00,000}$$

$$= 100\sqrt{10}\ ms^{-1}$$

387. At 27ºC, 500 mL of helium diffuses in 30 min. What is the time (in hours) taken for 1000 mL of SO_2 to diffuse under same experimental conditions?

(a) 240 (b) 3 (c) 2 (d) 4

A-P EAMCET 2004

Ans. (d) : Given that,

$$\gamma_{He} = \frac{500}{30}\text{mL/min},\ \gamma_{SO_2} = \frac{1000}{t}\text{mL/min}$$

$M_{He} = 4$, $M_{SO_2} = 64$

From Graham's law –

$$\frac{\gamma_{He}}{\gamma_{SO_2}} = \sqrt{\frac{M_{SO_2}}{M_{He}}}$$

$$\frac{500}{30} \times \frac{t}{1000} = \sqrt{\frac{64}{4}}$$

$$\frac{t}{60} = 4$$

t = 240 min = 4 hr.

388. The given figure shows the Maxwell distribution of molecular speeds of a gas at three different temperatures T_1, T_2 and T_3. The correct order of temperature is

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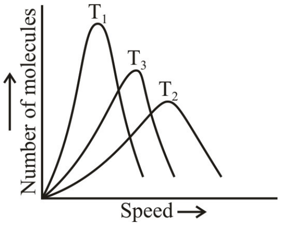

(a) $T_1 > T_2 > T_3$ (b) $T_1 > T_3 > T_2$
(c) $T_3 > T_2 > T_1$ (d) $T_2 > T_3 > T_1$

TS-EAMCET-2016

Ans. (d) : At lower temperature, the molecules have less energy. So, the molecular speeds are lower and distribution of molecules has smaller range. But as the temperature increases, distribution range flatters. So that correct order of temperature is : $T_2 > T_3 > T_1$.

389. How many times the volume of a diatomic gas should be increased reversibly and adiabatically in order to reduce its RMS velocity to half of its initial value.

(a) 4 (b) 8
(c) 16 (d) 32

TS-EAMCET (Engg.), 15.08.2021 Shift-II

Ans. (d) : $\Rightarrow V_{RMS} = \sqrt{\frac{3RT}{M}}$ or $V_{rms} \propto \sqrt{T}$

$T \propto V_{RMS}^2$, $\left(\frac{T_2}{T_1}\right) = \left(\frac{1}{2}\right)^2 \Rightarrow \frac{1}{4}$ .....(i)

Reversible adiabatic expansion –

$TV^{\gamma-1}$ = constant

$$\left(\frac{T_2}{T_1}\right) = \left(\frac{V_1}{V_2}\right)^{\gamma-1}$$

$$\frac{V_2}{V_1} = \left(\frac{T_1}{T_2}\right)^{\frac{1}{\gamma-1}}$$

Diatomic gas – $\gamma = \frac{7}{5} \Rightarrow \gamma - 1 \Rightarrow \frac{2}{5} \Rightarrow \frac{1}{\gamma-1} \Rightarrow \frac{5}{2}$ .....(ii)

$\Rightarrow \left(\frac{V_2}{V_1}\right) = \left(\frac{T_1}{T_2}\right)^{\frac{1}{\gamma-1}}$ [Putting the value of T_1/T_2 from equation (i)]

$$\Rightarrow \left(\frac{V_2}{V_1}\right) = (4)^{5/2}$$

$$\Rightarrow \boxed{\frac{V_2}{V_1} = 32}$$

Hence, gas should be expanded 32 times adiabatically.

390. Two gases of molecular masses M_A and M_B are at temperatures T_A and T_B respectively. If $T_AM_B = T_BM_A$, which one of the following properties has the same value for both the gases?

(a) Pressure (b) Kinetic energy
(c) RMS velocity (d) Density

AP EAMCET (Medical) - 2013

Ans. (c) : For gas-A
molecular mass = M_A
temperature = T_A

for gas-B
molecular mass M_B
temperature = T_B

Given- $T_AM_B = T_BM_A$

Now, from the root mean square velocity-

$$V_{rms} = \sqrt{\frac{3RT}{M}}$$

For gas - A

$$(V_{rms})_A = \sqrt{\frac{3RT_A}{M_A}} \text{ \_\_\_\_(I)}$$

and for gas-B

$$(V_{rms})_B = \sqrt{\frac{3RT_B}{M_B}} \text{ \_\_\_\_(II)}$$

From equation (I) and (II) - we get

$$\frac{(V_{rms})_A}{(V_{rms})_B}\sqrt{\frac{3RT_A}{M_A} \times \frac{M_B}{3RT_B}}$$

or $$\frac{(V_{rms})_A}{(V_{rms})_B} = \sqrt{\frac{T_AM_B}{M_AT_B}} \left(\because T_AM_B = M_AT_B\right)$$

$$\therefore \frac{(V_{rms})_A}{(V_{rms})_B} = 1$$

or $(V_{rms})_A = (V_{rms})_B$

391. Among the following identify the gas which has the greatest average speed of its molecules?

(a) 0.5 mol of O_2 at 500K
(b) 0.2 mol of CO_2 at 400K
(c) 1.0 mol of He at 200K
(d) 0.4 mol of NH_3 at 300K

AP EAPCET 25.08.2021, Shift-II

Ans. (c) :

Average speed ($V_{ag.}$) = $\sqrt{\frac{8RT}{\pi M}}$

Where M = Molar mass
T = Temperature
R = Gas Constant

(i) Molar mass of $O_2 = \frac{\text{mass}}{\text{moles}} = \frac{32}{0.5} = 64$

$$V_{ag} = \sqrt{\frac{8RT}{\pi M}} \quad \left\{\because \sqrt{\frac{8R}{\pi}} = \sqrt{21.18}\right\}$$

$$V_{ag} = \sqrt{\frac{21.18 \times 500}{64}} = 12.86 \text{ m/sec.}$$

(ii) Molar mass of $CO_2 = \frac{44}{0.2} = 220$

$$V_{ag} = \sqrt{\frac{21.18 \times 400}{200}} = 6.21 \text{ m/sec.}$$

(iii) Molar mass of He $= \frac{4}{1} = 4$

$$V_{ag} = \sqrt{\frac{21.18 \times 200}{4}} = 32.54$$

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(iv) Molar mass of $NH_3 = \frac{17}{0.4} = 42.5$

$$V_{ag} = \sqrt{\frac{21.18\times300}{42.5}} = 12.22$$

So, the $V_{ag.}$ of molecule is maximum in option (c).

392. The R.M.S. velocity of CH_4, He and SO_2 are in the ratio of

(a) 16:4:64 (b) 2:1:4
(c) 2:4:1 (d) 1:4:2

COMEDK 2012

Ans. (c) : R.M.S.velocity $= \sqrt{\frac{3RT}{M}}$

$\therefore$ The ratio of R.M.S. velocities of CH_4, He and SO_2 will be

$$\sqrt{\frac{3RT}{16}} : \sqrt{\frac{3RT}{4}} : \sqrt{\frac{3RT}{64}} = \frac{1}{4} : \frac{1}{2} : \frac{1}{8} = 2:4:1$$

393. The most probable velocity (in cm/sec) of hydrogen molecule at 27°C, will be:

(a) 19.3×10^4 (b) 17.8×10^4
(c) 24.93×10^9 (d) 17.8×10^8

AP-EAMCET (Medical), 2006

Ans. (b) : $\because$ Most probable velocity $= \sqrt{\frac{8RT}{\pi M}}$

Temperature (T) = 27 + 273 = 300K

Molecular mass of $H_2 = 2 g mol^{-1}$

Most probable velocity of (H_2)

$$= \sqrt{\frac{8\times8.314\times10^7\times300}{3.14\times2}}$$

$= 17.8 \times 10^4$ cm/s

394. If the r.m.s. velocity of a gas at 100K is 10^4cm. sec^{-1}, what is the temperature (in °C) at which the r.m.s velocity will be 3×10^4 cm. sec^{-1}?

(a) 900 (b) 627
(c) 327 (d) 1217

AP-EAMCET (Medical), 2002

Ans. (b) : Given

$(V_{rms})_1 = 10^4$ cm sec^{-1} $(V_{rms})_2 = 3 \times 10^4$ cm sec^{-1}

$T_1 = 100$ K $T_2 = ?$ (°C)

Now, relation between root mean square velocity and temperature –

$$V_{rms} = \sqrt{\frac{3RT}{M}}$$

Where, V_{rms} = root mean square velocity

R = gas constant

T = temperature

M = molecular weight

$$\therefore \quad (V_{rms})_1 = \sqrt{\frac{3RT_1}{M}} \quad \text{……….. (i)}$$

$$\text{and} \quad (V_{rms})_2 = \sqrt{\frac{3RT_2}{M}} \quad \text{……….. (ii)}$$

from equation (i) and (ii) we get

$$\frac{10^4 \text{cm sec}^{-1}}{3\times10^4 \text{cm sec}^{-1}} = \sqrt{\frac{3RT_1}{M}\times\frac{M}{3RT_2}}$$

or $\frac{1}{3} = \sqrt{\frac{100}{T_2}}$

or $\frac{1}{9} = \frac{100}{T_2}$

or $T_2 = 900$K

or $T_2 = 900 - 273$

or $T_2 = 627^\circ$C

395. The most probable velocity of a gas at 7200 K is equal to the RMS velocity of He gas at 27°C. The gas is

(a) O_2 (b) CO (c) N_2 (d) SO_2

TS EAMCET 04.08.2021, Shift-I

Ans. (d) : Given that T_{mp} = 7200K, T_{rms} = 27°C = 300K, $M_{rms} = 4$

We know that,

Most probable velocity $(v_{mp}) = \sqrt{\frac{2RT}{M}}$

and RMS velocity $(v_{rms}) = \sqrt{\frac{3RT}{M}}$

According to the question,

$$\therefore \quad \sqrt{\frac{2RT}{M}} = \sqrt{\frac{3RT}{M}}$$

Putting the value of these, we get–

$$\sqrt{\frac{2R\times7200}{M}} = \sqrt{\frac{3R\times300}{4}}$$

Squaring both side, we get–

$$\frac{2R\times7200}{M} = \frac{3R\times300}{4}$$

or $M = \frac{2\times7200\times4}{3\times300}$

$M = 64$

Hence, the gas is SO_2.

396. If the density ratio of O_2 and H_2 is 16:1, then ration of their V_{rms} will be

(a) 1 : 1 (b) 1 : 4
(c) 16 : 1 (d) 1 : 16

Assam CEE-2014
AIIMS-1994
BITSAT 2008

Ans. (b): Given that,

density of $O_2 = 16$

density of $H_2 = 1$

$\therefore$ We know that

$$V_{rms} = \sqrt{\frac{3KT}{M}}$$

Root mean speed is inversely proportional to the square root of density.

$$\frac{V_{rmsO_2}}{V_{rmsH_2}} = \sqrt{\frac{\text{density of } H_2}{\text{density of } O_2}}$$

$$\frac{V_{rmsO_2}}{V_{rmsH_2}} = \sqrt{\frac{1}{16}}$$

$$= \frac{1}{4}$$

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397. Which of the following gas molecules have equal total kinetic energy and translational kinetic energy?

(a) O_2 (b) He (c) CH_4 (d) N_2

AIIMS-1996

Ans. (b): Total kinetic energy = Translational K.E. + Rotational + Vibrational K.E.
For the monoatomic molecule do not posses vibrational and rotational kinetic energies but have only translational motion. Therefore the noble gas (He, Ne, Ar, Kr, etc) fulfill the criteria.

398. Assertion: All molecules in a gas have same speed.
Reason: Gas contains molecules of different size and shape.

(a) If both Assertion and Reason are correct and the Reason is a correct explanation of the Assertion.
(b) If both Assertion and Reason are correct but Reason is not a correct explanation of the Assertion.
(c) If the Assertion is correct but Reason is incorrect.
(d) If both the Assertion and Reason are incorrect.
(e) If the Assertion is incorrect but the Reason is correct.

AIIMS-2001

Ans. (d): All molecules of a gas are identical in shape and size, but have different energies due to which they have different speeds. It not all of the molecules of a particular gas at a given temperatures move at exactly the same speed.

399. The inversion temperature T_i(K) of hydrogen is (given van der Waals constants a and b are 0.244 atm L^2mol^{-2} and 0.027 $Lmol^{-1}$ respectively)

(a) 440 (b) 220
(c) 110 (d) 330

AIIMS-2010

Ans. (b): Given that,
a = 0.244 atm L^2 mol^{-2}
b = 0.027 L mol^{-1}
The inversion temperature is characteristic of each gas and is given as

$$Ti = \frac{2a}{bR}$$
$$= \frac{2\times 0.244}{0.027\times 0.0821}$$
$$= 220K$$

400. Amongst the following statements, the correct one is :

(a) The gas can not be compressed below the critical temperature.
(b) Below critical temperature, thermal motion of the molecules is slow enough for the intermolecular forces to come into play leading to condensation of the gas.
(c) At critical temperature liquid and gaseous phase can be distinguished.
(d) An ideal gas has a characteristic critical temperature.

AIIMS-2011

Ans. (b): If the temperature is below critical temperature and the pressure is also below its critical value then there is a possibility that we see an equilibrium between the liquid and gaseous states. Critical temperature of a gas is given by-

$$Tc = \frac{8a}{27Rb}$$

Where, a = Vander Waal's forces of attraction.
R = Gas constant.

401. Critical temperatures for A,B,C and D gases are 25ºC, 10ºC, –80ºC and 15ºC respectively. Which gas will be liquified more easily?

(a) A (b) B
(c) C (d) D

AIIMS-2007

Ans. (a): The gas with higher critical temperatures liquifies first.
Hence, 'A' will be liquified more easily.

402. For the diffusion of a gas at pressure P, the rate of diffusion is expressed by:

(a) $r \propto \frac{1}{\sqrt{M}}$ (b) $r = \frac{P}{M}$
(c) $r \propto \frac{M}{\sqrt{P}}$ (d) $r = \frac{P}{\sqrt{M}}$

AIIMS-1998

Ans. (a): According to the Graham's law of diffusion under similar conditions of temperature and pressure, rate of diffusion is inversely proportional to square root of molecular weight.

$$\gamma \propto \frac{1}{\sqrt{M}}$$

Where, M = Molar mass

403. A gas cylinder containing cooling gas can withstand a pressure of 14.9 atmosphere. The pressure gauge of cylinder indicates 12 atmosphere at 27ºC. Due to sudden fire in the building the temperature starts rising. The temperature at which cylinder explodes is:

(a) 87.5ºC (b) 99.5ºC
(c) 115.5ºC (d) 135.5ºC

AIIMS-1997

Ans. (b): Given that,
P_1 = 12 bar, P_2 = 14.9 bar
T_1= 27ºC = 27+273 = 300K, T_2 = ?

According to the pressure temperature law- $\frac{P_1}{P_2} = \frac{T_1}{T_2}$

or

$$T_2 = \frac{T_1 \times P_2}{P_1}$$

Putting the given values, we get-

$$T_2 = 300\times\frac{14.9}{12}$$
$$= 300 \times 1.2416$$
$$= 372.5K.$$

Hence, the temperature in centigrade
= 372.5–273
= 99.5ºC

@apna_pdf

404. Two flasks A and B have equal volumes. A is maintained at 300K and B at 600K. Equal masses of H_2 and CO_2 are taken in flasks A and B respectively. Find the ratio of total K.E. of gases in flask A to that of B

(a) 1 : 2 (b) 11: 1

(c) 33 : 2 (d) 55:7

AP EAPCET 19-08-2021, Shift-II

Ans. (b) : Given

For Flask A -	For Flask B -
$T_A = 300K$	$T_B = 600$ K
Molar mass of $(H_2)_A = 2$	Molar mass of $(CO_2)_B = 44$

$$\text{Kinetic energy} - V_{rms} = \sqrt{\frac{3RT}{M}}$$

For Flask A -

$$\left(V_{rms}\right)_A = \sqrt{\frac{3R \times 300K}{2}} \quad ...(i)$$

For Flask B -

$$\left(V_{rms}\right)_B = \sqrt{\frac{3R \times 600K}{44}} \quad ...(ii)$$

From (i) and (ii)

$$\frac{\left(V_{rms}\right)_A}{\left(V_{rms}\right)_B} = \sqrt{\frac{300K}{2} \times \frac{44}{600K}} = \frac{\sqrt{11}}{1}$$

$$\therefore \frac{(KE)_A}{(KE)_B} = \frac{\frac{1}{2}m\left(v_{rms}^2\right)_A}{\frac{1}{2}m\left(v_{rms}^2\right)_B} = \left(\frac{\sqrt{11}}{1}\right)^2 = \frac{11}{1}$$

405. The root mean square velocity of hydrogen at STP is 1.83×10^5 cm sec^{-1} and its mean free path is 1.78×10^{-3} cm. What will be the collision number at STP?

(a) 9.476×10^9 sec^{-1} (b) 9.746×10^{-9} sec^{-1}

(c) 9.746×10^9 sec^{-1} (d) 9.647×10^9 sec^{-1}

AMU-2016

Ans. (a) : Given that, $V_{rms} = 1.83 \times 10^5$ cm sec^{-1}

Mean free path $(\lambda) = 1.78 \times 10^{-5}$ cm

$\therefore$ we know that,

$$\text{Collision number (Z)} = \frac{V_{rms}}{\lambda}$$

Substituting the given value, we get-

$$Z = \frac{1.83 \times 10^5}{1.78 \times 10^{-5}}$$

$= 1.026 \times 10^{10}$

406. The root mean square velocity of an ideal gas at constant pressure varies with density (d) as

(a) d^2 (b) d

(c) $\sqrt{d}$ (d) $\sqrt{\frac{1}{d}}$

AMU-2015

WB-JEE-2008

Ans. (d) : The root mean square velocity is directly proportional to the square root of temperature and inversely proportional to the square root of molar mass.

$$\therefore V_{rms} = \sqrt{\frac{3RT}{M}}$$

Where, T = temperature

M = Molar mass

$$\text{We know that, density} = \frac{\text{mass}}{\text{volume}}$$

$\therefore$ density $\propto$ mass

$$\text{Hence, } V_{rms} = \sqrt{\frac{1}{\text{density}}}$$

$$V_{rms} \propto \sqrt{\frac{1}{d}}$$

407. The temperature of a gas is raised from 27°C to 927°C, the root mean square velocity is

(a) $\sqrt{\frac{927}{27}}$ times the earlier value

(b) same as before

(c) halved

(d) doubled

Assam CEE-2020

AP EAPCET 20.08.2021 Shift-II

Ans. (d) : Given,

$T_1 = 27^oC = 27 + 273 = 300$ K

$T_2 = 927^oC = 927 + 273 = 1200$ K

$$V_{rms} = \sqrt{\frac{3KT}{M}}$$

$$V_{rms} \propto \sqrt{T}$$

$$\frac{V_{rms_1}}{V_{rms_2}} = \sqrt{\frac{T_1}{T_2}}$$

$$\frac{V_{rms_1}}{V_{rms_2}} = \sqrt{\frac{300}{1200}}$$

$$\boxed{V_{rms_1} = 2V_{rms_2}}$$

408. The average kinetic energy of an ideal gas per molecule in SI unit at 25^0C will be

(a) 6.17×10^{-21} kJ (b) 6.17×10^{-21} J

(c) 6.17×10^{-20} J (d) 7.16×10^{-20} J

BITSAT 2016

NEET-1996

Ans. (b) : $\overline{KE} = \frac{3}{2}kT = \frac{3}{2} \times \frac{8.313}{6.023 \times 10^{23}} \times 298$

$= 6.17 \times 10^{-21}$ J.

(Average Kinetic energy $\overline{KE} = \frac{3}{2}kT = \frac{3}{2}\frac{R}{N}T$)

409. Increasing order of rms velocities of H_2, O_2, N_2 and HBr is

(a) $H_2 > O_2 > N_2 > HBr$ (b) $HBr < O_2 < N_2 < H_2$

(c) $H_2 > N_2 < O_2 > HBr$ (d) $HBr > N_2 < O_2 < H_2$

BITSAT 2013

AMU – 2008

NEET-1991

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Ans. (b) : RMS velocity (V_{rms}) of molecules depends on mass. When Mol.wt. increases then rms velocity of melocules decreases.

$$\text{rms} \propto \frac{1}{\sqrt{\text{mol.wt}}}$$

The order of increasing mol.wt. :–

$H_2 < N_2 < O_2 < HBr$

Increasing order of rms velocity of molecules

$HBr < O_2 < N_2 < H_2$.

410. Which one of the following statements is not true about the effect of an increase in temperature on the distribution of molecular speeds in a gas?

(a) The area under the distribution curve remains the same as under the lower temperature

(b) The distribution becomes broader

(c) The fraction of the molecules with the most probable speed increases

(d) The most probable speed increases

[AIEEE 2005]

Ans. (c) : On increasing the temperature, the motion of gas molecule become rapid so the value of most probable speed also increase.

The most probable speed is directly proportional to the square root of temperature. The area under the distribution curve remains the same as under the lower temperature and distribution curve represents the total number of molecules.

411. The molecular velocity of any gas is

(a) Inversely proportional to the square root of temperature

(b) Inversely proportional to absolute temperature

(c) Directly proportional to square of temperature

(d) Directly proportional to square root of temperature

[AIEEE 2011]

Ans. (d) : The molecular speed of gas is directly proportional to the square root of temperature.

We know that,

$$\text{Average velocity} = \sqrt{\frac{8RT}{\pi M}}$$

$$\text{Root mean square velocity} = \sqrt{\frac{3RT}{M}}$$

$$\text{Most Probable velocity} = \sqrt{\frac{2RT}{M}}$$

Hence, in all cases molecular velocity $\propto \sqrt{T}$

412. For gaseous state, if most probable speed is denoted by C*, average speed by C and mean square speed by C, then for a large number of molecules, the ratios of these speeds are

(a) $C^* : \bar{C} : C = 1.225 : 1.128 : 1$

(b) $C^* : \bar{C} : C = 1.128 : 1.225 : 1$

(c) $C^* : \bar{C} : C = 1 : 1.128 : 1.1225$

(d) $C^* : \bar{C} : C = 1 : 1.225 : 1.128$

[JEE Main 2013]

Ans. (c) : We know that,

$$C^* = \text{Most probable speed} = \sqrt{\frac{2RT}{M}}$$

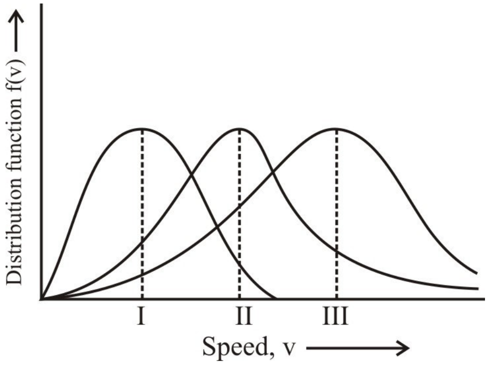
$$\bar{C} = \text{Average speed} = \sqrt{\frac{8RT}{\pi M}}$$

$$C = \text{Root square speed} = \sqrt{\frac{3RT}{M}}$$

Therefore, the ratio of speed are-

$C^* : \bar{C} : C = 1 : 1.128 : 1.225$

413. Points I, II and III in the following plot respectively correspond to (Vmp : most probable velocity)



(a) V_{mp} of H_2 (300 K); V_{mp} of N_2 (300 K); V_{mp} of O_2 (400 K)

(b) V_{mp} of O_2 (400 K); V_{mp} of N_2 (300 K); V_{mp} of H_2 (300 K)

(c) V_{mp} of N_2 (300 K); V_{mp} of O_2 (400 K); V_{mp} of H_2 (300 K)

(d) V_{mp} of N_2 (300 K); V_{mp} of H_2 (300 K); V_{mp} of O_2 (400 K)

[JEE Main 2019, 10 April Shift-II]

Ans. (c) : We know that, the most probable speed

$$(V_{mp}) = \sqrt{\frac{2RT}{M}}$$

$$\text{or } V_{mp} \propto \sqrt{\frac{T}{M}}$$

For N_2, O_2 and H_2

$$V_{mp}N_2 = \sqrt{\frac{300}{28}}, V_{mp}O_2 = \sqrt{\frac{400}{32}}$$

$$V_{mp}H_2 = \sqrt{\frac{300}{2}}$$

Hence, V_{mp} of N_2 (300K) < V_{mp} of O_2(400K) < V_{mp} of H_2 (300K)

414. Identify the correct labels of A, B and C in the following graph from the options given below:

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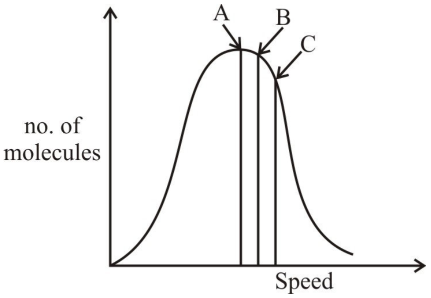


Root mean square speed (V_{rms});
Most probable speed (V_{mp});
Average speed (V_{av});

(a) A-v_{rms};B-v_{mp};C-v_{av}
(b) A-v_{mp};B-v_{rms};C-v_{av}
(c) A-v_{mp};B-v_{av};C-v_{rms}
(d) A-v_{av};B-v_{rms};C-v_{mp}

[JEE Main 2020, 7 Jan Shift-II]

Ans. (c) : We know that,

$$V_{rms} = \sqrt{\frac{3RT}{M}}$$

$$V_{av\cdot} = \sqrt{\frac{8RT}{\pi M}}$$

$$V_{mps} = \sqrt{\frac{2RT}{M}}$$

Therefore, $V_{rms} > V_{av} > V_{mps}$

$$\sqrt{3} > \sqrt{\frac{8}{\pi}} > \sqrt{2}$$

Hence, A = $V_{rms,}$ B= V_{av} and C = V_{mps}

415. What will be the relation between the T_1 of gas 1 with M_1 = 56 and T_2 of gas 2 with M_2 = 44 if the average speed of gas 1 is equal to most probable speed of gas 2?

(a) $T_1=T_2^2$
(b) $T_1=T_2$
(c) $T_1= (T_2)^{1/2}$
(d) $T_1=l/T_2$

J & K CET-(2018)

Ans. (b) : Given that, M_1 = 56, M_2 = 44

We know that,

$$C_{av} = \sqrt{\frac{8RT}{\pi M}}$$

$$\text{and } C_{mp} = \sqrt{\frac{2RT}{M}}$$

According to the equation

$$\sqrt{\frac{8RT_1}{\pi M_1}} = \sqrt{\frac{2RT_2}{M_2}}$$

$$\frac{8T_1}{\pi M} = \frac{2T_2}{M_2}$$

$$\frac{4T_1}{\pi \times 56} = \frac{T_2}{44}$$

$$\frac{T_1}{T_2} = \frac{56 \times \pi}{44 \times 4} = 1$$

Or $T_1 = T_2$.

416. Which of the following gas molecules has the longest mean-free path?

(a) H_2
(b) N_2
(c) O_2
(d) Cl_2

J & K CET-(1998)

Ans. (a) : The average distance travelled by a moving particle between successive collisions is known as mean free path. The smaller the molar mass, the higher the mean free path.

Hence, Hydrogen has smallest molar mass it has largest mean free path.

417. The volume of a gas is reduced to 1.0 L at 25ºC and 1 atm pressure. Its pressure at 35º C would be:

(a) 0.96 atm
(b) 1.03 atm
(c) 2.04 atm
(d) 3.08 atm

JCECE - 2003

Ans. (b): Given that,

V = 1 lit , T = 25°C = 298 K

P = 1 atm.

∴ PV = nRT

1 × 1 = n × 298 × 8.321

$$n = \frac{1}{298 \times 8.321}$$

At T = 35°C = 308 k

$$P \times 1 = \frac{1}{298 \times 8.321} \times 8.34 \times 308$$

$$P = \frac{308}{298}$$

= 1.03 atm.

418. At what temperature, the rms velocity of SO_2 be same as that of O_2 at 303 K?

(a) 273 K
(b) 606 K
(c) 303 K
(d) 403 K

JCECE - 2014

Ans. (b) : $\frac{(V_{rms})_{SO_2}}{(V_{rms})_{O_2}} = \sqrt{\frac{T_{SO_2}}{M_{SO_2}} \times \frac{M_{O_2}}{T_{O_2}}}$

i.e., $1 = \sqrt{\frac{T_{SO_2}}{64} \times \frac{32}{303}}$

or $T_{SO_2} = 606$ K

419. Given that the reduced temperature, $\theta = \frac{T}{T_C}$

The reduced pressure, $\pi = \frac{F}{F_C}$

The reduced volume, $\phi = \frac{V}{V_C}$

Thus, it can be said that the reduced equation of state may be given as

(a) $\left(\frac{\pi}{3} + \frac{1}{\varphi}\right)(3\phi - 1) = \frac{8}{3}\theta$

(b) $\left(\frac{\pi}{4} + \frac{1}{\varphi}\right)(3\theta - 1) = \frac{3}{8}\varphi$

@apna_pdf

(c) $\left(\frac{\pi}{3}+\frac{1}{\varphi}\right)(\phi-1)=\frac{3}{8}\theta$

(d) $\left(\frac{\pi}{3}+\frac{1}{\varphi^2}\right)(3\phi-1)=\frac{8}{3}\theta$

JIPMER-2015

Ans. (d) : According to the Vander Waal's equation –

$$\left(P+\frac{a}{v^2}\right)(v-b)=RT$$

Reduced temperature $(\theta)=\frac{T}{T_c}$

Reduced pressure $(\pi)=\frac{T}{P_c}$

and Reduced volume $(\phi)=\frac{v}{v_c}$

Substituting the value of these in equation by Vander Waal's constant –

$$\left(\pi\frac{a}{27b^2}+\frac{a}{\phi^2 9b^2}\right)(\phi 3b-b)=r\theta\frac{8a}{27Rb}$$

$$\left(\pi a+\frac{3a}{\phi^2}\right)(3b\phi-b)=8ab\theta$$

$$\left(\pi+\frac{3}{\phi^2}\right)(3\phi-1)=8\theta$$

Hence, the reduced equation of state is –

$$\left(\frac{\pi}{3}+\frac{1}{4^2}\right)(3\phi-1)=\frac{8}{3}\theta$$

420. The average velocity (in cm/s) of hydrogen molecule at $27^\circ C$ will be

(a) 19.3×10^4 (b) 17.6×10^4

(c) 24.93×10^9 (d) 17.8×10^8

JIPMER-2009

Ans. (b) : average velocity $=\sqrt{\frac{8RT}{\pi m}}$

$T=(27+273)=300K$

Molecular mass of $H_2=2\ g\ mol^{-1}$

=

$$\sqrt{\frac{8\times8.314\times300}{3.14\times2\times10^3}}=1782.5\,m/s=17.8\times10^4\,cm/sec$$

421. The rms velocity of hydrogen is $\sqrt{7}$ times the rms velocity of nitrogen. If T is the temperature of the gas, which of the following is true?

(a) $T_{H_2}=\sqrt{7}\,T_{N_2}$ (b) $T_{N_2}=T_{H_2}$

(c) $T_{N_2}=\sqrt{7}\,T_{H_2}$ (d) $T_{N_2}=2T_{H_2}$

Karnataka-CET-2011

Ans. (d) :

$$(V_{rms})_{H_2}=\sqrt{7}\,(V_{rms})_{N_2}$$

$$(V_{rms})=\sqrt{\frac{3RT}{M}}$$

$$(V_{rms})_{N_2}=\sqrt{\frac{3RT_{N_2}}{28}}$$

$$(V_{rms})_{H_2}=\sqrt{\frac{3RT_{H_2}}{2}}$$

$$\sqrt{\frac{3RT_{H_2}}{2}}=\sqrt{7}\sqrt{\frac{3RT_{H_2}}{28}}$$

Squiring both side,

$$\frac{3RT_{H_2}}{2}=7\times\frac{3RT_{N_2}}{28}$$

$$2T_{H_2}=T_{N_2}\Rightarrow\boxed{T_{N_2}=2T_{H_2}}$$

422. The rms velocity of molecules of a gas of density 4 kg m^{-3} and pressure 1.2×10^5 Nm^{-2} is

(a) 300 ms^{-1} (b) 900 ms^{-1}

(c) 120 ms^{-1} (d) 600 ms^{-1}

KARNATAKA-CET, 2009

Ans. (a) : $V_{rms}=\sqrt{\frac{3RT}{M}}=\sqrt{\frac{3PV}{M}}=\sqrt{\frac{3P}{\rho}}$

$$=\sqrt{\frac{3\times1.2\times10^5}{4}}=300ms^{-1}$$

423. The temperature of a gas is raised from 27°C to 927°C. The root mean square speed of the gas

(a) remains same (b) gets $\sqrt{\frac{927}{27}}$ times

(c) gets halved (d) gets doubled

NEET-1994

Ans. (d) :

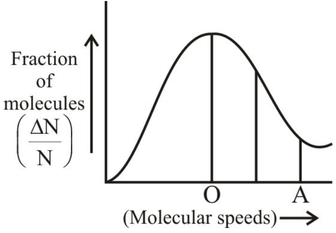
$$V_{rms}=\sqrt{\frac{3RT}{M}}\Rightarrow V_{rms}\propto\sqrt{T}$$

$$\frac{(V_{rms})_1}{(V_{rms})_2}=\sqrt{\frac{T_1}{T_2}}=\sqrt{\frac{300}{1200}}=\frac{1}{2}$$

$$\boxed{(V_{rms})_2=2(V_{rms})_1}$$

Final velocity is doubled the initial velocity.

424. The Maxwell-Boltzmann distribution law of molecular speeds is graphically represented as



This curve has which of the following characteristics?

(1) It has symmetrical distribution

(2) The point on axis represents the most probable speed

(3) The area under the curve gives the total number of molecules

(4) The maximum shifts to the right as the temperature increases

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Choose the correct answer using the codes given below

(a) 1, 2 and 3 (b) 1, 3 and 4
(c) 3 and 4 (d) only 4

UP CPMT-2013

Ans. (c) : According to Maxwell-Boltzmann's distribution curve

1. At a particular temperature, the different molecules of gas posses different speeds and their speeds keep on changing due to continuous ________ ______ _______ _______ _______ collisions, though some molecules are speeded up. Some others are slowed down and hence the fraction of molecules possessing particular speed remains constant at constant temperature.
2. The point A on X-axis does not represent the most probable speed, however, it represents threshold speed, i.e., the minimum speed which the colloiding molecules must have in order that the collision between them may be effective.
3. The area under the curve gives the total number of molecules. As velocity increases, distribution of molecules increases and it is maximum at most probable speed after which distribution of molecules decreases. Fraction of molecules with too high and too low velocities is very small but no molecule has zero velocity.
4. The peak of the curve corresponds to a speed possessed by the maximum fraction of molecules and is called the most probable speed. As temperature increases, the most probable speed also increases, however, the fraction of molecules possessing most probable speed decreases with increase in temperature. Thus, the maximum shift to right as the temperature increases.

425. The most probable velocity (in cm/s) of hydrogen molecule at 27°C will be

(a) 19.3×10^4 (b) 15.8×10^4
(c) 24.93×10^9 (d) 17.8×10^5

UP CPMT-2008

Ans. (b): Most probable velocity

$$(V_m) = \sqrt{\frac{2RT}{M}} = \sqrt{\frac{2\times8.314\times300}{2\times10^{-3}}} = 1579.3\,m/s$$

$$= 15.79\times10^4\,cm/sec$$

6. Liquefaction of Gases

426. Which one of the following processes does not produce dinitrogen?

(a) Thermal decomposition of ammonium dichromatic
(b) Thermal decomposition of barium azide
(c) Treating an aqueous solution of ammonium chloride with sodium nitrite
(d) Thermal decomposition of sodium azide
(e) Thermal decomposition of ammonium nitrate

Kerala CEE -03.07.2022

Ans. (e) : Thermal decomposition of ammonium nitrate does not produce dinitrogen.

427. Assertion: Solubility of gases increases with increase in pressure
Reason: Dissolution of gas in liquid is exothermic.

(a) If both Assertion and Reason are correct and the Reason is the correct explanation of Assertion.
(b) If both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.
(c) If Assertion is correct but Reason is incorrect.
(d) If both the Assertion and Reason are incorrect.

AIIMS-27 May, 2018 (E)

Ans. (b): Difference in pressure is independent of thermodynamic of the process.
Hence, if both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.

428. Assertion: Greater the value of van der Waal's constant'a'. greater is the liquefaction of gas.
Reason:'a' indirectly measures the magnitude of attractive forces between the molecules.

(a) If both Assertion and Reason are correct and the Reason is the correct explanation of Assertion.
(b) If both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.
(c) If Assertion is correct but Reason is incorrect.
(d) If both the Assertion and Reason are incorrect.

AIIMS-2014

Ans. (a): Considering the attractive force, pressure in the ideal gas equation (PV = nRT) is corrected by introducing a factor of $\frac{an^2}{V^2}$, where a is vander wall's constant.
Hence, if both Assertion and Reason are correct and the Reason is the correct explanation of Assertion.

429. Under which one of the following conditions do real gases approach the ideal gas behaviour?

(a) Low temperature and high pressure
(b) High temperature and high pressure
(c) High temperature and low pressure
(d) Low temperature and low pressure

AP-EAMCET- (Engg.)-2011

Ans. (c) : Real gases approach the ideal gas behaviour at high temperature and low pressure.

430. A, B, C and D are four different gases with critical temperatures 304.1, 154.3, 405.5 and 126.0 K respectively. While cooling the gas, which gets liquefied first?

(a) B (b) A
(c) D (d) C

AP-EAMCET – 2016

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Ans. (d) : Given that,

$$T_A = 304.1K$$
$$T_B = 154.3K$$
$$T_C = 405.5K$$
$$T_D = 126.0K$$

The critical temperature signifies the force of attraction between the molecules. The higher the critical temperature, higher is the intermolecular force of attraction and easier is the liquefaction of the gas.

In the given four different gases, C has highest critical temperature i.e. = 405.5K.

Hence, it gets liquefied first.

431. An ideal gas can't be liquefied because

(a) its critical temperature is always above 0^0C

(b) its molecule are relatively smaller in size

(c) it solidifies before becoming a liquid

(d) forces operated between its molecules are negligible

BITSAT 2012
BCECE-2010

Ans. (d) : In an ideal gas, the intermolecular forces of attraction are negligible and hence it cannot be liquefied.

432. When the temperature is raised, the viscosity of liquid decreases this is because

(a) decreased volume of the solution

(b) increased attraction between molecules

(c) decreased covalent and hydrogen bond forces

(d) increase in temperature increase the average kinetic energy of molecules which overcomes the attractive force between them

BITSAT 2010

Ans. (b) : When the temperature is raised, the viscosity of liquid decrease, this is because increasing in temperature increases the kinetic energy of molecules which overcome the affricative force between them.

433. A gas at high temperature is cooled. The highest temperature at which liquefaction of gas first occurs is called.

(a) Boyle temperature (b) critical temperature

(c) boiling temperature (d) freezing temperature.

J & K CET-(2015)

Ans. (b) : The highest temperature at which liquefaction of gas is first is called critical temperature.

434. The following is a method to determine the surface tension of liquids

(a) single capillary method

(b) refractometric method

(c) polarimetric method

(d) boiling point method

J & K CET-(2007)

Ans. (a) : The capillary rise methods is test conducted to determine the surface tension of a liquid or the contact angel. of liquid. Capillary rise takes place due to the combined effect of cohesive and adhesive force.

435. A gas can be liquefied

(a) at its critical temperature

(b) above its critical temperature

(c) below its critical temperature

(d) at $0^\circ C$

UP CPMT-2009

Ans. (c): A gas can be liquefied only when its temperature is below its critical temperature. This is because at critical temperature no distinction exists between the gaseous and liquid state and hence, no separate phase is formed.

436. A gas can be liquefied at temperature T and pressure p provided

(a) $T = T_C$ and $P < P_c$ (b) $T < T_C$ and $P > P_c$

(c) $T > T_C$ and $P > P_c$ (d) $T > T_C$ and $P < P_c$

WB-JEE-2015

Ans. (b) : A gas can be liquefied below critical temperature and above the critical pressure.

7. Intermolecular Forces

437. Dipole-induced dipole interactions are present in which of the following pairs?

(a) HCl and He atoms (b) SiF_4 and He atoms

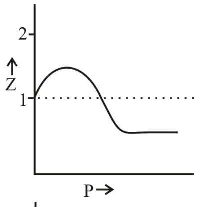
(c) H_2O and alcohol (d) Cl_2 and CCl_4

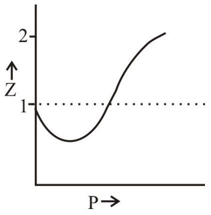
NEET-2013

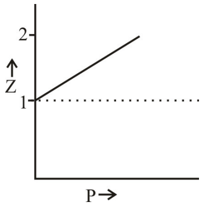
Ans. (a) : Dipole induced dipole interaction is present in the pair in which first species polar and the other is non polar (HCl and He atoms).

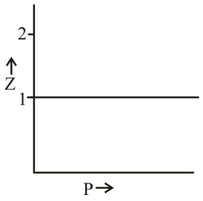
8. Behavior of Real Gases: Deviation From Ideal Gas Behavior

438. Which of the following indicates a plot of compressibility factor (Z) Vs P at room temperature for helium

(a)


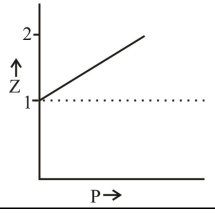
(b)


(c)


(d)


TS-EAMCET (Engg.), 07.08.2021 Shift-II

Ans. (c) : A graph of the compressibility factor (Z) vs. pressure (P) shows that gases can exhibit significant deviations from the behavior predicted by the ideal gas law. The graph of Z vs. P is given below–



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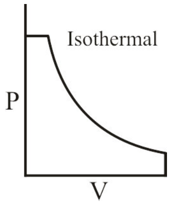
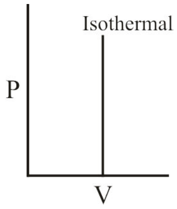
06.

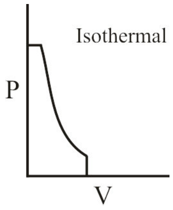
Thermodynamics

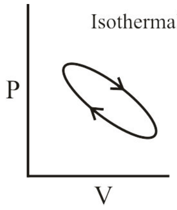
1. Thermodynamics terms

1. Which of the following p-V curve represents maximum work done?

(a)


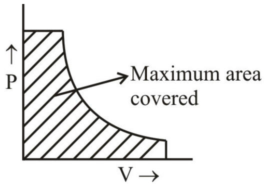
(b)


(c)


(d)


NEET-17.07.2022

Ans. (a) : Work done under any thermodynamics process can be determined by area under the P-V curve. Therefore the maximum area covered is–



2. $N_2(g)+3H_2(g) \rightleftharpoons 2NH_3(g)$

[ΔH = –93.6kJ]

The yield of ammonia does not increase when:

(a) Pressure is increased
(b) Pressure is decreased
(c) Temperature is lowered
(d) Volume of reaction vessel is decreased

CG PET-22.05.2022

Ans. (b) : In the reation,

$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g) \qquad [\Delta H = -93.6kJ]$

The yield of ammonia will increase when pressure is decreased because the decreasing of pressure will result in an increase in volume which shifts the equilibrium in the direction of increased volume i.e. backward.

3. Match List - I with List – II

List – I	List – II
(A) Spontaneous process	(I) $\Delta H < 0$
(B) Process with $\Delta P = 0, \Delta T = 0$	(II) $\Delta G_{T,P} < 0$
(C) $\Delta H_{reaction}$	(III) Isothermal and Isobaric process
(D) Exothermic Process	(IV) [Bond energies of molecules in reactants]-[Bond energies of product molecules]

Choose the correct answer from the option Given below:

(a) (A)-(III), (B)-(II), (C)-(IV), (D)-(I)
(b) (A)-(II), (B)-(III), (C)-(IV), (D)-(I)
(c) (A)-(II), (B)-(III), (C)-(I), (D)-(IV)
(d) (A)-(II), (B)-(I), (C)-(III), (D)-(IV)

JEE Main-27.06.2022, Shift-I

Ans. (b): Spontaneous process → $\Delta G < 0$
Process with $\Delta P = 0$, $\Delta T = 0$ → isobaric and isothermal process
$\Delta H_{reaction}$ → B.E. of reactants – B.E. of products
Exothermic → $\Delta H < 0$

4. Solubility of a gas in a liquid increases with

(a) increase of P and decrease of T
(b) decrease of P and decrease of T
(c) increase of P and increase of T
(d) decrease of P and increase of T

Karnataka CET-17.06.2022, Shift-II

Ans. (a) : The solubility of gases in liquids are affected by both temperature and pressure.
As temperature decrease and pressure increase solubility increases.
• The higher the pressure above a liquid, the more gas that can be dissolved in that liquid, to a limit of course.

5. The volume of 2.8g of CO at 27°C and 0.821 atm, pressure is $\left(R - 0.08210\ \text{lit.atm.K}^{-1}\text{mol}^{-1}\right)$

(a) 3 litres (b) 30 litres
(c) 0.3 litres (d) 1.5 litres

Karnataka CET-17.06.2022, Shift-II

Ans. (a) : Given that,

$$T = 27°C = 27 + 273 = 300K$$
$$R = 0.0821 \text{atm} K^{-1} \text{mol}^{-1}$$
$$P = 0.821 \ \text{atm}$$

Molecular mass of CO(M_{co}) = 12 + 16 = 28 g/mol

$$\text{No. of mole } (n) = \frac{W}{M} = \frac{2.8}{28} = 0.1 \text{ moles}$$

According to gas equation–

$$PV = nRT$$
$$\therefore \quad V = \frac{nRT}{P} = \frac{0.1 \times 0.0821 \times 300}{0.821} = 3\,L$$

6. For spontaneity of a cell, which is correct?

(a) $\Delta G = +ve, \Delta E = +ve$ (b) $\Delta G = -ve$
(c) $\Delta G = 0, \Delta E = 0$ (d) $\Delta G = -ve, \Delta E = 0$

Karnataka CET-17.06.2022, Shift-II

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Ans. (b) : The Gibbs free energy (G) related to the enthalpy and entropy of a system is given as–

$$\boxed{G = H - TS}$$

The free energy change (ΔG) is a measure of the spontaneity of a process and of the useful energy available from it.

$$\boxed{\Delta G_{Sys} = \Delta H_{Sys} - T\Delta S_{Sys}} \quad \boxed{\Delta G_{Sys} = -T\Delta S_{Univ.}}$$

$$\text{Therefore, } \Delta G < 0 \rightarrow \text{spontaneous process}$$

$$\Delta G > 0 \rightarrow \text{Non-spontaneous process}$$

$$\Delta G = 0 \rightarrow \text{Process at a equllibrium}$$

7. A rigid nitrogen tank stored inside a laboratory has a pressure of 30 atm at 06:00 am when the temperature is 27°C. At 03:00 pm, when the temperature is 45°C, the pressure in the tank will be — atm. [nearest integer]

JEE Main-25.06.2022, Shift-II

Ans. (32) : Given,

$$T_1 = 27°C = 27 + 273 = 300K$$

$$T_2 = 45 + 273 = 318K$$

$$P_1 = 30 \text{ atm}$$

At rigid nitrogen tank (Volume is constant)

$$\frac{P_1}{T_1} = \frac{P_2}{T_2}$$

$$\frac{30}{300} = \frac{P_2}{318}$$

$$P_2 = \frac{30 \times 318}{300} = 31.8 \text{ atm} \approx 32 \text{ atm}$$

8. At 25 °C 1 mole of butane upon heating forms CO_2 and H_2O. The work done is

(a) 75.6 L atm
(b) 85.6 L atm
(c) 50.3 L atm
(d) None of these

AIIMS 25 May 2019 (Morning)

Ans. (b): Given that,

$$C_4H_{10}(g) + \frac{13}{2}O_2(g) \rightarrow 4CO_2(g) + 5H_2O(l)$$

$$\because \quad \Delta n_g = 4 - \left(1 + \frac{13}{2}\right)$$

$$= 4 - 7.5$$

$$= -3.5$$

Work done, $W = -\Delta n_g RT$ .... (i)

Putting the value of Δn_g in equation (i)

$W = -(-3.5 \times 0.0821 \times 298)$

$W = 85.6$ L atm.

9. Consider the following statements:

Statement I : Mass, volume and pressure are extensive properties.

Statement II : Extensive properties depend upon the amount of the substance

Which one of the following is correct in respect of the above statements?

(a) Both the statements are true and statement II is the correct explanation of statement I
(b) Both the statement are true but statement II is not the correct explanation of statement I
(c) Statement I is true, but statement II is true
(d) Statement I is false, but statement II is true

SCRA-2015

Ans. (d): Extensive Properties– The properties depend on the mass of the system under consideration.

e.g. Mass, Internal energy, Enthalpy, Volume, Entropy etc.

Intensive Properties–These are the properties of the system which are independent of mass under consideration.

e.g. Pressure, Temperature, Density, Specific enthalpy etc.

10. Which of the following processes is associated with decrease in entropy?

(a) Vaporization of a mole of water into steam at its B.P.
(b) Dissociation of a mole of common salt in water at 300K
(c) Mixing of two partially miscible liquids
(d) Crystallization of a salt from its saturated solution

MPPET - 2012

Ans. (d) : Entropy is the measure of randomness. When randomness is more, entropy increases. Therefore when a liquid crystallises into solid, the molecules get arranged more orderly, hence randomness decreases. Thus the entropy also decreases.

11. At constant temperature and pressure, if ΔG < 0, the process is called

(a) isothermal
(b) non spontaneous
(c) spontaneous
(d) isobaric

(AP-EAMCET-1992)

Ans. (c) : ΔG gives a criteria for spontaneity at constant pressure and temperature.

(i) If ΔG is negative (< 0), the process is spontaneous.

(ii) If ΔG is positive (> 0), the process is non-spontaneous.

12. In which one of the following reactions does the heat change represent the heat of formation of water?

(a) $2H_2 + O_2 \rightarrow 2H_2O; \quad \Delta H = -116 \text{ kcal}$
(b) $H_2 + \frac{1}{2}O_2 \rightarrow H_2O; \quad \Delta H = -58 \text{ kcal}$
(c) $H^+ + OH^- \rightarrow H_2O; \Delta H = -13.7 \text{ kcal}$
(d) $C_2H_2 + 2\frac{1}{2}O_2 \rightarrow 2CO_2 + H_2O; \ \Delta H = -310 \text{kcal}$

(AP-EAMCET-1991)

Ans. (b) :

The reaction $H_2 + \frac{1}{2}O_2 \longrightarrow H_2O; \ \Delta H = -58 \text{ kcal}$

The above reaction represent the heat change of formation of water.

Heat of formation is the change in enthalpy, when one mole of a compound is formed from its constituent element in their standard state.

@apna_pdf

13. The reaction which proceeds with evolution of heat is called

(a) endothermic reaction
(b) exothermic reaction
(c) spontaneous reaction
(d) non spontaneous reaction

(AP-EAMCET-1993)

Ans. (b) : An exothermic reaction occurs when the temperature of a system increases due to the evolution of heat. An endothermic reaction occurs when the temperature of an isolated system decreases while the surroundings of a non-isolated system gains heat.

14. In the complete combustion of butanol $C_4H_9OH(l)$, if ΔH is enthalpy of combustion at constant pressure and ΔE is the heat of combustion at constant volume, then

(a) $\Delta H < \Delta E$
(b) $\Delta H = \Delta E$
(c) $\Delta H > \Delta E$
(d) $\Delta H, \Delta E$ relation cannot be predicted

(AP-EAMCET-1997)

Ans. (a) : The complete combustion of Butanol C_4H_9OH is–

$$C_4H_9OH(l) + 6O_2(g) \longrightarrow 4CO_2(g) + 5H_2O(l) + \text{Heat}$$

In the reaction, Δn_g(Δn_g = number of moles of gaseous product – no. of moles of gaseous reactant) is negative.

$\Delta n_g = 4 - 6 = -2$

$\Delta H = \Delta E + \Delta n_g RT$

$\Delta H = \Delta E - 2RT$

$\boxed{\Delta H + 2\,RT = \Delta E}$

$\therefore \boxed{\Delta E > \Delta H}$

15. Which of the following is an endothermic reaction?

(a) $N_2(g) + 3H_2(g) - 92\text{kJ} \rightarrow 2NH_3(g)$
(b) $N_2(g) + O_2(g) + 180.8\text{ kJ} \rightarrow 2NO(g)$
(c) $H_2(g) + Cl_2(g) \rightarrow 2HCl(g) + 184.6\text{ kJ}$
(d) $C_{(graphite)} + 2H_2(g) \rightarrow CH_4(g) + 74.8\text{kJ}$

AP-EAMCET-2004

Ans. (b): For the reaction-

$$N_2(g) + O_2(g) + 180.8\text{ kJ} \longrightarrow 2NO(g)$$

The endothermic reaction are those in which heat energy is absorbed. All the other reactions are exothermic as the heat is released during the process.

16. Which of the following options are correct?

Options	$\Delta H°$	$\Delta S°$	$\Delta G°$	Spontaneity of the reaction
A	+	+	+	Spontaneous at low T
B	+	+	–	Spontaneous at high T
C	–	–	–	Spontaneous at low T
D	+	–	+	Spontaneous at high T

(a) A,B,C only (b) B only
(c) B, C only (d) C, D only

TS-EAMCET (Engg.), 07.08.2021 Shift-II

Ans. (c) :

$\Delta H°$	$\Delta S°$	$\Delta G°$	Spontaneity of the reaction
–	+	–	Reaction spontaneous at all temperature
–	–	–	Reaction spontaneous at low temperature
+	+	–	Reaction spontaneous at high temperature

17. Consider the following :

$$Mg(s) + 2HCl(aq) \rightarrow MgCl_2(aq) + H_2(g)$$
$$\Delta H = -467\ kJmol^{-1}$$
$$MgO(s) + 2HCl(aq) \rightarrow MgCl_2(aq) + H_2O(l)$$
$$\Delta H = -151\ kJmol^{-1}$$
$$H_2(g) + \frac{1}{2}O_2(g) \rightarrow H_2O(l)$$

and given that for water,

$\Delta H_f^o = -286\ kJmol^{-1}$

What is ΔH_f^o for MgO (s)?

(a) –904 kJmol^{-1} (b) –602 kJmol^{-1}
(c) –334 kJmol^{-1} (d) –30 kJmol^{-1}

SCRA-2014

Ans. (b): The given reaction are :

$Mg(s) + 2HCl(aq) \rightarrow MgCl_2(aq) + H_2(g)$
$\Delta H = -467\ kJmol^{-1}$

$Mg(s) + 2HCl(aq) \rightarrow + MgCl_2(aq) + H_2O(l)$
$\Delta H = -151 kJmol^{-1}$

And, $H_2(g) + \frac{1}{2}O_2 \rightarrow H_2O(l)$ $\Delta H_f = -286 kJmol^{-1}$

Reaction 1 and reaction 3 need to propagate in forward direction and reaction 2 need to progress in backward direction.

$Mg(s) + 2HCl(aq) \rightarrow MgCl_2(aq) + H_2(g)$
$\Delta H = -467\ kJmol^{-1}$ .....(i)

$MgCl_2(aq) + H_2O(l) \rightarrow Mg(s) + 2HCl(aq)$
$\Delta H = +151\ kJmol^{-1}$ .....(ii)

$H_2(g) + \frac{1}{2}O_2 \rightarrow H_2O(l)$ $\Delta H = -286\ kJmol^{-1}$ .....(iii)

The net reaction is :

$$Mg(s) + \frac{1}{2}O_2 \rightarrow MgO(s)$$

The overall heat would be:

Heat of reaction-(i) + Heat of reaction-(ii) + Heat of reaction-(iii)

$\Delta H = -467 + 151 + (-286)$

$\Delta H = -602\ kJmol^{-1}$

18. An ideal gas at initial pressure p_i and volume V_i undergoes reversible expansion to the same volume V_f either isothermally or adiabatically. Consider the following statements :

1. P_f (adiabatic) < P_f (isothermal)
2. $|W \text{ (adiabatic)}| < |W \text{ (isothermal)}|$
3. T_f (adiabatic) < T_f (isothermal)
4. $|q \text{ (adiabatic)}| < |q \text{ (isothermal)}|$

(a) Only one (b) Only two
(c) only three (d) All

SCRA-2014

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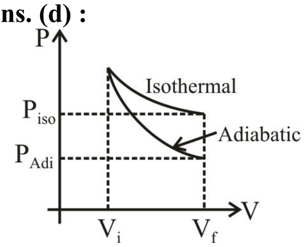
Ans. (d) :



$$\left(\frac{dP}{dV}\right)_{Adia.} > \left(\frac{dP}{dV}\right)_{Iso}$$

Pressure : $(P_f)_{isothermal} > (P_f)_{adiabatic}$

Workdone : Area under the P-V diagram.

$W_{isothermal} > W_{adiabatic}$

Heat : $W \propto q$

$q_{isothermal} > q_{adiabatic}$

Temperature : $T \propto P$

$T_{isothermal} > T_{adiabatic}$

19. $CaCO_3(s) \rightleftharpoons CaO(s) + CO_2(g)$, ΔH = 110 kJ

The pressure of CO_2.

(a) Increases on adding catalyst
(b) Decreases if T is raised
(c) Increases if T is raised
(d) Increases if inert gas is passed keeping T constant

MPPET-2013

Ans. (c) : $CaCO_3(s) \rightleftharpoons CaO(s) + CO_2(g)$

ΔH = 110 kJ (Endothermic reaction)

Positive value of the enthalpy change indicates that the reaction is endothermic.

∴ The forward reaction is favour by increasing temperature.

Thus, when the temperature is increased, more carbon dioxide is formed which increases the pressure of carbon dioxide until it reaches a constant value.

20. For the formation of $NH_3(g)$ from its constituent elements, the favourable conditions for its formation are

(a) High pressure and low temperature
(b) High pressure and high temperature
(c) Low pressure and high temperature
(d) Low pressure and low temperature

TS-EAMCET (Engg.), 07.08.2021 Shift-II

Ans. (a) $N_2 + 3H_2 \rightleftharpoons 2NH_3$[exothermic reaction]

$\Delta n = \Sigma\Delta n_p - \Sigma\Delta n_r = 2-(1+3) = -2$

Reaction proceed in such direction where number of mole decreases so for above reaction pressure will be more for more yield of NH_3. Since reaction is exothermic at low temperature reaction proceed in forward direction.

21. Which of the following substances has highest value of standard molar enthalpy of formation at 298 K ?

(a) NaF(s) (b) NaCℓ(s)
(c) NaBr(s) (d) NaI(s)

JEE Main-2019

Ans. (a) : Higher the stability of a substance, higher will be its standard molar enthalpy of formation value, $|\Delta_f H^o|$

Among the halides, F^- is smallest and I^- is largest in size. So, according to Fajan's rule, NaF is mostly ionic in nature.

NaI < NaBr < NaCl < NaF
→ Ionic in nature
→ Thermal stability

So, NaF has highest value of $|\Delta_f H^o|$.

22. In the reaction,

$$4NO_2(g) + O_2(g) \rightarrow 2N_2O_5(g), \ \Delta H = -111kJ$$

If $N_2O_5(s)$ is formed instead of $N_2O_5(g)$, the ΔH value in kJ is

$(\Delta H_{sublimation} \text{ for } N_2O_5 = 54\,kJ\,mol^{-1})$

(a) –165 (b) –57
(c) +219 (d) –219

AP EAMCET (Medical) - 2013

Ans. (d): Given that,

(i) $4NO_2(g) + O_2(g) \rightarrow 2N_2O_5(g), \Delta H = -111kJ\ mol^{-1}$

(ii) $N_2O_5(s) \longrightarrow N_2O_5(g), \Delta H = 54kJ\ mol^{-1}$

Reverse the reaction and multiplied by 2–

(iii) $2N_2O_5(g) \longrightarrow 2N_2O_5(s), \Delta H = 108kJ\ mol^{-1}$

subtracting eq^n. (iii) from (i), we get

$4NO_2(g) + O_2(g) \longrightarrow 2N_2O_5(s)$

then, ΔH = – 111 – 108
= – 219 kJ mol^{-1}

23. If, ΔH > 0 and ΔS > 0, the reaction can proceed spontaneously at ....

(a) low temperature
(b) high temperature
(c) all temperature
(d) will never be spontaneous

AP EAMCET (Engg.) 21.09.2020, Shift-I

Ans. (b) :

ΔH°	ΔS°	ΔG°	Spontaneity of the reaction
–	+	–	Reaction spontaneous at all temperature
–	–	–	Reaction spontaneous at low temperature
+	+	–	Reaction spontaneous at high temperature

24. For the formation of $NH_3(g)$ from its constituent elements at constant temperature and pressure, which of the following options is correct

(a) ΔH = 0 (b) ΔH = ΔU
(c) ΔH > ΔU (d) ΔH < ΔU

TS EAMCET 10.08.2021, Shift-II

Ans. (d) : For formation of $NH_3(g)$ from its constituent elements.

At constant temperature & pressure $\boxed{\Delta H < \Delta U}$

25. The change in internal energy equals ———

(a) Isothermal work (b) Isochoric work
(c) Isobaric work (d) Adiabatic work

AP EAPCET 25.08.2021, Shift-II

Ans. (d) : The change in internal energy of the system equals to the net heat transfer into the system.

ΔU = Q – W

@apna_pdf

The change in internal energy equals to adiabatic work. Because for adiabatic process heat transfer equals to zero so, $\Delta U = -W$

26. Molar heat capacity (C_p) of water at constant pressure is 75 $JK^{-1}mol^{-1}$. The increase in temperature (in K) of 100 g of water when 1 kJ of heat is supplied to it is

(a) 2.4 (b) 0.24
(c) 1.3 (d) 0.13

AP EAMCET (Engg.) - 2012

Ans. (a): $Q = nC_P\Delta T$

$$n = \frac{\text{Mass in gram}}{\text{Molecular weight}}$$

$$n_{H_2O} = \frac{100}{18}$$

$$1000J = \frac{100}{18} \times 75 \times \Delta T$$

$$\frac{18000}{100 \times 75} = \Delta T$$

$$\frac{180}{75} = \Delta T$$

$2.4 = \Delta T$

27. Which one the following is not a state function

(a) Enthalpy (b) Entropy
(c) Work (d) Free energy

AP EAMCET (Engg.) 17.09.2020, Shift-II
MPPET-2008

Ans. (c): A state function is describes the equilibrium state of a system.

- Entropy and free energy is a state function while work and heat is a path function.

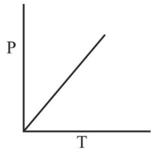
28. Isochores are drawn at ....

(a) constant volume, pressure vs temperature
(b) constant pressure, volume vs temperature
(c) constant temperature, pressure vs volume
(d) constant temperature, volume vs temperature

AP EAMCET (Engg.) 17.09.2020 Shift-I

Ans. (a) : Isochores are drawn at constant volume, $\Delta V=0$.

We get a plot of pressure (P) vs temperature (T in K) as;
For 1 mole of an ideal gas, PV = RT
Isochoric condition $P \propto T$



29. Which of the following is an extensive property?

(a) Temperature (b) Volume
(c) Density (d) Pressure

AP EAMCET (Engg.) 17.09.2020 Shift-I

Ans. (b) : Extensive properties are mass dependent, like volume, enthalpy etc.

Intensive properties are mass independent, like temperature, pressure and density.

30. What is the value of internal energy change (ΔE) at 27°C of a gaseous reaction $2A_2(g) + 5B_2(g) \rightarrow 2\ A_2B_5(g)$ (whose heat change at constant pressure is –50700 J) ? [$R = 8.314\ JK^{-1}\ mol^{-1}$]

(a) –50700 J (b) –63171 J
(c) –38229 J (d) +38229 J

SCRA - 2009

Ans. (c) : $2A_2(g) + 5B_2(g) \rightarrow 2A_2B_5(g)$

ΔH at $C_p = -50700\,J$

Gas constant (R) = 8.314 Joule $K^{-1}mol^{-1}$

We know that, $\boxed{\Delta H = \Delta E + \Delta n_g RT}$

$$\Delta E = \Delta H - \Delta n_g RT \qquad \left\{\begin{array}{l}\Delta n_g = 2-7 \\ \because \Delta n_g = -5\end{array}\right\}$$

$$\Delta E = -50700 - \{(-5) \times 8.314 \times 300\}$$

$$= -50,700 + 12,471 \qquad \left\{\begin{array}{l}T = 27°C \\ T = 27+273 \\ T = 300K\end{array}\right\}$$

$= -38,229\,J$

31. Among the following processes, for which process, the change in entropy (ΔS) is negative?

(a) Sublimation of iodine
(b) Freezing of water
(c) Burning of rocket fuel
(d) Dissolution of sugar

AP EAMCET (Engg.) 21.09.2020, Shift-II

Ans. (b) : When water freezes its entropy decreases. A negative change in entropy indicates that the disorder of an isolated system has decreased. When liquid water freezes into ice represents decrease in entropy because liquid particles are more disordered than solid particles. Hence, option (b) is correct.

32. Given ΔH_{f° for $CO_2(g)$, $CO(g)$ and $H_2O(g)$ are –393.5, –110.5 and –241.8 kJ mol^{-1}, respectively. The ΔH_{f° [in kJ mol^{-1}] for the reaction
$CO_2(g) + H_2(g) \rightarrow CO(g) + H_2O(g)$ is

(a) 524.1 (b) –262.5
(c) –41.7 (d) 41.2

TS EAMCET-2017

Ans. (d) : Given, $\Delta H^\circ_{f(CO_2)} = -393.5\,kJ/mole$

$$\Delta H^\circ_{f(CO)} = -110.5\,kJ/mole$$

$$\Delta H^\circ_{f(H_2O)} = -241.8\,kJ/mole$$

$$CO_2(g) + H_2(g) \rightarrow CO(g) + H_2O(g)$$

$$\therefore \Delta H^\circ_f = (\Delta H)_{products} - (\Delta H)_{reactunts}$$

$$= \left[\Delta H^\circ_{f(CO)} + \Delta H^\circ_{f(H_2O)}\right] - \left[\Delta H^\circ_{f(CO_2)}\right]$$

$$= -110.5 - 241.8 - (-393.5)$$

Or $\Delta H^\circ_f = 41.2\,kJ/mol^{-1}$

@apna_pdf

33. Calculate ΔH° for the reaction, $Na_2O(s)+SO_3(g)\rightarrow Na_2SO_4(g)$
Given the following:

(A) $Na(s)+H_2O(l)\rightarrow NaOH(s)+\frac{1}{2}H_2(g)$
$\Delta H^0=-146\,kJ$

(B) $Na_2SO_4(s)+H_2O(l)\rightarrow 2NaOH(s)+SO_3(g)$
$\Delta H^0=+418\,kJ$

(C) $2Na_2O(s)+2H_2(g)\rightarrow 4Na(s)+2H_2O(l)$
$\Delta H^0=+259\,kJ$

(a) + 823 kJ (b) – 581 kJ
(c) – 435 kJ (d) + 531 kJ

AP EAMCET (Engg.)-2009

Ans. (b):

$Na(s)+H_2O(l)\rightarrow NaOH(s)+\frac{1}{2}H_2(g);\ \Delta H_1^0=-146\,kJ$ ...(1)

$Na_2SO_4(s)+H_2O(l)\rightarrow 2NaOH(s)+SO_3(g);\ \Delta H_2^0=+418\,kJ$ ...(2)

$2Na_2O(s)+2H_2(g)\rightarrow 4Na(s)+2H_2O(g);\ \Delta H_3^0=+259\,kJ$ ...(3)

$Na_2O(s)+SO_3(g)\rightarrow Na_2SO_4(g)$ ... (4)

The required reaction equation can be obtained by

($\frac{1}{2}$ equation 3) + (equation 1× 2) – (equation 2)

$$\Delta H^o=\frac{+259}{2}+(-146)\times 2-(+418)=-580.5\approx -581\,kJ.$$

34. For strong acid and strong base neutralization net chemical change is
$H^++OH^-\rightarrow H_2O\ (l)\ \Delta H_r^0=-55.84\ kJ\ mol^{-1}$ If enthalpy of neutralization of CH_3COOH by NaOH is 49.86 kJ mol^{-1} then enthalpy of ionization of CH_3COOH is ___

(a) 5.98 kJ mol^{-1} (b) –5.98kJ mol^{-1}
(c) 105.7 kJ mol^{-1} (d) –59.8 kJ mol^{-1}

AP EAPCET 24.08.2021 Shift-II

Ans. (a) : The enthalpy of neutralization (ΔH_n) is the change in enthalpy that occurs when one equivalent of acid and base undergo neutralization reaction to form water and a salt given.

$H^++OH^-\longrightarrow H_2O(l)\quad \Delta H_r^o=-55.84\,kJ/mole$

$CH_3COOH+NaOH\longrightarrow CH_3COONa+H_2O$
$\Delta H_n=49.86\,kJ/mole$

So, enthalpy of ionization
$=-\Delta H_r^0-\Delta H_n$
= 55.84 – 49.86
= 5.98 kJ / mole

35. For the reaction $H_2O_{(l)}\longrightarrow H_2O_{(g)}$ at T = 100° and P = l atm. Choose the correct option:

(a) $\Delta S_{system}>0$ & $\Delta S_{surroundings}>0$
(b) $\Delta S_{system}>0$ & $\Delta S_{surroundings}<0$
(c) $\Delta S_{system}<0$ & $\Delta S_{surroundings}>0$
(d) $\Delta S_{system}<0$ & $\Delta S_{surroundings}<0$

AP EAPCET 20.08.2021 Shift-I

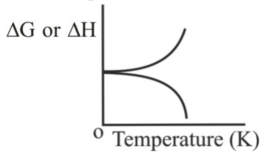
Ans. (b) : At 100° C and 1 atm.
$H_2O(l)\longrightarrow H_2O(g)$
For equilibrium.
$\Delta S_{total}=0$
And $\Delta S_{system}+\Delta S_{surrounding}=0$
$\Delta S_{system}>0$ and $\Delta S_{surrounding}<0$.

36. If a chemical reaction is known to be non-spontaneous at 298K but spontaneous at 350 k, then which among the following conditions is true for the reaction?

(a) ΔG = –ve, ΔH = –ve, ΔS = +ve
(b) ΔG = +ve, ΔH = +ve, ΔS = +ve
(c) ΔG = –ve, ΔH = +ve, ΔS = +ve
(d) ΔG = +ve, ΔH = +ve, ΔS = –ve

AP EAPCET 19-08-2021 Shift-I

Ans. (c) : ΔG = ΔH – TΔS —— (i)
ΔG must be – ve for a spontaneous reaction.



This graph depicted the value of ΔH is +ve
i.e. ΔG = –ve, ΔH = +ve putting these in equation— (i)
We get,

$\Delta S=\frac{1}{T}(\Delta H-\Delta G)=+ve$

So, the value of ΔS is also + ve.

37. When equal volumes of Helium and Neon at same temperature and pressure are mixed, the ratio $C_p:C_v$ of the mixture equals _____.

(a) 3 : 5 (b) 1 : 2
(c) 5 : 3 (d) 2 : 1

AP EAPCET 24.08.2021, Shift-I

Ans. (c) : Given, $V_{He}=V_{Ne}$
and $T_{He}=T_{Ne}$
then $C_p:C_v=?$
We can write the further relation –

$C_p=\frac{5}{2}nR$ and $C_v=\frac{3}{2}nR$

$$\therefore \frac{C_p}{C_v}=\frac{5}{2}nR\times\frac{2}{3nR}$$

$$\frac{C_p}{C_v}=\frac{5}{3}$$

38. Molar heat capacity (C_p) of water at constant pressure is 75 $J.K^{-1}$ mol^{-1}. The increase in temperature (in K) of 100 g of water when 1 kJ of heat is supplied to it is

(a) 2.4 (b) 0.24
(c) 1.3 (d) 0.13

AP EAMCET (Engg.) 2012

@apna_pdf

Ans. (a) : Given that,

$C_P = 75\ JK^{-1}mol^{-1}$

$\Delta H = 1000$

$n = \frac{100}{18}$

Molar heat capacity is the amount of heat required to raise the temperature of 1 mol of a substance by 1^o C.

$\therefore\ \Delta H = nC_p\Delta T$

$1000 = \frac{100}{18} \times 75 \times \Delta T$

$\Delta T = \frac{180}{75} = 2.4K$

39. An intensive property is

(a) boiling point (b) mass
(c) enthalpy (d) work.

COMEDK-2011

Ans. (a) : Boiling point does not depend upon the quantity of matter present in the system or size of the system.

40. The temperature of one mole of an ideal gas increases from 298 K when it absorbs 200 J of heat at constant volume. The change in the internal energy of the gas is

(a) 200 J (b) 140 J
(c) –200 J (d) –140 J

COMEDK-2012

Ans. (a) : Internal energy change is the heat evolved or absorbed at constant volume.

At constant volume, $\Delta V = 0$

Applying, $\Delta U = Q + W = Q + P\Delta V$

$\Delta U = Q + P \times 0 = Q$

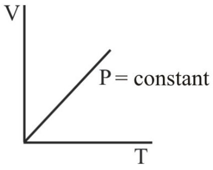
We get, $\Delta U = Q = 200J$

41. For all gases, at any given pressure, the graph of volume vs temperature (in celsius) is a straight line. This graph is called

(a) isomer (b) isochore
(c) isobar (d) isotherm

COMEDK-2014

Ans. (c) :



If, P = constant then process is called Isobar.

42. What will be the value of ΔG for ice at 8°C temperature?

(a) Zero (b) Positive
(c) Negative (d) One

GUJCET-2008

Ans. (b) : The value of ΔG for ice to 8°C temperature will be positive as at this temperature melting of ice is started. The melting of an ice is an equilibrium process, the value of ΔG for an equilibrium process is equal to zero (ΔG = 0).

43. For a chemical reaction $A + B \rightleftharpoons C + D$ ($\Delta_rH^o = 80\,kJ\,mol^{-1}$) the entropy change Δ_rS^o depends on the temperature T (in K) as ($\Delta_rS^o = 2T(JK^{-1}mol^{-1})$.

Minimum temperature at which it will become spontaneous is ______K. (Integer)

JEE Main 26.02.2021, Shift-I

Ans. (200) : Given, a chemical reaction

$A + B \rightleftharpoons C + D$

$\Delta_rH^o = 80kJ/mole$

$\Delta_rS^o = 2T(JK^{-1}mol^{-1})$

We know that,

$\Delta G° = \Delta H° - T\Delta S°$

$\Delta G° < 0$ (Spontaneous process)

$\Delta H° - T\Delta S° < 0$

$T > \frac{\Delta H°}{\Delta S°}$

$T > \frac{80 \times 10^3}{2T}$

$2T^2 > 80,000$

$T^2 > 40,000$

T>200

The minimum temperature to make it spontaneous is 200 K.

44. In conversion of lime-stone to lime, $CaCO_3(s) \rightarrow CaO(s) + CO_2\ (g)$ the values of ΔH^o and ΔS^o do not change with temperature, temperature are +179.1 kJmol^{-1} and 160.2 J/K respectively at 298K and 1 bar. Assuming that ΔH^o and ΔS^o above which conversion of limestone at lime will be spontaneous is

(a) 1118 K (b) 1008 K
(c) 1200 K (d) 845 K

AIIMS 25 May 2019 (Evening)

Ans. (a): $\Delta G^o = \Delta H^o - T\Delta S^o$

For spontaneous process, $\Delta G^o < 0$

$\therefore\ \Delta H^o - T\Delta S^o < 0$

$\therefore\ \frac{\Delta H^o}{\Delta S^o} < T$

$\therefore\ T > \frac{179.1 \times 1000}{160.2} K$

T > 1117.97 K

T = 1118 K

45. One mole of a non-ideal gas undergoes a change of state (2.0 atm, 3.0 L, 95 K) → (4.0 atm, 5.0 L, 245 K) with a change in internal energy, ΔU = 30.0 L atm. The change in enthalpy ΔH of the process in L atm is.

(a) 40.0
(b) 42.3
(c) 44.0
(d) Not defined because pressure is not constant

AIIMS 25 May 2019 (Evening)

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Ans. (c): Given

(2 atm, 3.0 L, 95 K) → (4 atm, 5.0L, 245 K)

Therefore, $P_1 = 2$ atm, $P_2 = 4$ atm

$V_1 = 3$ L, $V_2 = 5$L

$T_1 = 95$ K, $T_2 = 245$ K

$\Delta U = 30$ L atm

As we know that

$$\Delta H = \Delta U + (P_2V_2 - P_1V_1)$$

$$\therefore \Delta H = 30 + (4 \times 5 - 2 \times 3)$$

$$\Rightarrow \quad \Delta H = 30 + 14 = 44 \text{ L atm}$$

46. 1 mole of a diatomic gas is heated through isochoric process from 300 K to 500 K. The entropy is:

(a) 10.61 (b) 38.26

(c) 20.05 (d) 30

AIIMS 25 May 2019 (Evening)

Ans. (a): As we know that, for an isochoric process

$$\Delta S = C_V \ln\frac{T_2}{T_1}$$

For diatomic process

$$C_V = \frac{5}{2}R$$

Therefore, $\Delta S = \frac{5}{2}R \times \ln\frac{500}{300}$

$$\Delta S = \frac{5}{2} \times 8.314 \times (\ln 5 - \ln 3) = 10.61$$

47. Assertion: Air that quickly leaks out of a balloon becomes cooler.

Reason: The leaking air undergoes adiabatic expansion.

(a) If both Assertion and Reason are correct and Reason is the correct explanation of Assertion.

(b) If both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.

(c) If Assertion is correct but Reason is incorrect.

(d) If both the Assertion and Reason are incorrect.

AIIMS 26 May 2019 (Evening)

Ans. (a): When a system undergoes a change under the condition that no exchange of heat takes place between the system and surrounding, then such a process is called adiabatic process.

The leaking air of balloon undergoes adiabatic expansion. In this expansion, due to work done against external pressure.

Note : Adiabatic expansion such as bursting of tyre.

48. Assertion: U is state function.

Reason: T is an intensive property.

(a) If both Assertion and Reason are correct and Reason is the correct explanation of Assertion.

(b) If both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.

(c) If Assertion is correct but Reason is incorrect.

(d) If both the Assertion and Reason are incorrect.

AIIMS 26 May 2019 (Evening)

Ans. (b): U is state function because it depends only on the state of system independent of the path followed T is intensive property because it does not depend on the mass of the substance or system.

So, both assertion and reason are true but reason is not the correct explanation of assertion.

49. The correct relation is:

(a) $\Delta G = -RT \ln K/Q$ (b) $\Delta G = +RT \ln K$

(c) $\Delta G = -RT \ln Q/K$ (d) $\Delta G = +RT \ln Q$

AIIMS 25 May 2019 (Morning)

Ans. (a): $\Delta G = \Delta G^o + RT \ln Q$

At Equilibrium

$\Delta G = 0$

And $Q = K$

K → Equilibrium constant

At Equilibrium

$$0 = \Delta G^o + R \ln K$$

$$\Delta G^o = -RT \ln K$$

Now,

$$\Delta G = -RT \ln K + RT \ln Q$$

$$\Delta G = RT \ln \frac{Q}{K}$$

$$\Delta G = -RT \ln \frac{K}{Q}$$

50. Which of the following statement regarding entropy is correct?

(a) at absolute zero temperature, the entropy of all crystalline substances is taken to be zero

(b) at 0^oC, the entropy of all crystalline substances is taken to be zero

(c) at absolute zero temperature, entropy of a perfect crystalline substance is taken to be zero

(d) at 0^oC, the entropy of a perfect crystalline substance is taken to be zero

AIIMS-1994

Ans. (c): Correct statement regarding entropy is at about zero temperature the entropy of a perfect crystalline substances is taken to be zero.

51. Which of the following is a characteristic of a reversible reaction?

(a) It never proceeds to completion

(b) It can be influenced by a catalyst

(c) It proceeds only in forward direction

(d) number of moles of reactants and products are equal.

AIIMS-1996

Ans. (b): Reversible reactions always attain equilibrium and never go for completion. Reversible reactions, however a static equilibrium is not being established. In these most of the reactions when carried out in closed vessels do not go completion, under a given set of conditions of temperature and pressure because reversible reaction are occurs in closed vessel's mostly.

52. Assertion: Addition of Q and W give ΔU

Reason: Addition of two path function cannot give state function.

(a) If both Assertion and Reason are correct and the Reason is the correct explanation of Assertion.

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(b) If both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.
(c) If Assertion is correct but Reason is incorrect.
(d) If both the Assertion and Reason are incorrect.

AIIMS-27 May, 2018 (M)

Ans. (c): According to first law of Thermodynamics –
$\Delta U = Q + W$
Internal energy is a state function but Q and W are path functions.
- When the two path functions are combined to form state function.

53. Assertion: In Free expansion, $\Delta U = 0$
Reason: No work is done is free expansion.
(a) If both Assertion and Reason are correct and the Reason is the correct explanation of Assertion.
(b) If both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.
(c) If Assertion is correct but Reason is incorrect.
(d) If both the Assertion and Reason are incorrect.

AIIMS-27 May, 2018 (M)

Ans. (b): Both are true but unrelated. At constant volume work done is also-zero.

54. Assertion: When ideal gas expand from P_1,V_1,T_1 to P_2, V_2, T_2 in multiple steps, work done is high where number of steps are high.
Reason: Work is path function.
(a) If both Assertion and Reason are correct and the Reason is the correct explanation of Assertion.
(b) If both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.
(c) If Assertion is correct but Reason is incorrect.
(d) If both the Assertion and Reason are incorrect.

AIIMS-26 May, 2018 (M)

Ans. (b): When ideal gas expand from two steps, and work done is high in which number of steps are high.

$$\boxed{W = PdV}$$

55. Assertion: Entropy of ice is less than water.
Reason: Ice has cage like structure.
(a) If both Assertion and Reason are correct and the Reason is correct explanation of the Assertion.
(b) If both Assertion and Reason are correct but Reason is not a correct explanation of the Assertion.
(c) If the Assertion is correct but Reason is incorrect.
(d) If both the Assertion and Reason are incorrect.
(e) If the Assertion is incorrect but the Reason is correct.

AIIMS-2000

Ans. (b): Entropy of ice is less than water because water molecules in solid state lose kinetic energy and hence their tendency of movement is minimized. Hence, entropy decreases in solid state. The reason that ice have cage like structure is also correct but reason is not a correct explanation of the assertion.
Entropy – gas > liquid > solid

56. Assertion : During an adiabatic process, heat energy is not exchanged between system and its surroundings.
Reason: The temperature of a gas increases when it undergoes and adiabatic expansion.
(a) If both Assertion and Reason are correct and the Reason is correct explanation of the Assertion.
(b) If both Assertion and Reason are correct but Reason is not a correct explanation of the Assertion.
(c) If the Assertion is correct but Reason is incorrect.
(d) If both the Assertion and Reason are incorrect.
(e) If the Assertion is incorrect but the Reason is correct.

AIIMS-2002

Ans. (c): For an adiabatic process, Q = 0
$TV^{\gamma-1}$ = constant, for adiabatic process In an adiabatic expansion, temperature may increase or decrease depending upon the value of γ.

57. Assertion: Mass and volume are extensive properties.
Reason: Mass/ volume is also an extensive parameter.
(a) If both Assertion and Reason are correct and the Reason is correct explanation of the Assertion.
(b) If both Assertion and Reason are correct but Reason is not a correct explanation of the Assertion.
(c) If the Assertion is correct but Reason is incorrect.
(d) If both the Assertion and Reason are incorrect.
(e) If the Assertion is incorrect but the Reason is correct.

AIIMS-2002

Ans. (c): Mass and volume are extensive properties mass/volume is not an extensive parameter.
Because mass/volume are density. Density does not depend on mass.

58. Assertion: Absolute values of internal energy of substances cannot be determined.
Reason: It is impossible to determine exact values of constituent energies of the substances.
(a) If both Assertion and Reason are correct and the Reason is correct explanation of the Assertion.
(b) If both Assertion and Reason are correct but Reason is not a correct explanation of the Assertion.

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(c) If the Assertion is correct but Reason is incorrect.
(d) If both the Assertion and Reason are incorrect.
(e) If the Assertion is incorrect but the Reason is correct.

AIIMS-2002

Ans. (a): It is impossible to determine the absolute values of energy therefore internal energy of substances is relatives and thus absolute value cannot be determined.

$$\boxed{\Delta E = C_v dT}$$

59. Assertion: The increase in internal energy (ΔE) for the vaporization of one mole of water at 1 atm and 373 K is zero.

Reason: For all isothermal processes, ΔE=0

(a) If both Assertion and Reason are correct and the Reason is correct explanation of the Assertion.
(b) If both Assertion and Reason are correct by Reason is not a correct explanation of the Assertion.
(c) If the Assertion is correct but Reason is incorrect.
(d) If both the Assertion and Reason are incorrect.
(e) If the Assertion is incorrect but the Reason is correct.

AIIMS-2003

Ans. (a): The increase in internal energy for the vaporization of one mole of water at 1atm and 373K is zero is true and for all isothermal process internal energy is zero.

At Isothermal → $\Delta H = 0$

$\Delta E = 0$

$\Delta T = 0$

60. Assertion: ΔH and ΔE are almost same for the reaction $N_2(g) + O_2(g) \rightleftharpoons 2NO(g)$

Reason: All reactants and products are gases.

(a) If both Assertion and Reason are correct and the Reason is correct explanation of the Assertion.
(b) If both Assertion and Reason are correct by Reason is not a correct explanation of the Assertion.
(c) If the Assertion is correct but Reason is incorrect.
(d) If both the Assertion and Reason are incorrect.
(e) If the Assertion is incorrect but the Reason is correct.

AIIMS-2003

Ans. (b): $\Delta H = \Delta E + \Delta nRT$

If there is no change in the moles of reactants (gaseous) and products (gaseous)

$\Delta n = 2 - (1 + 1) = 0$

$\therefore \Delta H = \Delta E$

All reactant and product are gases but this is not reason for $\Delta H = \Delta E$.

61. Assertion: Molar enthalpy of vaporization of water is different from ethanol.

Reason: Water is more polar than ethanol.

(a) If both Assertion and Reason are correct and the Reason is correct explanation of the Assertion.
(b) If both Assertion and Reason are correct by Reason is not a correct explanation of the Assertion.
(c) If the Assertion is correct but Reason is incorrect.
(d) If both the Assertion and Reason are incorrect.
(e) If the Assertion is incorrect but the Reason is correct.

AIIMS-2004

Ans. (b): Molar heat of vaporization of water is more than alcohol due to which large amount of energy is required to break H-bond in H_2O. It is also true that H_2O is more polar than alcohol.

Water have higher dielectric constant than ethanol that's why water is more polar.

62. Assertion: Water in liquid state is more stable than ice at room temperature

Reason: Water in liquid form has higher entropy than ice.

(a) If both Assertion and Reason are correct and the Reason is correct explanation of the Assertion.
(b) If both Assertion and Reason are correct by Reason is not a correct explanation of the Assertion.
(c) If the Assertion is correct but Reason is incorrect.
(d) If both the Assertion and Reason are incorrect.
(e) If the Assertion is incorrect but the Reason is correct.

AIIMS-2006

Ans. (a): At room temperature water is more stable and ice will tend to melt at room temp. $\Delta S = \frac{\Delta Q}{T} = \frac{mL}{T}$

which is positive entropy of an amount of ice at 0^oC is less than the entropy of the same amount (mass) of H_2O at 0^oC. At room temperature ice are melted this is the reason ice are unstable.

63. Assertion: When a salt such as NaCl dissolves, the Na^+ and Cl^- ions leaving the crystal lattice acquire far greater freedom.

Reason: In thermodynamic terms, the formation of solution occurs with a favorable change in free energy, i.e., ΔH has a high positive value and TΔS a low negative value.

(a) If both Assertion and Reason are correct and the Reason is correct explanation of the Assertion.
(b) If both Assertion and Reason are correct by Reason is not a correct explanation of the Assertion.
(c) If the Assertion is correct but Reason is incorrect.

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(d) If both the Assertion and Reason are incorrect.
(e) If the Assertion is incorrect but the Reason is correct.

AIIMS-2007

Ans. (c): NaCl are strongly bonded due to electrostatic attraction. As it is dissolved in solvent in thermodynamics terms formation of solution occurs with a favourable change in ΔG, ΔG is negative for dissolution of salt. It $\Delta G < 0$ it is spontaneous process.

64. Assertion: Many endothermic reactions that are not spontaneous at room temperature become at high temperature.

Reason: Entropy of the system increase with increase in temperature.

(a) If both Assertion and Reason are correct and the Reason is the correct explanation of Assertion.
(b) If both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.
(c) If Assertion is correct but Reason is incorrect.
(d) If both the Assertion and Reason are incorrect.

AIIMS-2012

Ans. (c): $\Delta G = \Delta H - T\Delta S$

ΔH is +ve for endothermic process

For spontaneous process $\Delta G < 0$

$\therefore\ \Delta H - T\Delta S < 0$

i.e. $\Delta H < TS$

$\Delta G = 0$ At equilibrium

Entropy of the system also increases with increase in temperature but only slightly.

65. Assertion : For an isothermal reversible process $Q = -W$ i.e. work done by the system equals to the heat absorbed by the system.

Reason: Enthalpy change (ΔH) is zero for isothermal process.

(a) If both Assertion and Reason are correct and the Reason is the correct explanation of Assertion.
(b) If both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.
(c) If Assertion is correct but Reason is incorrect.
(d) If both the Assertion and Reason are incorrect.

AIIMS-2011,2013

Ans. (b): For an isothermal process change in internal energy (ΔE) is zero (as it is a function of temperature).

According to first law of thermodynamics

$$Q + W = \Delta E$$

Hence, $Q = -W$ (if $\Delta E = 0$)

If a system undergoes a change in which internal energy of the system remains constant (i.e. $\Delta E = 0$) then $-W = Q$.

This mean that work done by the system is equal to the heat absorbed by the system.

66. What is entropy change is 2 mol N_2, when its temperature is taken from 400 K to 800 K, adiabatically

(a) $30\frac{J}{K}$ (b) $60\frac{J}{K}$
(c) $40\frac{J}{K}$ (d) $20\frac{J}{K}$

AIIMS-27 May, 2018 (M)

Ans. (c): $\Delta S = nC_p \ln\frac{T_2}{T_1}$

C_v (for diatomic) $= \frac{5}{2}R$

$C_p = C_v + R$

$C_p = \frac{5}{2}R + R = \frac{7}{2}R$

$$\Delta S = 2\times\frac{7}{2}\times R\times\ln\frac{800}{400}$$

$$= 2\times\frac{7}{2}\times R\times\ln 2$$

$$= 7\times 8.314\times\ln 2$$

$$= 40.33$$

$$\simeq 40\ J/K$$

67. Which of following factor always increases for spontaneous process?

(a) ΔS (b) ΔH
(c) $\Delta H - T\Delta S$ (d) $\Delta S - \frac{\Delta H}{T}$

AIIMS-26 May, 2018 (M)

Ans. (d): For spontaneous process-

$\Delta G = -ve$

$\Delta G = \Delta H - T\Delta S$

Entropy of universe always increases

$$-\frac{\Delta G}{T} = \Delta S_{total} = \Delta S - \frac{\Delta H}{T}$$

68. Which of the following are extensive properties?

(a) V & E (b) V & T
(c) V & C_p (d) P and T

AIIMS-26 May, 2018 (M)

Ans. (a): The volume of any matter or substance depends on the mass or amount. Thus, volume is considered as an extensive property V & E are extensive in nature.

69. The ΔH_f° for CO_2 (g), CO(g) and H_2O(g) are–393.5, –110.5 and –241.8 kJ/mol respectively, the standard enthalpy change (in kJ) for the reaction

$CO_2(g) + H_2(g) \rightarrow CO(g) + H_2O(g)$ is

(a) 524.1 (b) 41.2
(c) –262.5 (d) –41.2

AIIMS-2013, 2017

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Ans. (b): $\Delta H = \Sigma H_f^\circ$ (product) – ΣH_f° (reactants)

$=[\Delta H_f^\circ(CO) + \Delta H_f^\circ(H_2O)] - [\Delta H_f^\circ(CO_2) + \Delta H_f^\circ,(H_2)]$

$=[-110{\cdot}5-241{\cdot}8] - [-393{\cdot}5+0]$

$= -352{\cdot}3 + 393{\cdot}5$

$= +41{\cdot}3$ kJ/mol

70. Choose the reaction in which ΔH is not equal to ΔU?

(a) $C_{(graphite)} + O_2(g) \rightarrow CO_2(g)$

(b) $C_2H_4(g) + H_2(g) \rightarrow C_2H_6(g)$

(c) $2C_{(graphite)} + H_2(g) \rightarrow C_2H_2(g)$

(d) $H_2(g) + I_2(g) \rightarrow 2HI(g)$

AIIMS-2016

Ans. (b): We know that

$\Delta H = \Delta U + \Delta n_g RT$

If $\Delta n_g = 0$ then $\Delta H = \Delta U$

Where, $\Delta n_g = n_P - n_R$

n_P = no. of moles of gaseous products

n_R = no. of moles of gaseous reactants

So,

(a) $C_{(graphite)} + O_2(g) \rightarrow CO_2(g)$

$\Delta n_g = n_P - n_R = 1 - 1 = 0$

(b) $C_2H_4(g) + H_2(g) \rightarrow C_2H_6(g)$

$\Delta n_g = n_P - n_R = 1 - 2 = -1$

(c) $2C_{(graphite)} + H_2(g) \rightarrow C_2H_2(g)$

$\Delta n_g = n_P - n_R = 1 - 1 = 0$

(d) $H_2(g) + I_2(g) \rightarrow 2HI(g)$

$\Delta n_g = n_P - n_R = 2 - 2 = 0$

So, in option (b) $\Delta H \neq \Delta U$

71. Which of the following condition favour the reduction of a metal oxide to metal?

(a) $\Delta H = +ve, T\Delta S = +ve$ at low temperature

(b) $\Delta H = +ve, T\Delta S = -ve$ at low temperature

(c) $\Delta H = -ve, T\Delta S = -ve$ at low temperature

(d) $\Delta H = -ve, T\Delta S = +ve$ at any temperature

AIIMS-2012

Ans. (d): $\Delta G = \Delta H - T\Delta S$ ($\Delta G < 0$ – Spontaneous Process) for the reduction of a metal oxide, ΔG value must be negative and this can only achieved all possibilities of ΔH and TΔS values, when the ΔH = –ve and TΔS = +ve at any temperature.

72. What is the enthalpy change for, $2H_2O_2(l) \rightarrow 2H_2O(l) + O_2(g)$ if heat of formation of H_2O_2 (*l*) and $H_2O(l)$ are–188 and –286kJ/mol respectively?

(a) –196kJ/mol (b) +948kJ/mol

(c) +196kJ/mol (d) –948kJ/mol

AIIMS-2014

Ans. (a): Given, the reaction is–

$2H_2O_2(l) \rightarrow 2H_2O(l) + O_2(g)$

ΔH_f $H_2O_2(l) = -188$ kJ/mol

ΔH_f $H_2O(l) = -286$ kJ/mol

For 2 moles $H_2O_2 = 2 \times -188 = -376$ kJ/mol

For 2 moles of $H_2O = 2 \times -286 = -572$ kJ/mol

$\Delta H_r = -572 - (-376)$

$= -196$ kJ/mol

73. Enthalpy of formation of HF and HCl are –161kJ and –92kJ respectively. Which of the following statements is incorrect?

(a) HCl is more stable than HF.

(b) HF and HCl are exothermic compounds.

(c) The affinity of fluorine to hydrogen is greater than the affinity of chlorine to hydrogen.

(d) HF is more stable than HCl.

AIIMS-2010

Ans. (a): Enthalpy of formation of HF is more than the Enthalpy of formation of HCl. So, HF is more stable than HCl. Formation of HF and HCl are Exothermic.

74. Which of the following processes takes place with decrease of entropy?

(a) Solid →gas

(b) sugar + water → solution

(c) $NH_3(g)+HCl(g) \rightarrow NH_4\,Cl(s)$

(d) A(g)+ B(g) → mixture

AIIMS-2011

Ans. (c): The structure of a solid is generally organised and liquid are less organised and gas are random in nature.

$NH_3(g) + HCl(g) \rightarrow NH_4Cl(s)$

NH_4Cl are well organised

Thus, the entropy decreases.

75. For the reaction, $2Cl(g) \rightarrow Cl_2(g)$, the signs of ΔH and ΔS respectively, are:

(a) +,– (b) +,+

(c) –,– (d) –,+

AIIMS-2010

Ans. (c): $2\,Cl(g) \rightarrow Cl_2(g)$

For the given reaction, entropy is decreasing (–ve) in the reaction. Also the reaction is exothermic due to the bond formation so, ΔH is also –ve.

76. When a solid melts reversibly

(a) H decreases (b) G increase

(c) E decreases (d) S increase

AIIMS-2009

Ans. (d): When a solid melts, its entropy (S) increases because on change from solid to liquid, randomness increases.

77. ΔH_{fusion} of a substance is 'x' and ΔH_{vap} is 'y', then $\Delta H_{sublimation}$ will be

(a) x+y (b) x–y

(c) x/y (d) y/x

AIIMS-2007

Ans. (a):

$$\begin{tikzcd}
\text{Solid} \arrow[r, "\Delta H_{fusion}"] \arrow[rr, bend right, "\Delta H_{sub}"'] & \text{Liquid} \arrow[r, "\Delta H_{Vap}"] & \text{Vapour}
\end{tikzcd}$$

$\Delta H_{sub} = \Delta H_{fus} + \Delta H_{vap} = x + y$

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78. **ΔS_{surr} for an exothermic reaction is**
(a) always positive
(b) always negative
(c) zero
(d) may be positive or negative

AIIMS-2007

Ans. (a): $\Delta S_{surrounding}$ for an exothermic reaction is always positive. In exothermic process, heat released by the reaction, increases the entropy of the surrounding. The overall entropy changes is certainly positive when the entropy of the system is positive. In some exothermic reactions, entropy of the system may decrease. If reaction is highly exothermic and increase in entropy of the surrounding is very high. The total entropy change will be positive.

79. **For a spontaneous process, the correct statement is :**
(a) Entropy of the system always increases.
(b) Free energy of the system always increases.
(c) Total entropy change is always negative.
(d) Total entropy change is always positive.

AIIMS-2006

Ans. (d): $\Delta S_{total} = \Delta S_{system} + \Delta S_{surroundings}$
For a spontaneous process, the ΔS_{total} must be positive i.e. $\Delta S_{total} > 0$ Total entropy change is always positive.

80. **For a phase change,**

$$\mathrm{H_2O}(l)\xrightleftharpoons{0^\circ\mathrm{C},\ 1\mathrm{bar}}\mathrm{H_2O}(s)$$

(a) $\Delta G = 0$ (b) $\Delta S = 0$
(c) $\Delta H = 0$ (d) $\Delta U = 0$

AIIMS-2006

Ans. (a): A system at equilibrium has ΔG equal to zero (the free energy change), ΔG is neither positive nor negative because process at equilibrium has a zero free energy change. At phase change ΔG are also zero.
$\Delta G = -RT\ln K$
ΔG = standard free energy
K = equation constant

81. **Which one of the following has ΔS^o greater than zero?**
(a) $\mathrm{CaO(s) + CO_2(g) \rightleftharpoons CaCO_3(s)}$
(b) $\mathrm{NaCl(aq) \rightleftharpoons NaCl(s)}$
(c) $\mathrm{NaNO_3(s) \rightleftharpoons Na^+(aq) + NO_3^-(aq)}$
(d) $\mathrm{N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)}$

AIIMS-2003

Ans. (c): We know that, in transition from solid state to liquid state, entropy increases. Hence, the value of ΔS will be greater than zero for the reaction.
$\mathrm{NaNO_3(s) \rightleftharpoons Na^+(aq) + NO_3^-(aq)}$
ΔS > 0 Mean's positive entropy.

82. **In the exothermic reaction, the enthalpy of reaction is always:**
(a) zero (b) positive
(c) negative (d) None of these

AIIMS-2001

Ans. (c) : Exothermic reactions are reactions or process that release energy, usually in the form of heat or light. In an exothermic reaction, energy is released because the total energy of the products is less than the total energy of the reactants. A system that releases heat to the environment, and chemical reaction, features a negative ΔH by convention, because the enthalpy of the products is less than the enthalpy of the reactants of the system.
Exothermic Reactions are energy liberating process. $\Delta H = \Sigma H_{product} - \Sigma H_{reactant}$ Mean's ΔH = Negative

83. **One mole of an ideal gas for which $C_v=(3/2)R$ is heated reversibly at a constant pressure of 1 atm from 25°C to 100° C. The ΔH is:**
(a) 3.75 cal (b) 37.5 cal
(c) 375 cal (d) 3725.0 cal

AIIMS-2000

Ans. (c): We know that,
$\Delta H = \Delta U + P\Delta V$ .....(i)
To find ΔU,
$\Delta U = C_v \times (T_2 - T_1)$ for 1 mole gas
$$\Delta U = \frac{3}{2}R \times (75)$$
Put this value in (i),
$$\Delta H = \left(\frac{3}{2} \times R \times 75\right) + (R \times 75)$$
$$\Delta H = \frac{5}{2} \times R \times 75$$
$\Delta H = 372.56$ cal (Take R = 1.987 cal)
$\Delta H \approx 375$ cal

84. **Enthalpy of neutralisation of CH_3COOH by NaOH is –50.6kJ/mol and the heat of neutralisation of a strong acid with NaOH is –55.9kJ/mol. The value of ΔH for the ionisation of CH_3COOH is:**
(a) 3.5kJ/mol (b) 4.6 kJ/mol
(c) 5.3 kJ/mol (d) 6.4 kJ/mol

AIIMS-2000

Ans. (c): Net ionic reaction for neutralization of strong acid and NaOH is
$\mathrm{H^+ + OH^- \rightarrow H_2O}$; -55.9 kJ/mol
For neutralization of acetic acid is
$\mathrm{CH_3COOH + OH^- \rightarrow CH_3COO^- + H_2O}$; –50.6 kJ/mol
Since the total reaction has an enthalpy change of –55.9 kJ/mol. The heat of ionisation must be equal to the difference between the value.
heat of ionisation = – 50.6 – (–55.9) kJ/mol
= 5.3 kJ/mol

85. **The internal energy of a substance:**
(a) increases with increase in temperature
(b) decreases with increase in temperature
(c) remains unaffected with temperature
(d) can be calculated by the equation, $E=mc^2$

AIIMS-2001

Ans. (a): Internal energy of a substance increase with increases in temperature due to increase in rotational, translational and vibrational energy of the molecule.
Internal energy is the function of temperature.
$\Delta U = nC_v\Delta T$

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86. Combustion of glucose takes place according to the equation:

$$C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O, \Delta H = -72\,kcal$$

The energy required for production of 1.6 g of glucose is (molecular mass of glucose is 180g)

(a) 0.064 kcal (b) 0.64 kcal
(c) 6.4 kcal (d) 64 kcal

AIIMS-1998

Ans. (b): Molecular mass of $C_6H_{12}O_6$ = 180 g mol^{-1}

$\because$ 180 g of glucose require energy = 72 kcal

$\therefore$ 1.6 g of glucose required energy $= \frac{72 \times 1.6}{180}$

= 0.64 kcal.

87. For a spontaneous process, entropy:

(a) Increases (b) Decreases
(c) Unchanged (d) Not clear

AIIMS-1998

Ans. (a): $-\Delta G = -\Delta H + T\Delta S$ ($\Delta G = \Delta H - T\Delta S$)
The spontaneity of the process appears to be associated with a highly ordered system going to a less–ordered, uniform state. The more disordered a state, the larger its entropy. Therefore, entropy should be increases.

88. Internal energy does not include:

(a) Rotational energy
(b) Nuclear energy
(c) Vibrational energy
(d) Energy due to gravitational pull

AIIMS-1999

Ans. (d): Every substance is associated with definite amount of energy which depends upon chemical nature. The energy stored within a substance is called its internal energy. It is total energy of a substance depending upon its chemical nature, temperature, pressure, volume and amount of substances. Internal energy does not includes gravitational energy translational energy, rotational energy, vibrational energy and bond energy.
Because Internal Energy is the function of temperature only for ideal gas.

89. At a constant volume the specific heat of a gas is 0.075 and its molecular weight is 40. The gas is :

(a) Monoatomic (b) Diatomic
(c) Triatomic (d) None of these

AIIMS-1998

Ans. (a): Molar heat capacity at constant volume,
C_v = specific heat at constant volume × mol.wt.
= 0.075 × 40 = 3.0 cal (Monoatomic > Diatomic)

$\because C_p - C_v = R$

or $C_p = R + C_v = 2 + 3 = 5$

Now, $\frac{C_p}{C_v} = \gamma$

$\therefore \quad \gamma = \frac{5}{3} = 1.66$

This value shows that the gas is monoatomic.

90. The enthalpy change of a reaction does not depend on:

(a) initial and final enthalpy change of reaction.
(b) state of reactants and products.
(c) different intermediate reactions.
(d) nature of reactants and products.

AIIMS-1997

Ans. (c): Enthalpy change is a state function so it does not depend on the path taken by the reaction, it depends only on the difference of final and initial value of enthalpy change.
$\Delta H = 0$, $\Delta H = nC_p\Delta T$
State function only depend on initial and final State.

91. Calculate the entropy change in melting 1 mole of ice at 273K, $\Delta H_f^o = 6.025\,kJ/mole$ -

(a) 11.2 JK^{-1} mol^{-1} (b) 22.2 JK^{-1} mol^{-1}
(c) 15.1 JK^{-1} mol^{-1} (d) 5.1 JK^{-1} mol^{-1}

VITEEE-2019

Ans. (b) : Change entropy,

$$\Delta S_f = \frac{\Delta H_f}{T} = \frac{6025\,jmol^{-1}}{273K} = 22.04 \simeq 22.2\,J/mol\,K$$

92. For the reaction

$$H_2(g) + \frac{1}{2}O_2(g) \rightarrow H_2O(l), \Delta H = -285.8\,kJ\,mol^{-1}$$

$$\Delta S = -0.163\,kJ\,mol^{-1}K^{-1}$$

What is the value of free energy change at 27°C for the reaction ?

(a) –236.9 kJ mol^{-1} (b) –281.4 kJ mol^{-1}
(c) –334.7 kJ mol^{-1} (d) +334.7 kJ mol^{-1}

Ans. (a) : Given,

$$H_2(g) + \frac{1}{2}O_2(g) \rightarrow H_2O(l)$$

$\Delta H = -285.8$ kJ/mole

$\Delta S = -0.163$ kJ/mole

$\therefore \quad \Delta G = \Delta H - T\Delta S$

$\Delta G = -285.8 + 300 \times 0.163$

$\Delta G = -236.97$ kJ/mole

93. In a closed insulated container, a liquid is stirred with a paddle to increase its temperature. In this process, which of the following is true?

(a) $\Delta E = W = Q = 0$ (b) $\Delta E \neq 0, Q = W = 0$
(c) $\Delta E = W \neq 0, Q = 0$ (d) $\Delta E = Q \neq 0, W = 0$

VITEEE-2019

Ans. (c) : According to Ist Law of Thermodynamic

q = ΔE + W
E = change in internal energy
W = work done on system

Since system is closed and insulated, q = 0
Paddle work is done on system.
Hence internal energy of the system is increases.

$\therefore \quad \Delta E = W \neq 0$

94. The values of ΔH and ΔS for the reaction, C(graphite) +CO_2(g) → 2CO(g) are 170 kJ and 170 JK^{-1}, respectively. This reaction will be spontaneous at

@apna_pdf

(a) 910 K (b) 1000 K
(c) 510 K (d) 710 K

AIPMT-2009

Ans. (b) : Given–

$\Delta H = 170$ kJ

$\Delta S = 170\ JK^{-1}$

T = ?

Now, $\Delta G = \Delta H - T\Delta S$ (at equilibrium $\Delta G = 0$)

$\therefore$ $\Delta H = T\Delta S$

or $T = \frac{\Delta H}{\Delta S}$, $T = \frac{170}{170 \times 10^{-3}}$

T = 1000 K

Therefore, this reaction is spontaneous at this temperature.

95. Calculate enthalpy change for the change $8S(g) \rightarrow S_8(g)$, given that
$H_2S_2(g) \rightarrow 2H(g) + 2S(g)$, $\Delta H = 239.0$ k cal mol^{-1}
$H_2S_2(g) \rightarrow 2H(g) + S(g)$, $\Delta H = 175.0$ k cal mol^{-1}

(a) + 512.0 k cal (b) – 512.0 k cal
(c) 508.8 k cal (d) – 508.0 k cal

VITEEE-2018

Ans. (b) : Given that-

$$H_2S_2(g) \rightarrow 2H(g) + 2S(g) \quad \Delta H = 239.0\,k\,cal\,mol^{-1}$$

$$H_2S_2(g) \rightarrow 2H(g) + S(g) \quad \Delta H = 175.0\,k\,cal\,mol^{-1}$$

$\Delta H_{S-S} + 2\Delta H_{H-S} = 239$

And $2\Delta H_{H-S} = 175$

Hence, $2\Delta H_{S-S} = 239 - 175 = 64$ k cal mol^{-1}

Then, ΔH for $8S(g) \rightarrow S_8(g)$ is

$8 \times (-64) = -512$ k cal

96. For the process $H_2O(l)$ (1 bar, 373 K) $\rightarrow$ $H_2O(g)$ (1 bar, 373 K), the correct set of thermodynamic parameters is

(a) $\Delta G = 0, \Delta S = +ve$ (b) $\Delta G = 0, \Delta S = -ve$
(c) $\Delta G = +ve, \Delta S = 0$ (d) $\Delta G = -ve, \Delta S = +ve$

IIT JEE, 2007

Ans. (a) : For the process, water goes one state to another state. Due to equilibrium between liquid and gaseous state of H_2O on 373K, $\Delta G = 0$, and entropy also increases i.e. $\Delta S = +ve$

97. Consider the reaction: $N_2 + 3H_2 \rightarrow 2NH_3$ carried out at constant temperature and pressure. If ΔH and ΔU are the enthalpy and internal energy changes for the reaction, which of the following expressions is true ?

(a) $\Delta H > \Delta U$ (b) $\Delta H < \Delta U$
(c) $\Delta H = \Delta U$ (d) $\Delta H = 0$

AIEEE-2005

Ans. (b) : Given the reaction –

$$N_2 + 3H_2 \rightarrow 2NH_3$$

$\Delta n = 2 - (3+1) = -2$

$\therefore$ $\Delta H = \Delta U + \Delta nRT$

$\Delta H = \Delta U - 2RT$

So, $\boxed{\Delta U > \Delta H}$

98. Standard entropy of X_2, Y_2 and XY_3 are 60, 40 and 50 $JK^{-1}mol^{-1}$, respectively. For the reaction, $\frac{1}{2}X_2 + \frac{3}{2}Y_2 \rightleftharpoons XY_3, \Delta H = -30kJ$, to be at equilibrium, the temperature will be

(a) 1250 K (b) 500 K
(c) 750 K (d) 1000 K

NEET-2010, AIEEE-2008

Ans. (c) : For the reaction

$$\frac{1}{2}X_2 + \frac{3}{2}Y_2 \rightarrow XY_3; \quad \Delta H = -30kJ \ \ (\text{given})$$

Calculating the ΔS for the above reaction–

$$\Delta S = 50 - \left[\frac{1}{2} \times 60 + \frac{3}{2} \times 40\right] JK^{-1}$$

$$\Delta S = 50 - [30 + 60]$$

$$\Delta S = -40\,JK^{-1}$$

At equilibrium, $\Delta G = 0$, $\Delta G = \Delta H - \Delta ST$

$T\Delta S = \Delta H$

$$T = \frac{\Delta H}{\Delta S} = \frac{-30 \times 1000}{-40}$$

$T = 750\,K$.

99. One mole of an ideal gas at 300 K is expanded isothermally from an initial volume of 1 litre to 10 litres. Then ΔS (cal deg^{-1} mol^{-1}) for this process is: (R = 2 cal K^{-1} mol^{-1})

(a) 7.12 (b) 8.314
(c) 4.6 (d) 3.95

VITEEE-2016

Ans. (c) : Given that, T = 300K

$V_1 = 1$ litre, $V_2 = 10$ litres

R = 2 cal K^{-1} Mol^{-1}

For isothermal process,

$$\Delta S = 2.303\,nR\log\frac{V_2}{V_1}$$

$$\Delta S = 2.303 \times 1 \times 2 \log\frac{10}{1}$$

$\Delta S = 4.606 \log 10$

$\Delta S = 4.6$ cal deg^{-1} mol^{-1}

100. Match List I (Equations) with List II (Types of process) and select the correct option.

List - I (Equations)	List - II (Types of process)
A. $K_P > Q$	1. Non – spontaneous
B. $\Delta G^\circ < RT\ln Q$	2. Equilibrium
C. $K_P = Q$	3. Spontaneous and endothermic
D. $T > \frac{\Delta H}{\Delta S}$	4. Spontaneous

Codes :

	A	B	C	D
(a)	1	2	3	4
(b)	3	4	2	1
(c)	4	1	2	3
(d)	2	1	4	3

VITEEE- 2012

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Ans. (c) : By option (A) If $K_p > Q$ and goes in forward direction then reaction is spontaneous

Option (B) Given, $\Delta G° < RT \ln Q$,

Thus, $\Delta G°$ = + ve and hence, the reaction is non-spontaneous.

Option (C) At equilibrium, $K_p = Q$

Option (D) $T > \dfrac{\Delta H}{\Delta S}$

or $\quad T\Delta S = \Delta H$

This is valid condition for spontaneous endothermic reactions (as $\Delta G \geq \Delta H - T\Delta S$)

101. For the reaction,

$$\mathbf{C_3H_8(g) + 5O_2(g) \longrightarrow 3CO_2(g) + 4H_2O(l)}$$

at constant temperature, $\Delta H - \Delta E$ is

(a) RT (b) –3RT

(c) 3RT (d) – RT

VITEEE- 2011

Ans.(b): For the reaction-

$$C_3H_8(g) + 5O_2(g) \rightarrow 3CO_2(g) + 4H_2O(l)$$

Given that, at constant temperature

Now, from the following equation-

$$\Delta H = \Delta E + P\Delta V \left(\because P\Delta V = \Delta n_g RT\right)$$

or $\quad \Delta H = \Delta E + \Delta n_g RT$

Where, $\Delta n_g = n_p - n_r = 3 - 6 = -3$

$\therefore \quad \Delta H - \Delta E = -3RT$

102. For which one of the following reactions will there be a positive ΔS?

(a) $H_2O(g) \longrightarrow H_2O(l)$

(b) $H_2(g) + I_2(g) \longrightarrow 2HI(g)$

(c) $CaCO_3(s) \longrightarrow CaO(s) + CO_2(g)$

(d) $N_2(g) + 3H_2(g) \longrightarrow 2NH_3(g)$

VITEEE- 2010

Ans. (c) : ΔS (entropy change) is the measure of randomness and thus in solid, liquid and gas, the order of entropy is gas > liquid > solid.

Thus, ΔS is positive for the reaction given in option (c) because solid $CaCO_3$ is forming gaseous CO_2.

103. Calculate ΔH° for the reaction,

$$\mathbf{Na_2O(s) + SO_3(g) \rightarrow NaSO_4(g)}$$

given the following :

(a) $\mathbf{Na(s) + H_2O(\mathit{l}) \rightarrow NaOH(s) + \frac{1}{2}H_2(g)}$

$\mathbf{\Delta H° = -146 kJ}$

(b) $\mathbf{Na_2SO_4(s) + H_2O(\mathit{l}) \rightarrow 2NaOH(s) + SO_3(g)}$

$\mathbf{\Delta H° = +418 kJ}$

(c) $\mathbf{2NaO(s) + 2H_2(g) \rightarrow 4Na(s) + 2H_2O(\mathit{l})}$

$\mathbf{\Delta H° = +259 kJ}$

(a) +823 kJ (b) –581 kJ

(c) –435 kJ (d) +531 kJ

VITEEE- 2009

Ans. (b) :

$Na(s) + H_2O(l) \rightarrow NaOH(s) + \frac{1}{2}H_2(g)$ .....(1)

$\Delta H° = -146$ kJ

$Na_2SO_4(s) + H_2O(l) \rightarrow 2NaOH(s) + SO_3(g)$ .....(2)

$\Delta H° = +418$ kJ

$2NaO(s) + 2H_2(g) \rightarrow 4Na(s) + 2H_2O(l)$ .....(3)

$\Delta H° = +259$ kJ

Given that enthalpies of reactions are –144 kJ, 418 kJ and 359 kJ.

Required reaction = (equation 3 ÷ 2) + (equation 1 × 2) – (equation 2)

$$Na_2O + SO_3 \longrightarrow Na_2SO_4;$$

$$\Delta H° = +\frac{259}{2} + (-146) \times 2 - (418)$$

$$\Rightarrow \Delta H = -580.5 \approx 581 \text{ kJ}$$

104. A spontaneous process is one in which the system suffers :

(a) no energy change

(b) a lowering of free energy

(c) a lowering of entropy

(d) an increase in internal energy

VITEEE- 2008

Ans. (b) : In any reaction, if the Gibbs free energy is negative then reaction will be spontaneous. ΔG = –ve for a spontaneous process.

105. If an endothermic reaction occurs spontaneously at constant temperature T and P, then which of the following is true?

(a) $\Delta G > 0$ (b) $\Delta H < 0$

(c) $\Delta S > 0$ (d) $\Delta S < 0$

VITEEE- 2008

Ans. (c) : For a reaction to take place spontaneously the value of ΔG must be negative i.e. ΔG<0.

Now, ΔG = ΔH– TΔS.

- As the reaction is endothermic, so value of ΔH must be positive, i.e. ΔH > 0.

Hence, to have a negative ΔG.

ΔH < TΔS. As T & P are constant.

- TΔS must be positive to give the total value a negative sign.

Hence, ΔS> 0.

106. Enthalpy is equal to

(a) $-T^2\left[\dfrac{\delta(\Delta G)}{\delta T}\right]_V$ (b) $-T^2\left[\dfrac{\delta(G/T)}{\delta T}\right]_P$

(c) $T^2\left[\dfrac{\delta(G/T)}{\delta T}\right]_V$ (d) $-T^2\left[\dfrac{\delta(\Delta G)}{\delta T}\right]_P$

VITEEE- 2007

Ans. (d) : Gibb's Helmholtz Equation–

$$\Delta G = \Delta H - T\Delta S \quad ....(1)$$

Differentiate this equation w.r.t. temperature at constant pressure,

$$\left(\frac{\partial \Delta G}{\partial T}\right)_P = \left(\frac{\partial G_y}{\partial T}\right)_P - \left(\frac{\partial G_x}{\partial T}\right)_P \quad ....(2)$$

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$= -S_y - (-S_x)$

$= -(S_y - S_x) = -\Delta S$ ....(3)

Where, ΔS change in entropy

On combining equation (1) & (3), we get–

$$\Delta G = \Delta H + T\left(\frac{\partial(\Delta G)}{\partial T}\right)_P \qquad ....(4)$$

Equation (4) is an alternative form of Gibbs Helmholtz equation,

Dividing equation (4) by T^2, we get

$$\frac{\Delta G}{T^2} = \frac{\Delta H}{T^2} + \frac{1}{T}\left[\frac{\partial(\Delta G)}{\partial T}\right]_P$$

On rearrangement, we get

$$\left[\frac{\partial(\Delta G)}{\partial T}\right]_P = -\frac{\Delta H}{T^2}$$

$$\therefore \Delta H = -T^2\left[\frac{\partial(\Delta G)}{\partial T}\right]_P$$

107. Condition for spontaneity in an isothermal process is

(a) $\Delta A + W < 0$ (b) $\Delta G + U < 0$

(c) $\Delta A + U > 0$ (d) $\Delta G - U < 0$

VITEEE- 2007

Ans. (a) : Since $\Delta G = \Delta A + P.\ \Delta V$

For a spontaneous process ΔG should be negative which is possible only if $\Delta G < 0$

$\Delta A + W < 0$

108. The reaction,

$Zn(s) + CuSO_4(aq) \rightarrow ZnSO_4(aq) + Cu(s)$ is an example of a

(a) spontaneous process

(b) isobaric process

(c) non-spontaneous process

(d) reversible process

VITEEE- 2006

Ans. (a) : It is spontaneous process because zinc is more reactive than copper, hence can easily replace Cu from $CuSO_4$.

109. ΔS will be highest for

(a) $Ca_{(s)} + 1/2O_{2(g)} \rightarrow CaO_{(s)}$

(b) $CaCO_{3(s)} + CaO_{(s)} \rightarrow CO_{2(g)}$

(c) $C_{(s)} + O_{2(g)} \rightarrow CO_{2(g)}$

(d) $N_{2(g)} + O_{2(g)} \rightarrow 2NO_{(g)}$

SRMJEEE – 2014

Ans. (b) : The entropy of a system increases whenever its particles have more freedom of motion. Thus, the entropy increases whenever you have more moles of gaseous products than of reactants and whenever you have more product particles in solution than you have of reactant particles. Hence, among the given reaction, the entropy increases in –

$$CaCO_{3(s)} \longrightarrow CaO_{(s)} + CO_{2(g)}$$

Since, the reactant side has no gaseous particle while the product side has 1 gaseous particle. Hence, entropy increases and ΔS will be highest.

110. Which of the following conditions lead to a spontaneous process?

(a) ΔH is + ve ; TΔS is – ve

(b) TΔS = ΔH

(c) Both ΔH and TΔS are + ve but ΔH > TΔS

(d) Both ΔH and TΔS are + ve but TΔS > ΔH

SRMJEEE – 2013

Ans. (d) : We know that,

$\Delta G = \Delta H - T\Delta S$

Where, ΔG = Gibb's free energy change

ΔH = enthalpy change

ΔS = entropy change.

For the spontaneous process, ΔG should be negative which is possible in only option (d) because both ΔH and TΔS are positive and TΔS>ΔH due to which $\Delta G < 0$.

111. Enthalpy of neutralization of a strong acid by a strong base

1. has a constant value of – 57.32 kJ

2. is independent of the nature of strong acid and strong base

3. is heat change accompanying the reaction

$H^+_{(aq)} + HO^-_{(aq)} \rightarrow H_2O$

(a) 1 and 2 (b) 1 and 3

(c) 1 only (d) 1, 2 and 3

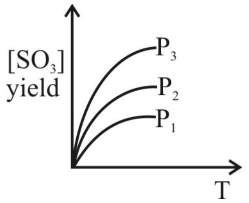
SRMJEEE – 2016

Ans. (d) : The enthalpy of neutralization of any strong acid with a strong base is always the same i.e. 57.1 kJ. The reason is that both the acid and base undergo complete ionisation. It is independent of the nature of the strong acid and strong base.

Enthalpy of neutralization is always constant for a strong acid and a strong base this is because all strong acids and strong base are completely ionized in dilute solution. Enthalpy change in neutralization are always negative.

$$H^+_{(aq)} + HO^-_{(aq)} \longrightarrow H_2O$$

112. For the reaction $SO_{2(g)} + \frac{1}{2}O_{2(g)} \rightleftharpoons SO_{3(g)}$ percentage yield of product at different pressure is shown in the figure. Then, which among the following is true?



$$SO_{2(g)} + \frac{1}{2}O_{2(g)} \rightleftharpoons SO_{3(g)}$$

(a) Pressure has no effect (b) $P_1 < P_2 < P_3$

(c) $P_1 > P_2 > P_3$ (d) $P_1 = P_2 = P_3 = 0$

AP- EAPCET- 07-09-2021, Shift-I

Ans. (c) : $SO_{2(g)} + \frac{1}{2}O_{2(g)} \rightleftharpoons SO_3(g)$

The percentage yield of product increases when $P_1 > P_2 > P_3$.

@apna_pdf

113. A gaseous mixture was prepared by taking equal number of moles of Helium and Neon. If the total pressure of the mixture was found to be 10 atm, the partial pressure of Helium in the mixture is _____

(a) 1 atm (b) 5 atm
(c) 10 atm (d) 0 atm

AP- EAPCET- 07-09-2021, Shift-I

Ans. (b) : Partial pressure = Mole fraction × Total pressure

$$X_{He} = \frac{n_{He}}{n_{He}+n_{Ne}} = \frac{n_{He}}{2n_{He}} = \frac{1}{2} \qquad (\because n_{He} = n_{Ne})$$

$P_{He} = (1 - X_{He}) \times P_T$

$P_{He} = 0.5 \times 10 = 5$ atm

114. For which one of the following reactions, the entropy change is positive?

(a) $H_2(g) + \frac{1}{2}O_2(g) \longrightarrow H_2O(l)$

(b) $Na^+(g) + Cl^-(g) \longrightarrow NaCl(s)$

(c) $NaCl(1) \longrightarrow NaCl(s)$

(d) $H_2O(1) \longrightarrow H_2O(g)$

AP-EAMCET (Engg.) 2013

Ans. (d) :

Entropy change is positive for vaporization of liquid water to water vapor. The entropy of a compound in gaseous state is higher than the entropy of compound in liquid state.

$H_2O(\ell) \longrightarrow H_2O(g)$; $\Delta H = +40.8\ kJmol^{-1}$

115. A chemical reaction cannot occur at all if its

(a) ΔH is (+)ve and ΔS is (–)ve
(b) ΔH is (–)ve and ΔS is (+)ve
(c) ΔH and ΔS are (+)ve but $\Delta H > T\Delta S$
(d) ΔH and ΔS are (–)ve but $\Delta H > T\Delta S$

AP - EAMCET(MEDICAL) - 2009

Ans. (c) : The mathematical expression of Gibb's Helmholtz equation is given as–

$$\Delta G = \Delta H - T\Delta S$$

Where, ΔG = Change in Gibb's energy
ΔH = Change in enthalpy
T = Temperature
ΔS = Change in entropy

If ΔG has the positive value then a chemical reaction cannot occur. This condition is true when ΔH and ΔS both are positive in such a way that $\Delta H > T\Delta S$.

116. Density of carbon monoxide is maximum at

(a) 2 atm and 600 K (b) 0.5 atm and 273 K
(c) 6 atm and 1092 K (d) 4 atm and 500 K

Karnataka-CET-2014

Ans. (d) : For ideal gas equation, P = dRT (d = Density)

$\therefore \quad d \propto \frac{P}{T}$

(a) $\frac{P}{T} = \frac{2}{600} = 0.0033$ (b) $\frac{P}{T} = \frac{0.5}{273} = 0.00183$

(c) $\frac{P}{T} = \frac{6}{1092} = 0.00549$ (d) $\frac{P}{T} = \frac{4}{500} = 0.0080$

∵ P/T ratio is highest at 4 atm and 500 K.

∴ Density is maximum at this condition.

117. The Gibbs free energy for the decomposition of Al_2O_3 at 500°C is 482.5 kJ/mol. The potential difference needed for electrolytic reduction of Al_2O_3 at 500°C is at least

(a) 2.5 V (b) 5.0 V
(c) 1.25 V (d) 4.5 V

AMU-2019

Ans. (c) : Reaction formed,

$$\frac{2}{3}Al_2O_3 \longrightarrow \frac{4}{3}Al + O_2$$

Where, $\Delta_r G = +482.5\ kJ\ mol^{-1}$

(i) $\underset{\text{(At anode)}}{2O^{2-} + 4e^- \longrightarrow O_2]\times 3}$

(ii) $\underset{\text{(At cathode)}}{Al^{3+} \longrightarrow Al + 3e^-]\times 4}$

Accurate reaction,

$$\frac{4}{3}Al + 2O^{2-} \longrightarrow O_2 + \frac{4}{3}Al$$

So, number of electron transferred $= \frac{12}{3} = 4$

From formula,

$\Delta G° = -nFE°$

$(482.5 \times 1000) J/mol = -4 \times 96500 \times E°$

$$E° = \frac{(482.5 \times 1000) J/mol}{4 \times 96500} = 1.25$$

118. The melting point of benzene is 5.5°C. What is the sign of ΔH, ΔS and ΔG for melting point of benzene at 0°C?

(a) ΔH>0, ΔS>0, ΔG>0 (b) ΔH<0, ΔS>0, ΔG<0
(c) ΔH>0, ΔS>0, ΔG<0 (d) ΔH>0, ΔS<0, ΔG>0

AMU-2019

Ans. (a) : The melting point of benzene is 5.5°C. The sign of ΔH, ΔS and ΔG for melting point of benzene at 0°C is–

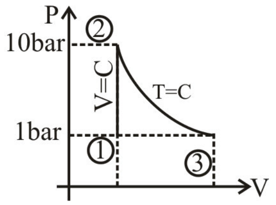
ΔH>0, ΔS>0, ΔG>0

119. An ideal gas initially at temperature, pressure and volume, 27°C, 1.00 bar and 10 L, respectively is heated at constant volume until pressure is 10.0 bar; it then undergoes a reversible isothermal expansion until pressure is 1.00 bar. What is the total work W, during this process?

(a) -23.02×10^3 J (b) -14.0×10^3 J
(c) 14.0×10^3 J (d) Zero

AMU-2018

Ans. (b) :



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For process 1-2 : V = C

$W_1 = -P\Delta V$

$\because \quad \Delta V = 0$

$\therefore \quad W_1 = 0$

For process 2-3 : T = C

$$W_2 = -2.303 \text{ nRT} \log \frac{P_2}{P_3}$$

We know that, PV = nRT

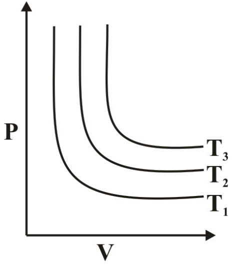
$$W_2 = -2.303 \times P \times V \times \log \frac{10}{1}$$

$= -2.303 \times 1 \times 10^5 \times 10^{-3} \log 10$

$= -2.303 \times 10^2$ J

$= -23.03 \times 10^3 \text{ J} \approx 23.02 \times 10^3$ J

120. For the given PV isotherms, which of the following is correct for T_1, T_2, T_3 ?

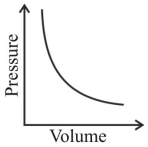


(a) $T_1 < T_2 < T_3$ (b) $T_3 < T_2 < T_1$

(c) $T_2 < T_3 < T_1$ (d) $T_1 > T_3 > T_2$

AMU-2018

Ans. (a) : According to Boyle's law, the product of volume and pressure of a given gas is constant at constant temperature. The curve between pressure and volume is plotted as



On increasing temperature the curve shifts to higher value.

121. A better criterion for ideality of a gas than $\left(\frac{\partial U}{\partial V}\right)_T = 0$ is

(a) $\left(\frac{\partial H}{\partial P}\right)_T < 0$ (b) $\left(\frac{\partial H}{\partial P}\right)_T > 0$

(c) $\left(\frac{\partial H}{\partial P}\right)_T = 0$ (d) $\left(\frac{\partial H}{\partial P}\right)_T \neq 0$

AMU-2017

Ans. (c) : $\left(\frac{\partial H}{\partial P}\right)_T = 0$

122. 30.4 kJ is required to melt one mole of NaCl. The entropy change during melting is 28.4 J mol^{-1} K^{-1}. What is the melting point of sodium chloride?

(a) 1070.4 K (b) 535.2 K

(c) 273.1 K (d) 1007.4 K

AMU-2016

Ans. (a) : $NaCl_{(s)} \longrightarrow NaCl_{(l)}$ (ΔG = 0, At phase)

$0 = \Delta H - T\Delta S$,

Entropy change, $\Delta S = \frac{\Delta H}{T}$

So, $T = \frac{\Delta H}{\Delta S} = \frac{30.4 \times 10^3}{28.4} = 1070.4\text{K}$

123. For an isolated system, ΔU = 0, then

(a) $\Delta S = 0$

(b) $\Delta S < 0$

(c) $\Delta S > 0$

(d) the value of ΔS cannot be predicted.

AMU-2012

Ans. (c) : ΔS is independent of ΔU

And for isolated system,

$\Delta S > 0 \rightarrow$ Always

124. An adiabatic process occurs in

(a) open system

(b) closed system

(c) isolated system

(d) in all the given systems

AMU – 2009

Ans. (c) : Adiabatic process is a process in which energy transfer take place in form of work only and heat transfer is zero. For that, system must be thermally insulated.

125. A reaction is spontaneous at high temperatures if

(a) ΔH and ΔS both are negative

(b) ΔH and ΔS both are positive

(c) ΔH is negative and ΔS is positive

(d) ΔH is positive and ΔS is negative.

AMU – 2007

Ans. (b) : A reaction is spontaneous at high temperature, if ΔH and ΔS are positive and it is an entropy driven process.

126. Calculate the entropy change for $CH_4(g)+H_2O(g) \rightarrow 3H_2(g)+CO(g)$ $JK^{-1}mole^{-1}$ are 186.2, 188.7, 130.6, 197.6 respectively. The entropy change is

(a) $-46\ JK^{-1}mole^{-1}$ (b) $+46\ JK^{-1}mole^{-1}$

(c) $-214.8\ JK^{-1}mole^{-1}$ (d) $+214.8\ JK^{-1}mole^{-1}$

AMU-2005

Ans. (d) : Given,

$CH_4(g) = 186.2\ JK^{-1}mol^{-1}$

$H_2O(g) = 188.7\ JK^{-1}mol^{-1}$

$H_2(g) = 130.6\ JK^{-1}mol^{-1}$

$CO(g) = 197.6\ JK^{-1}mol^{-1}$

The entropy change (ΔS°) for the reaction,

$CH_4(g)+H_2O(g) \rightarrow 3H_2(g)+CO(g)$

Entropy of a reaction = Entropy of products – Entropy of reactants

Entropy change (ΔS°) = (197.6 + 3×130.6) – (186.2 + 188.7)

$= 589.4 - 374.9$

$= 214.5\ JK^{-1}mole^{-1}$

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127. A process is spontaneous at high temperature if

(a) $\Delta H > 0$ and $\Delta S > 0$ (b) $\Delta H < 0$ and $\Delta S < 0$

(c) $\Delta H > 0$ and $\Delta S < 0$ (d) $\Delta H = 0$ and $\Delta S < 0$

AMU-2004

Ans. (a) : $\Delta G = \Delta H - T\Delta S$

If ΔH is +ve and ΔS is +ve then . at high temperature ΔG is – ve, i.e the process is spontaneous.

128. ∆H and ∆E will have same value in

(a) $N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$

(b) $N_2O_4(g) \rightarrow 2NO_2(g)$

(c) $H_2(g) + I_2(g) \rightarrow 2HI(g)$

(d) $2H_2(g) + O_2(g) \rightarrow 2H_2O(l)$

AMU–2003

Ans. (c) : For $H_2(g) + I_2(g) \rightarrow 2HI(g)$

$\Delta H = \Delta E + P\Delta V$

$\Delta V = 0$

$\therefore \Delta H = \Delta E$

129. For the reversible process, the value of ∆S is given by the expression

(a) $q_{(rev)} \times T$ (b) $q_{(rev)} \div T$

(c) $\Delta H/\Delta T$ (d) $T \div q_{(rev)}$

AMU 2002

Ans. (b) : According to the second law of thermodynamics, the change in entropy for reversible reaction during a process is expressed as,

$$\Delta S = \frac{q_{rev}}{T}$$

130. For the precipitation reaction of Ag^+ ions with NaCl, which of the following statements is correct ?

(a) ΔG for the reaction is zero

(b) ΔG for the reaction is negative

(c) $[\Delta G] = [\Delta H]$

(d) none of these.

AMU–2001

Ans. (b) : For spontaneous reaction, the value of free energy is negative (i.e. $\Delta G < 0$).

Since, both ΔH and ΔS can be either positive or negative.

131. Enthalpy of formation of a compound

(a) is always positive

(b) is always negative

(c) can be either positive or negative

(d) can be either negative or zero

Assam CEE-2014

Ans. (c) : Enthalpy of formation of a compound can be positive or negative. It depends on standard form of elements that are taken into consideration.

132. For the gaseous reaction $N_2O_4(g) \rightarrow 2NO_2(g)$

(a) $\Delta H = 0$ (b) $\Delta H = \Delta U$

(c) $\Delta H < \Delta U$ (d) $\Delta H > \Delta U$

Assam CEE-2014

Ans. (d) : $\Delta H = \Delta U + \Delta n_g RT$

$\Delta n_g = n_p - n_R = 2 - 1 = 1$

Where, n_P = Mole of product

n_R = Mole of reactant

$\therefore \Delta H = \Delta U + (1)\,RT$

$\boxed{\therefore \Delta H > \Delta U}$

133. The temperature of a gas in a closed container is 27 °C. If the temperature is raised to 327 °C, the pressure exerted is

(a) reduced to half

(b) doubled

(c) reduced to one-third

(d) Cannot be calculated

Assam CEE-2014

Ans. (b) : Closed container mean volume is constant,

$$\frac{P_1}{T_1} = \frac{P_2}{T_2}$$

Given, $T_1 = 27 + 273 = 300$ K

$T_2 = 327 + 273 = 600$ K,

$$\frac{P_1}{300} = \frac{P_2}{600}$$

$$\therefore P_2 = \frac{600}{300} \times P_1 = 2P_1$$

So, Pressure become double.

134. For the reaction, $2Cl(g) \rightarrow Cl_2(g)$. the signs of ∆H and ∆S are

(a) ΔS is – Ve, ΔH is –Ve

(b) ΔS is + Ve, ΔH is –Ve

(c) ΔS is – Ve, ΔH is +Ve

(d) ΔS is + Ve, ΔH is +Ve

Assam CEE-2020

Ans. (a) : $2Cl(g) \rightarrow Cl_2(g)$

As we can see from the reaction, Entropy is decreasing in the reaction as no. of molecules are decreasing. It means the randomness at the system decreases and reaction is exothermic hence ΔH is also negative (–).

135. If temperature of a liquid is raised surface tension of the liquid

(a) Increases (b) decreases

(c) remains the same (d) decreases to 0^0C

Assam CEE-2019

Ans. (b) : Surface tension is defined as the resistance offered by the surface of the liquid to penetration. As the temperature increases, surface tension decreases.

136. An equilibrium mixture of ice and water is under constant pressure, where ice melts if heat is supplied. For this process

(a) Free energy increases

(b) Entropy increases

(c) Enthalpy increases

(d) Entropy decreases

Assam CEE-2018

Ans. (b) : As temperature increases, volume also increases due to increase in volume randomness of molecules also increases

Hence, entropy of system increases.

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137. For a reaction, K = 100 the value of ΔG will be

(a) -2.303 RT (b) -4.606 RT
(c) $-$RT (d) RT

Assam CEE-2021

Ans. (b) : Given, K = 100
and

$$\Delta G = -2.303 \text{ RT} \log K$$
$$= -2.303 \text{ RT} \log(100)$$
$$= -2.303 \text{ RT} \times 2 \log 10$$
$$= -4.606 \text{ RT}$$

138. Highest entropy is in :

(a) hydrogen (b) water
(c) graphite (d) mercury

BCECE-2006

Ans. (a) : Entropy is defined as the degree of the randomness of molecules. It means, the molecules which have high randomness will have higher entropy.

So, Gas molecules have more entropy because it have more randomness motion.

Gas > Liquid > Solid.

From the above given option, Hydrogen is in gaseous state.

Hence, have more entropy.

139. Which of the following is always negative for exothermic reaction ?

(a) ΔH (b) ΔS
(c) ΔG (d) None of these

BCECE-2005

Ans. (a) : ΔH always negative for exothermic reactions, because exothermic process are energy librating process. i.e. $\Delta H = -ve$

140. What is ΔE for system that does 500 cal of work on surrounding and 300 cal of heat is absorbed by the system?

(a) -200 cal (b) -300 cal
(c) $+200$ cal (d) $+300$ cal

BCECE-2003

Ans. (a) : Given,

q = +300 cal (Heat is absorbed)
W= 500 cal (work done on surrounding)

From first law of thermodynamic

$\Delta E = q + W = 300 + (-500) = -200$ cal.

141. Which of the following will produce the highest rise in temperature ?

(a) 67 mL of 1 M NaOH + 33 mL of 0.5 M H_2SO_4
(b) 33 mL of 1 M NaOH + 67 mL of 0.5 M H_2SO_4
(c) 40 mL of 1 M NaOH + 60 mL of 0.5 M H_2SO_4
(d) 50 mL of 1 M NaOH + 50 mL of 0.5 M H_2SO_4

BCECE-2009

Ans. (d) : Here all the reaction are acid-base i.e neutralization.

Option (d) has highest heat evolved. So rise in temperature is maximum.

142. Unit of entropy is

(a) $JK^{-1}mol^{-1}$ (b) $J\ mol^{-1}$
(c) $J^{-1}K^{-1}mol^{-1}$ (d) $JK\ mol^{-1}$

BCECE-2012

Ans. (a) : Change in Entropy $(\Delta S) = \dfrac{q_{rev}}{T}$

Unit of,

$q_{rev.} \rightarrow J\ mol^{-1}$
$T \rightarrow K$
$\therefore \quad \Delta S \rightarrow JK^{-1}\ mol^{-1}$

143. Given that dE = TdS – pdV and H = E + pV. Which one of the following relations is true?

(a) dH = TdS + Vdp (b) dH = SdT + Vdp
(c) dH = –SdT – Vdp (d) dH = dE – pdV

BCECE-2014

Ans. (a) : dE = TdS – PdV ...(i)
H = E + PV ... (ii)
Differentiating Eq. (ii),
dH = dE + PdV + VdP ... (iii)
From equation (i) and (ii),
dH = TdS + Vdp

144. Which one of the following equations represents the variation of viscosity coefficient (η) with temperature (T)?

(a) $\eta = Ae^{-E/RT}$ (b) $\eta = Ae^{E/RT}$
(c) $\eta = Ae^{-E/KT}$ (d) $\eta = Ae^{-E/T}$

BCECE-2014

Ans. (b) : The variation of viscosity coefficient (η) with temperature (T) is given by,
$\eta = Ae^{E/RT}$
Viscosity are taken in Fluid medium

145. Which one of the following is an exothermic reaction?

(a) $N_2(g)+O_2(g)+180.8kJ \longrightarrow 2NO(g)$
(b) $C(\text{graphite})+2S(s) \longrightarrow CS_2(l)-91.9kJ$
(c) $N_2(g)+3H_2(g)-92kJ \longrightarrow 2NH_3(g)$
(d) $C(g)+H_2O(g) \longrightarrow CO(g)+H_2(g)-131.4kJ$

BCECE-2015

Ans. (c) : Reaction in which heat evolved from the system is known as Exothermic reaction.
$N_2(g) + 3H_2(g) \rightarrow 2\ NH_3(g) + 92\ kJ\downarrow$ heat is evolved
So, ΔH = Negative

146. Which of the following gases has maximum value of root mean square velocity (v_{rms}) at same temperature CO_2, H_2, NH_3?

(a) CO_2 (b) H_2
(c) NH_3 (d) All have same velocity

BCECE-2016

Ans. (b) : $v_{rms} = \sqrt{\dfrac{3RT}{M}}$

T = Constant

Its means, higher be the value of molecular mass, lower be the v_{rms} and vice-versa.

We have, $M_{CO_2} = 44,\ M_{H_2} = 2,\ M_{NH_3} = 17$

Hence, v_{rms} of H_2 will be maximum

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147. Compounds with high heat of formation are less stable because

(a) It is difficult to synthesize them
(b) Energy rich state leads to instability
(c) High temperature is required to synthesize them
(d) Molecules of such compounds are distorted

BITSAT 2006

Ans. (b) : Higher values of heat of formation indicates a higher amount of energy released during the formation of a compound, which makes it more stable.
So, more the energy, lesser is the stability.

148. K for CH_3COOH at 25^0C is 1.754×10^{-5}. At 50^0C K is 1.633×10^{-5}. What are ΔH^0 and ΔS^0 for the ionization of CH_3COOH?

(a) $-1.55\,kJmol^{-1}, -96.44\,Jmol^{-1}K^{-1}$
(b) $-2.55\,kJmol^{-1}, -106.44\,Jmol^{-1}K^{-1}$
(c) $1.55\,kJmol^{-1}, 96.44\,Jmol^{-1}K^{-1}$
(d) $-1.55\,kJmol^{-1}, 96.44\,Jmol^{-1}K^{-1}$

BITSAT 2008

Ans. (a) : Given,
$T_1 = 25°C + 273 = 298K$, $T_2 = 50°C + 273 = 323K$

$$\left(K_{CH_3COOH}\right)_{25°C} = 1.754 \times 10^{-5}$$

$$\left(K_{CH_3COOH}\right)_{50°C} = 1.633 \times 10^{-5}$$

We know,

$$\Delta G^0 = -2.303\ RT \log K$$

$$\Delta G^0_{(323)} = -2.303 \times 8.314 \times 323 \log\left(1.633 \times 10^{-5}\right)$$
$$= 29605\,J$$

$$\Delta G^0_{(298)} = -2.303 \times 8.314 \times 298 \log\left(1.754 \times 10^{-5}\right)$$
$$= 27194\,J$$

$$\Delta G^0 = \Delta H^0 - T\Delta S^0$$

$$29605 = \Delta H^0 - 323\Delta S^0 \qquad .....(i)$$

$$27194 = \Delta H^0 - 298\Delta S^0 \qquad .....(ii)$$

From eqn. (i) & (ii) on calculation, We find

$$\Delta S^0 = -96.44\ J\,K^{-1}\,mol^{-1}$$

$$\therefore \Delta H^0 = -1.55\ kJ/mol$$

149. For the reaction

$$N_2 + 3H_2 \rightleftharpoons 2NH_3$$

Which one of the following is correct regarding ΔH :

(a) $\Delta H = \Delta E + 2RT$
(b) $\Delta H = \Delta E - 2RT$
(c) $\Delta H = \Delta E + RT$
(d) $\Delta H = \Delta E - RT$

BITSAT 2009

Ans. (b) : $N_2 + 3H_2 \rightleftharpoons 2NH_3$
According to 1st law of thermodynamics,
$\Delta H = \Delta E + nRT$
Where ΔH = enthalpy of reaction at constant pressure
ΔE = heat of reaction at constant volume
R = molar gas constant
T = temperature of the reaction
n = (no. of moles of product) – (no. of moles of reactant.)
From reaction, $n = n_P - n_R = 2 - 4 = -2$
Hence, $\Delta H = \Delta E - 2RT$

150. One mole of an ideal gas at 300 K is expanded isothermally from an initial volume of 1 litre to 10 litres. The ΔE for this process is ($R = 2$ cal $mol^{-1}K^{-1}$)

(a) 163.7 cal
(b) zero
(c) 1381.1 cal
(d) 9 lit atom

BITSAT 2009

Ans. (b) : For isothermal process, ΔE = 0 because for ideal gas, internal energy is a function of temperature only.

151. A spontaneous reaction is impossible if

(a) both ΔH and ΔS are negative
(b) both ΔH and ΔS are positive
(c) ΔH is negative and ΔS is positive
(d) ΔH is positive and ΔS is negative

BITSAT 2015

Ans. (d) : For non spontaneous reaction,
ΔH is positive and ΔS is negative.

152. For a particular reversible reaction at temperature T, ΔH and ΔS were found to be both +ve. If T_e is the temperature at equilibrium, the reaction would be spontaneous when

(a) $T_e > T$
(b) $T > T_e$
(c) T_e is 5 times T
(d) $T = T_e$

BITSAT 2016
AIEEE-2010

Ans. (b) : At equilibrium, ΔG = 0
Hence, $\Delta G = \Delta H - T_e\Delta S$
$0 = \Delta H - T_e\Delta S$
$\Delta H = T_e\Delta S$
For a spontaneous reaction
ΔG must be negative which is possible only if $\Delta H - T\Delta S < 0$
$\therefore \Delta H < T\Delta S$
or $T > \dfrac{\Delta H}{\Delta S}$; $T_e < T$

153. For the reaction $CO(g) + \frac{1}{2}O_2(g) \rightarrow CO_2(g)$

Which one of the statement is correct at constant T and P?

(a) ΔH = ΔE
(b) ΔH < ΔE
(c) ΔH > ΔE
(d) ΔH is independent of physical state of the reactants.

BITSAT 2017

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Ans. (b) : $CO(g)+\frac{1}{2}O_2(g)\rightarrow CO_2(g)$

Δn = [1 mol of CO_2] – [1 mol of CO + 0.5 mol of O_2]
= –0.5

$\Delta H=\Delta E-\frac{1}{2}RT$

$\therefore\ \Delta E>\Delta H$

154. For the chemical reaction,
$N_2+3H_2\rightarrow 2NH_3$, if
$\frac{d[NH_3]}{dt}=2\times10^{-4}$ mol L^{-1} s^{-1}, the value of
$\frac{-d[H_2]}{dt}$ is

(a) $1\times10^{-4}\,mol\,L^{-1}s^{-1}$ (b) $3\times10^{-4}\,mol\,L^{-1}s^{-1}$
(c) $4\times10^{-4}\,mol\,L^{-1}s^{-1}$ (d) $6\times10^{-4}\,mol\,L^{-1}s^{-1}$

CG PET -2008

Ans. (b) : $N_2+3H_2\rightarrow 2NH_3$ (Haber's Process)

Given that $\frac{d[NH_3]}{dt}=2\times10^{-4}\,mol\,L^{-1}s^{-1}$

Using above reaction,

$$\frac{-d[H_2]}{dt}=\frac{3d[NH_3]}{2dt}$$

$$\frac{-d[H_2]}{dt}=\frac{3}{2}\times2\times10^{-4}\,mol\,L^{-1}s^{-1}$$

$$\therefore\quad \frac{-d[H_2]}{dt}=\frac{3}{2}\times2\times10^{-4}\,mol\,L^{-1}s^{-1}$$

$$=3\times10^{-4}\,mol\,L^{-1}s^{-1}$$

155. Which of the following units of energy, represents maximum amount of energy?

(a) Calorie (b) Joule
(c) Erg (d) Electron volt

CG PET -2008

Ans. (a) : 1 eV energy = 1.6×10^{-19} J

- 1 erg energy = 10^{-7} J
- 1 calorie energy = 4.18 J

Hence, maximum amount of energy represented by calorie.

156. 1.0L of 1.0 M solution of sodium hydroxide is neutralised by 1.0 L of 1.0 M of methanoic acid. If the heat of formation of water is X, the neutralisation energy of above reaction is

(a) less than X (b) more than X
(c) equal to X (d) None of the above

CG PET -2008

Ans. (a) : Heat of Neutralization of a strong acid with strong base is constant and equal to 13.7 kcal. Here, constant value represents the heat of formation of one mole of H_2O.

$H^++OH^-\rightarrow H_2O$,

ΔH = 13.7 kcal.

But the heat of neutralization of weak acid and strong base is less than 13.7 kcal (X) because some heat is utilized to dissociate the molecule of weak acid into ions.

Heat of Neutralization are taken strong Acid with strong base.

157. Match List I with List II and select the correct answer using the codes.

List I	List II
A. Spontaneous process	1. $\Delta H<0$
B. Exothermic process	2. Heat of reaction
C. Enthalpy at constant Pressure	3. $\Delta G<0$
D. Cyclic process	4. $\Delta U=0,\Delta H=0$

Codes

	A	B	C	D
(a)	4	2	1	3
(b)	3	1	2	4
(c)	1	3	4	2
(d)	1	2	3	4

CG PET- 2016

Ans. (b) : By option –

A – spontaneous process

$\Delta G<0$

B – Exothermic process

$\Delta H<0$

C – Enthalpy at constant Pressure

ΔH (Heat of reaction)

D – In cyclic process

All state function are zero

$\Delta u=0$, $\Delta H=0$

158. In an adiabatic process which of the following is true

(a) q=+W (b) q=0
(c) $\Delta E=q$ (d) $p\Delta V=0$

CG PET -2006

Ans. (b) : In an adiabatic process, q = 0 as no heat is exchanged between system and surrounding.

Adiabatic expansion → cooling effect and vice versa .

159. The decomposition of dinitrogen tetroxide at 300 K and 1.0 atm pressure is 20%. At equilibrium, the partial pressure (in atm) of nitrogen peroxide is

(a) 0.2 (b) 0.67
(c) 0.33 (d) 0.8

CG PET -2017

Ans. (c) : $\because N_2O_4 \rightleftharpoons 2NO_2$

Molar ratio= 1:2

Also, only 20% of N_2O_4 gets decomposed means.

Thus, Total number of moles at equilibrium = 0.4 + 0.8 = 1.2 moles

$\because$ Total pressure (P_t) =1 atm (given)

According to Daltons law of partial pressure,

$$P_{N_2O_4}=X_{(N_2O_4)}\times P_t$$

$$P_{NO_2}=X_{(NO_2)}\times P_t$$

$$P_{NO_2}=\frac{0.4}{1.2}\times1=0.33$$

@apna_pdf

160. In a reversible isothermal process, the change in internal energy is

(a) zero (b) positive

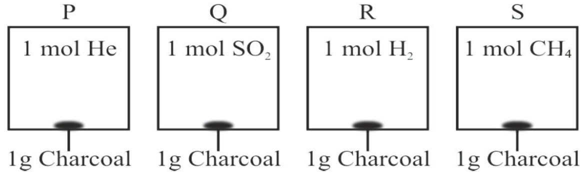
(c) negative (d) None of these

CG PET- 2010

Ans. (a) : $\Delta E = 0$ for reversible isothermal process (T = constant)

- Internal energy is function of temperature only for ideal gas.

161. From the figure, in which of the following vessel, the pressure of the gas is the highest, (Temperature and volume of the gases are the same in each vessel).



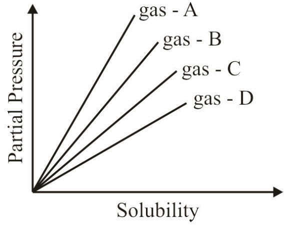
(a) Q (b) P

(c) R (d) S

GUJCET-2020

Ans. (b) : Helium has the highest moles So, it has the highest pressure. As He gas will not absorbed so the pressure of the gas will be highest in P.

162. From the given graph at constant, temperature, which gas has the least solubility?



(a) gas-D (b) gas-B

(c) gas-A (d) gas-C

GUJCET-2014

Ans. (c) : Henry's law is gas law which states "at the amount of gas that is dissolved in a liquid is directly proportional to the partial pressure of that gas above the liquid when the temperature is kept constant".

$P = K_H X$

The constant of proportionality for this relationship is called Henry's law constant.

$$\text{Solubility} \propto \frac{1}{\text{Henry's constant}}$$

It means, Less value of Henry Constant, more the solubility.

163. At the equilibrium position in the process of adsorption :

(a) $\Delta H > 0$ (b) $\Delta H = T\Delta S$

(c) $\Delta H > T\Delta S$ (d) $\Delta H < T\Delta S$

HP CET-2018

Ans. (b) : At equilibrium position during adsorption, $\Delta G = \Delta H - T\Delta S$ [ΔG=0, at equilibrium]

So, that

$\Delta H = T\Delta S$

164. In conversion of limestone to lime,

$CaCO_3(s) \longrightarrow CaO(s) + CO_2(g)$ the values of $\Delta H°$ and $\Delta S°$ are +179.1 kJ mol^{-1} and 160.2 J/K, respectively at 298 K and 1 bar. Assuming that $\Delta H°$ and $\Delta S°$ do not change with temperature, temperature above which conversion of limestone to lime will be spontaneous is

(a) 1008 K (b) 1200 K

(c) 845 K (d) 1118 K

AIEEE-2007

Ans. (d) : $CaCO_3(s) \rightarrow CaO(s) + CO_2(g)$

Given that,

$\Delta H^o = +179.1$ kJ/mol

$\Delta S^o = 160.2$ J/mol

$\Delta G^o = \Delta H^o - T\Delta S^o$

For spontaneous process, $\Delta G^o < 0$

$\therefore \Delta H^o - T\Delta S^o < 0$

$\therefore 179.1\times10^3 < 160.2 \times T$

$$\therefore T > \frac{179.1\times10^3}{160.2}$$

$\therefore \boxed{T > 1118 \text{ K}}$

Therefore, above 1118 K, the reaction will be spontaneous.

165. The entropy change involved in the isothermal reversible expansion of 2 moles of an ideal gas from a volume of 10 dm^3 to a volume of 100 dm^3 at 27°C is

(a) 38.3 J mol^{-1} K^{-1} (b) 35.8 J mol^{-1} K^{-1}

(c) 32.3 J mol^{-1} K^{-1} (d) 42.3 J mol^{-1} K^{-1}

AIEEE-2011

Ans. (a) : Given, n = 2 mole

$V_1 = 10\ dm^3$

$V_2 = 100\ dm^3$

$T = 27°C + 273 = 300$ K

$$\Delta S = 2.303 nR \log\left(\frac{V_2}{V_1}\right)$$

$$= (2.303)\,(2)(8.314)\log\left(\frac{100}{10}\right)$$

$= 38.3$ J $mol^{-1}K^{-1}$

Thus, entropy change of reaction is 38.3J $mol^{-1}K^{-1}$.

166. Two blocks of the same metal having same mass and at temperature T_1 and T_2 respectively, are brought in contact with each other and allowed to attain thermal equilibrium at constant pressure. The change in entropy, ΔS for this process is

(a) $2C_p k \ln\left[\frac{(T_1+T_2)^{\frac{1}{2}}}{T_1T_2}\right]$ (b) $2C_p \ln\left[\frac{(T_1+T_2)}{4T_1T_2}\right]$

(c) $C_p \ln\left[\frac{(T_1+T_2)^2}{4T_1T_2}\right]$ (d) $2C_p \ln\left[\frac{T_1+T_2}{2T_1T_2}\right]$

JEE Main-2019 Shift-I

@apna_pdf

Ans. (c) At the thermal equilibrium,

$$\text{Final Temperature } T_f = \frac{T_1 + T_2}{2}$$

For the 1st block, $\Delta S_I = C_P \ln\frac{T_f}{T_1}$

For the 2nd block, $\Delta S_{II} = C_P \ln\frac{T_f}{T_2}$

When brought in contact with each other,

$$\Delta S = \Delta S_I + \Delta S_{II} = C_P \ln\frac{T_f}{T_1} + C_P \ln\frac{T_f}{T_2}$$

$$= C_P \ln\left(\frac{T_f}{T_1}\times\frac{T_f}{T_2}\right) = C_P \ln\left[\frac{T_f^2}{T_1T_2}\right]$$

$$= C_P \ln\left[\frac{\left(\frac{T_1+T_2}{2}\right)^2}{T_1T_2}\right] = C_P \ln\left[\frac{(T_1+T_2)^2}{4T_1T_2}\right]$$

167. The reaction,
$MgO(s) + C(s) \rightarrow Mg(s) + CO(g)$, for which $\Delta_r H° = +491.1$ kJ mol^{-1} and $\Delta_r S° = 198.0$ JK^{-1} mol^{-1}, is not feasible at 298 K. Temperature above which reaction will be feasible is

(a) 2040.5 K (b) 1890.0 K
(c) 2380.5 K (d) 2480.3 K

JEE Main-2019, Shift-II

Ans. (d) : At equilibrium $T = \frac{\Delta H}{\Delta S} = \frac{491.1\times1000}{198}$

$= 2480.3$ K

It is the temperature above which reaction is not possible.

168. The entropy change associated with the conversion of 1 kg of ice at 273 K to water vapours at 383 K is (Specific heat of water liquid and water vapour are 4.2 kJK^{-1} kg^{-1} and 2.0 kJK^{-1} kg^{-1}; heat of liquid fusion and vapourisation of water are 334 kJ kg^{-1} and 2491kJkg^{-1} respectively).
(log273 = 2.436, log 373 = 2.572, log383 = 2.583)

(a) 9.25 kJ kg^{-1} K^{-1} (b) 8.49 kJ kg^{-1} K^{-1}
(c) 7.90 kJ kg^{-1} K^{-1} (d) 2.64 kJ kg^{-1} K^{-1}

JEE Main-2019 Shift-II

Ans. (a) : The conversion of 1kg of ice at 273 K into water vapours at 383 K takes place as follow–

$$\underset{273K}{H_2O(s)} \xrightarrow{\Delta S_1} \underset{273K}{H_2O(l)} \xrightarrow{\Delta S_2} \underset{373K}{H_2O(l)} \xrightarrow{\Delta S_3} \underset{373K}{H_2O(g)} \xrightarrow{\Delta S_4} \underset{383K}{H_2O(g)}$$

$$\Delta S_1 = \frac{\Delta H_{Fusion}}{\Delta T_{Fusion}} = \frac{334}{273} = 1.22\,kJ\,kg^{-1}K^{-1}$$

$$\Delta S_2 = C\log\frac{T_2}{T_1} = 4.2\log\left(\frac{373}{273}\right)$$

$= 4.2 \times 2.303(\log373 - \log273)$ kJ K^{-1} kg^{-1}
$= 4.2 \times 2.303(2.572 - 2.436)$
$= 1.31$ kJ K^{-1} kg^{-1}

$$\Delta S_3 = \frac{\Delta H_{vap.}}{\Delta T_{vap.}} = \frac{2491}{373} = 6.67\,kJ\,kg^{-1}K^{-1}$$

$$\Delta S_4 = C\log\frac{T_2}{T_1} = 2\log\left(\frac{383}{273}\right)$$

$= 2\times2.303(\log383 - \log373)$
$= 2\times2.303(2.583 - 2.572)$
$= 0.05$ kJ K^{-1} kg^{-1}

$\Delta S_{Total} = \Delta S_1 + \Delta S_2 + \Delta S_3 + \Delta S_4$
$= 1.22+1.31+6.67+0.05$
$= 9.26$ kJ kg^{-1} K^{-1}

169. A process has $\Delta H = 200$ J mol^{-1} and $\Delta S = 40$ JK^{-1} mol^{-1}. Out of the values given below, choose the minimum temperature above which the process will be spontaneous

(a) 20 K (b) 4 K
(c) 5 K (d) 12 K

JEE Main-2019, Shift-II

Ans. (c) : $\Delta G = \Delta H - T\Delta S < 0$ $(\Delta G = \Delta H - T\Delta S)$

$$T = \frac{\Delta H}{\Delta S} = \frac{200}{40} = 5K$$

170. The process with negative entropy change is

(a) Synthesis of ammonia from N_2 and H_2
(b) Dissociation of $CaSO_4(s)$ to $CaO(s)$ and $SO_3(g)$
(c) Dissolution of iodine in water
(d) Sublimation of dry ice

JEE Main-2019, Shift-II

Ans. (a) : Four moles of gas ($N_2 + 3H_2 \rightarrow 2NH_3$) reacts to give two mole of gas
Hence, Entropy decreases.
$\Delta n_g < 0$, it mean's entropy = Negative

171. The true statement amongst the following is-

(a) S is not a function of temperature but ΔS is a function of temperature.
(b) Both ΔS and S are functions of temperature.
(c) Both S and ΔS are not functions of temperature
(d) S is a function of temperature but ΔS is not a function of temperature.

JEE Main-2020, Shift-II

Ans. (b) : By definition of entropy

$$ds = \frac{dQ}{T} \text{ and } \Delta s = \int\frac{dQ}{T}$$

So, ΔS, S both are the function of temperature.

172. Data given for the following reaction is as follows. $FeO(s) + C_{(graphite)} \longrightarrow Fe(s) + CO(g)$

Substance	**ΔH° (kJ mol^{-1})**	**ΔS° (J mol^{-1} K^{-1})**
FeO(s)	–266.3	57.49
$C_{(graphite)}$	0	5.74
Fe(s)	0	27.28
CO(g)	–110.5	197.6

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The minimum temperature in K at which the reaction becomes spontaneous is .... (Integer answer)

JEE Main-2021, Shift-II

Ans. (964): $FeO_{(s)} + C_{(graphile)} \longrightarrow Fe_{(s)} + CO_{(g)}$

$$\Delta H^o_{reaction} = \Delta H^o_{f(product)} - \Delta H^o_{f(reactants)}$$
$$= [\Delta H^o_{f(Fe)} + \Delta^o_{f(CO)}] - [\Delta^o_{f(FeO)} - \Delta^o_{f(C)}]$$
$$= [0 + (-110.5)] - [266.3 - 0]$$
$$= 156\,kJ\,mol^{-1}$$
$$\Delta S^o_{reaction} = \Delta S^o_{product} - \Delta S^o_{reactant}$$
$$= [\Delta S^o_{(Fe)} + \Delta S^o_{(CO)}] - [\Delta S^o_{(FeO)} - \Delta S^o_{(C)}]$$
$$= [27.28 + 197.6] - [57.49 + 5.79]$$
$$= 161\,JK^{-1}\,mol^{-1}$$

According to Gibb's equation,

$$\Delta G^o = \Delta H^o - T\Delta S^o$$
$$T\Delta S^o = \Delta H^o$$
$$\Rightarrow \quad T = \frac{\Delta H^o}{\Delta S^o} = \frac{156}{161}$$
$$= \frac{156000}{161} = 964\,K$$

The temperature at which reaction becomes spontaneous is 964 K.

173. For the reaction,

$$\mathbf{2NO_2(g) \rightleftharpoons N_2O_4(g)}\ \textbf{when}$$

$\Delta S = -176.0\ JK^{-1}$ and $\Delta H = -57.8\ kJ\ mol^{-1}$, the magnitude of ΔG at 298 K for the reactions is .... $kJ\ mol^{-1}$. (Nearest integer)

JEE Main-2021 Shift-II

Ans. (5) : Given that,

$\Delta S = -176.0\ JK^{-1}$

$\Delta H = -57.8\ kJ\ mol^{-1}$

$\Delta G = \Delta H - T\Delta S$

$$\Delta G = 57.8 - \frac{298(-176)}{1000}$$

$\Delta G = -5.352$ kJ/mole

174. ($\Delta H - \Delta E$) for the formation of carbon monoxide (CO) from its elements at 298 K is ($R = 8.314\ JK^{-1}\ mol^{-1}$)

(a) $-1238.78\ J\ mol^{-1}$ (b) $1238.78\ J\ mol^{-1}$

(c) $-2477.57\ J\ mol^{-1}$ (d) $2477.57\ J\ mol^{-1}$

AIEEE-2006

Ans. (b) : $C_{(s)} + \frac{1}{2}O_{2(g)} \longrightarrow CO_{(g)}$

$\Delta ng = 1 - \frac{1}{2} = 0.5$ ($\Delta nq \to Gaseous_P - Gaseous_R$)

$\Delta H = \Delta U + \Delta ng\ RT$

$\therefore \quad \Delta H - \Delta U = \Delta ng \times R \times T$

$= 0.5 \times 8.314 \times 298$

$\Delta H - \Delta U = 1238.78$J/mol.

175. The enthalpy changes for the following processes are listed below

Cl_2 (g) = 2Cl(g), 242.3 $kJ\ mol^{-1}$

I_2 (g) = 2I (g), 151.0 $kJ\ mol^{-1}$

ICl(g) = I(g) + Cl(g), 211.3 $kJ\ mol^{-1}$

I_2 (s) = I_2 (g), 62.76 $kJ\ mol^{-1}$

Given that the standard states for iodine and chlorine are I_2 (s) and Cl_2 (g), the standard enthalpy of formation of ICl is

(a) $-14.6\ kJ\ mol^{-1}$ (b) $-16.8\ kJ\ mol^{-1}$

(c) $+16.8\ kJ\ mol^{-1}$ (d) $+244.8\ kJ\ mol^{-1}$

AIEEE-2006, AIIMS-2015

Ans. (c) : Here correct option is (b) Not (c).

$$\frac{1}{2}I_2(s) \to \frac{1}{2}Cl_2(g) \to ICl(g)$$
$$\Delta H = \left[\frac{1}{2}\Delta H_{s\to g} + \frac{1}{2}\Delta H_{diss}(Cl_2) + \frac{1}{2}\Delta H_{diss}(l)\right] - \Delta H_{ICl}$$
$$= \left(\frac{1}{2}\times 62.76 + \frac{1}{2}\times 242.3 + \frac{1}{2}\times 151.0\right) - 211.3$$
$$= 228.03 - 211.3$$
$$\Delta H = 16.73\ kJ\,mol^{-1}$$

176. The value of enthalpy change (ΔH) for the reaction

$$\mathbf{C_2H_5OH(\mathit{l}) + 3O_2(g) \to 2CO_2(g) + 3H_2O(\mathit{l})}\ \textbf{at}$$

27^oC is – 1366.5 $kJ\ mol^{-1}$. The value of internal energy change for the above reaction at this temperature will be

(a) –1371.5 kJ (b) –1369.0 kJ

(c) –1364.0 kJ (d) –1361.5 kJ

AIEEE-2011

Ans. (c) : $\Delta H = \Delta E + \Delta n_gRT$

$\Delta E = -1366.5 + 1 \times 8.314 \times 10^{-3} \times 300$

$= -1363.6$ kJ

177. Consider the reaction,

$$\mathbf{4NO_2(g) + O_2(g) \to 2N_2O_5(g)\ \Delta_rH = -111kJ}$$

If N_2O_5 (s) is formed instead of N_2O_5(g) in the above reaction, the Δ_rH value will be

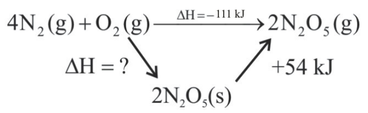
(Given, ΔH of sublimation for N_2O_5 is 54 kJ mol^{-1})

(a) –165 kJ (b) +54 kJ

(c) +219 kJ (d) –219 kJ

AIEEE-2011

Ans. (a) :


$4N_2(g) + O_2(g) \xrightarrow{\Delta H = -111\,kJ} 2N_2O_5(g)$
ΔH = ?
+54 kJ
$2N_2O_5(s)$

From Hess's law,

$\Delta H_f + \Delta H_{sub} = \Delta H_{reaction}$

$\Delta H_f = \Delta H_{reaction} - \Delta H_{sub}$

$= -111kJ - (54\ kJ)$

$= -111 - 54\ kJ = -165$ kJ

178. Given, $C_{(graphite)} + O_2(g) \to CO_2(g)$;

$$\mathbf{\Delta_rH^o = -393.5\,kJ\ mol^{-1}}$$

$$\mathbf{H_2(g) + \frac{1}{2}O_2(g) \to H_2O(\mathit{l});}$$

$$\mathbf{\Delta_rH^o = -285.8\,kJ\ mol^{-1}}$$

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$CO_2(g) + 2H_2O(l) \rightarrow CH_4(g) + 2O_2(g)$;

$\Delta_r H^o$ = +890.3 kJ mol^{-1} Based on the above thermochemical equations, the value of $\Delta_r H^o$ at 298 K for the reaction,

$C_{(graphite)} + 2H_2(g) \rightarrow CH_4(g)$ will be

(a) + 78.8 kJ mol^{-1} (b) + 144.0 kJ mol^{-1}
(c) –74.8 kJ mol^{-1} (d) –144.0 kJ mol^{-1}

[JEE Main 2017]

Ans. (c) :

$C_{graphite} + O_{2(g)} \rightarrow CO_{2(g)}$; ΔrH^o = – 393.5 ... (1)

$H_2(g) + \frac{1}{2}O_2(g) \rightarrow H_2O(1)$; $\Delta rH^o = -285.8$ ...(2)

$CO_2(g) + 2H_2O(I) \rightarrow CH_4 + 2O_2(g)$; ΔrH^o = + 890.3 ... (3)

Add reactions (1) and (3)

$C_{(graphite)} + 2H_2O(I) \rightarrow CH_4(g) + O_2(g)$ ... (4)

Multiply reaction (2) with 2

$2H_2(g) + O_2(g) \rightarrow 2H_2O(1)$ ...(5)

ΔH = – 285.8 × 2 = –571.6 kJ/mol

Add reaction (4) and (5)

$C_{(graphites)} + 2H_2(g) \rightarrow CH_4(g)$

ΔH = 496.8 – 571.6

= –74.8 kJ/mol

179. For silver, $C_p(JK^{-1}mol^{-1})$ 23 + 0.01T. If the temperature (T) of 3 moles of silver is raised from 300 K to 1000 K at 1 atm pressure, the value of ΔH will be close to

(a) 62 kJ (b) 16 kJ
(c) 21 kJ (d) 13 kJ

[JEE Main 2019, 8 April Shift-I]

Ans. (a) : $\Delta H = n\int_{T_1}^{T_2} C_P dT = 3 \times \int_{300}^{1000}(23 + 0.01T)dT$

$= 3\left[23(1000-300) + \frac{0.01}{2}(1000^2 - 300^2)\right]$

= 61950J ≈ 62 kJ.

180. The difference between ΔH and ΔU ($\Delta H - \Delta U$), when the combustion of one mole of heptane (*l*) is carried out at a temperature T, is equal to

(a) –4 RT (b) 3 RT
(c) 4 RT (d) –3 RT

[JEE Main 2019, to April Shift-II]

Ans. (a) : $C_7H_{16}(l) + 11HO_2(g) \rightarrow 7CO_2(g) + 8H_2O(l)$

Now,

$\Delta n_g = n_p - n_r = 7 - 11 = -4$

$\because \Delta H = \Delta U + \Delta n_g RT$

$\therefore \Delta H - \Delta U = -4RT$

181. At 298.2 K the relationship between enthalpy of bond dissociation (in kJ mol^{-1}) for hydrogen (E_H) and its isotope, deuterium E_D), is best described by

(a) $E_H = \frac{1}{2}E_D$ (b) $E_H = E_D$
(c) $E_H = E_D - 7.5$ (d) $E_H = 2E_D$

[JEE Main 2021, 25 July Shift-I]

Ans. (c) : Enthalpy of bond dissociation (kJ/mole) at 298.2 K.

For, Hydrogen = 435.88

For, Deuterium = 443.35

$E_H = E_D - 7.5$

182. When 400 mL of 0.2 M H_2SO_4 solution is mixed with 600 mL of 0.1 M NaOH solution, the increase in temperature of the final solution is .... × 10^{-2} K. (Round off to the nearest integer).

[Use : $H^+(aq) + OH^+(aq) \rightarrow H_2O$; ΔH = –57.1kJ mol^{-1}]

Specific heat of H_2O = 4.18 J $K^{-1}g^{-1}$, density of H_2O = 1.0 g cm^{-3}. Assume no change in volume of solution on mixing.

[JEE Main 2021, 27 July Shift-II]

Ans. (82) :

$nH^+ = \frac{400 \times 0.2}{1000} \times 2 = 0.16$

$nOH^- = \frac{600 \times 0.1}{1000} = 0.06$ (L.R.)

Now, heat liberated from reaction = heat gained by solutions.

0.06 × 57.1 × 10^3 = (1000 × 1.0) × 4.18 × ΔT

ΔT = 0.8196 K

= 81.96 × 10^{-2} K = 82 × 10^{-2} K

183. For water at 100°C and 1 bar, $\Delta_{vap}H - \Delta_{vap}U$= ....×$10^2$ J mol^{-1}.

(Round off to the nearest integer)

[Use : R = 8.31J $mol^{-1}K^{-1}$]

[Assume volume of $H_2O(l)$ is much smaller than volume of $H_2O(g)$. Assume $H_2O(g)$ treated as an ideal gas]

[JEE Main 2021, 27 July Shift-I]

Ans. (31) : $\Delta H - \Delta U = \Delta n_g RT$

$\Delta n_g = 1 - 0 = 1$

$\Delta H - \Delta U$ = 1 × 8.31 × 3.73

$\Delta H - \Delta U$ = 30.99 × 10^2 J mol^{-1}

$\Delta H - \Delta U$ ≈ 31 × 10^2 J mol^{-1}

= 31

184. The Born-Haber cycle for KCl is evaluated with the following data :

$\Delta_f H^o$ for KCl = –436.7 kJ mol^{-1}

$\Delta_{sub}H^o$ for K = 89.2 kJ mol^{-1}.

$\Delta_{ionisation}$ H^o for K = 419.0 kJ mol^{-1}

$\Delta_{electron\ gain}$ H^o for Cl(g) = –348.6 kJ mol^{-1}, $\Delta_{bond}H^o$ for Cl_2 = 243.0 kJ mol^{-1}

The magnitude of lattice enthalpy of KCI in kJ mol^{-1} is ....

(Nearest integer)

[JEE Main 2021, 26 Aug Shift-I]

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Ans. (718) :

$$\begin{tikzcd}
K(s) \arrow[d, "\Delta H_{sublimation}"'] & +\frac{1}{2}Cl_2(g) \arrow[r] \arrow[d, "\Delta H_{dissociation}"] & KCl(s);\Delta H_f^0 \\
K(g) \arrow[d, "IE_1"'] & Cl(g) \arrow[d, "EA"] & \\
K^+(g) & +\frac{1}{2}Cl^-{}_2(g) \arrow[r] & KCl(s);\Delta H^0_{lattice}
\end{tikzcd}$$

$$\therefore \Delta_f^0 = \Delta H_{sublimation} + \frac{1}{2}\Delta H_{dissociation} + IE_1 + EA + \Delta H^0_{lattice}$$

$$-436.7\,kJ/mol = 89.2\,kJ/mol + \frac{1}{2}\times(243\,kJ/mol)$$

$$+419\,kJ/mol + (-348.6\,kJ/mol) + \Delta H^0_{lattice}$$

$$\Delta H^0_{lattice} = -717.8\,kJ/mol$$

$\therefore$ Magnitude of lattice enthalpy of KCl in kJ/mol is 718 (nearest).

185. Heat required to raise the temperature of 1 mole of a substance by 1^o is called

(a) specific heat (b) molar heat capacity

(c) water equivalent (d) specific gravity

AIEEE-2002

Ans. (b) : Heat required to raise the temperature of 1 mole of a substance by 1^{o}C is called molar heat capacity.

186. An ideal gas is allowed to expand both reversibly and irreversibly in an isolated system. If T_i is the initial temperature and T_f is the final temperature, then which of the following statements is correct?

(a) $(T_f)_{irrev} > (T_f)_{rev}$

(b) $T_f > T_i$ for reversible process but $t_f = t_i$ for irreversible process

(c) $(T_f)_{rev} = (T_f)_{irrev}$

(d) $T_f = T_i$ for both reversible and irreversible processes

AIEEE-2006

Ans. (a) : According to law of thermodynamics,

$\Delta E = \Delta q + \Delta W$

Since, the system is isolated, therefore the change takes place adiabatically. Thus,

$\Delta q = 0$

So, $\Delta E = \Delta W$

We know, $\Delta W_{irreversible} > \Delta W_{reversible}$

This implies $\Delta E_{irreversible} > \Delta E_{reversible}$

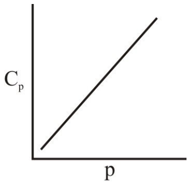
$\Delta E = nR\Delta T$

As a result, $\Delta T_{irrev} > \Delta T_{rev.}$

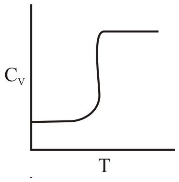
Thus, $(T_f)_{irrev} > (T_f)_{rev.}$

187. For a diatomic ideal gas in a closed system, which of the following plots does not correctly describe the relation between various thermodynamic quantities?

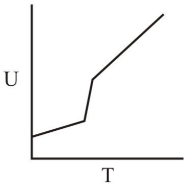
(a)



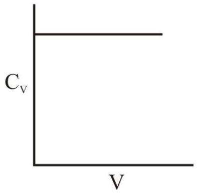
(b)



(c)



(d)



JEE Main-2019

Ans. (a) : At higher temperature the rotational degree of freedom become active

$$C_P = \frac{7}{2}R \text{ (Independent of P)}$$

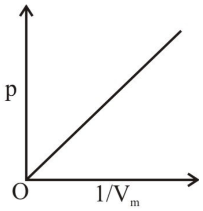
$$C_V = \frac{5}{2}R \text{ (Independent of V)}$$

C_V depends on T and independent of V.

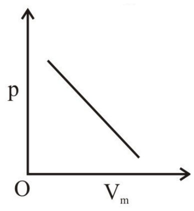
C_P depends on T and independent of P.

188. The combination of plots which does not represent isothermal expansion of an ideal gas is

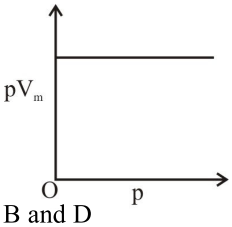
(a)



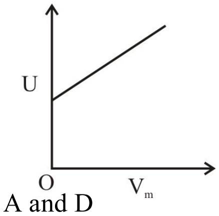
(b)



(c)



(d)



(a) B and D (b) A and D

(c) B and C (d) A and C

[JEE Main 2019, 12 Jan Shift-II]

Ans. (a) :

From graph B

Here, $P \propto \frac{1}{V_m}$

For Isothermal expansion,

$PV_m = K$ (Where K = Constant)

So, if graph is parabolic in nature then it will represent Isothermal expansion of an ideal gas.

From Graph D :

here, U = Constant and it shows straight line.

So, option (b) and (d) does not represent isothermal expansion of an ideal gas.

189. ΔU is equal to

(a) isochoric work (b) isobaric work

(c) adiabatic work (d) isothermal work

[JEE Main-2017]

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Ans. (c) : $\Delta U = Q + \Delta W$

For adiabatic work, heat value is zero (Q = 0). So change in energy is equal to the work.

$\Delta U = 0 + \Delta W$

$\Delta U = \Delta W_{adiabatic}$

Thus, ΔU is equal to adiabatic work.

190. 5 moles of an ideal gas at 100 K are allowed to undergo reversible compression till its temperature becomes 200 K. If $C_v = 28\ JK^{-1}\ mol^{-1}$, calculate ΔU and ΔPV for this process. ($R = 8.0\ JK^{-1}\ mol^{-1}$)

(a) ΔU=2.8kJ; Δ(pV)=0.8kJ

(b) ΔU=14 J; Δ(pV) = 0.8 J

(c) ΔU=14 kJ; Δ(pV) = 4 kJ

(d) ΔU=14 kJ; Δ(pV) = 18 kJ

[JEE Main 2019, 8 april Shift-II]

Ans. (c) : Given that,

Number of moles of an ideal gas (n) = 5 mol

Temperature, $T_2 = 200$ K

$T_1 = 100$ K

Specific heat at constant pressure $(C_v) = 28\,J/mol\,K$

$$\Delta U = nC_v\Delta T$$

$$= 5mol \times 28J/mol\,K \times (200-100)K$$

$$= 14000J = 14k\,J$$

$$C_p = C_v + R = (28+8)J/mol\,K$$

$$= 36J/mol\,K$$

$$\Delta H = nC_p\Delta T = 5mol \times 36J/mol\,K \times 100K$$

$$= 18000J = 18kJ$$

$$\Delta H = \Delta U + \Delta PV$$

$$\Delta PV = \Delta H - \Delta U = (18-14)kJ = 4kJ$$

191. Among the following the set of parameters that represents path function, is

(A) q + W (B) q

(C) W (D) H–TS

(a) (A) and (D) (b) (A), (B) and (C)

(c) (B), (C) and (D) (d) (B) and (C)

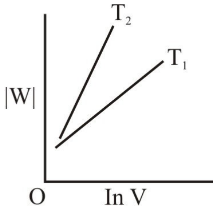
[JEE Main 2009, 9 April Shift-I]

Ans. (d) : A property whose value does not depend on the path taken to reach that specific value is known to as state function or point functions. In contrast, those function which do depend on the path from two points are known as path function.

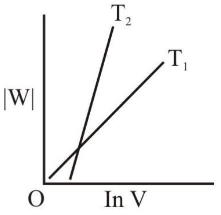
Hence, we know that heat and work are not state function but Q + W = ΔU (Definite quantity) is state function. H – TS (i.e., G) is also a state function. In essence, heat and work changes in every step of the process hence they are path function.

192. Consider the reversible isothermal expansion of an ideal gas in a closed system at two different temp. T_1 and T_2 ($T_1 < T_2$). The correct graphical depiction of the dependence of work done (W) on the final volume (V) is

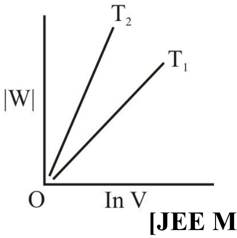
(a)



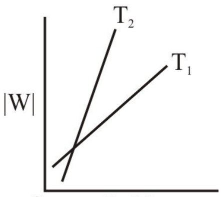
(b)



(c)



(d)



[JEE Main 2019, 9 Jan Shift-I]

Ans. (b) : For isothermal expansion–

$$w_{rev.} = -nRT\ln\frac{V_f}{V_i}$$

$$|w_{rev.}| = nRT\ln\frac{V_f}{V_i}$$

$|w_{rev.}| = nRT \ln V_f - nRT \ln V_i$

Comparing it with straight line equation, y = mx + c

Therefore, slope of curve (a) is more than curve (d) and intercept of curve (b) is more negative than curve (d).

193. For water $\Delta_{vap}H = 41kJ\ mol^{-1}$ at 373 K and 1 bar pressure. Assuming that water vapour is an ideal gas that occupies a much larger volume than liquid water, the internal energy change during evaporation of water is ....kJ mol^{-1}.

[User $R = 8.3\ J\ mol^{-1}\ K^{-1}$]

[JEE Main 2021, 26 Aug Shift-II]

Ans. 38 : $H_2O(l) \rightleftharpoons H_2O(g)\ \Delta H_{vap.} = 41\ kJ\ mol^{-1}$

For the reaction–

$\Delta H = \Delta E + \Delta n_g RT$

Given that,

$\Delta H = 41\ kJ\ mol^{-1}$

Gas constant (R) = 8.314 J/K mol

Temperature (T) = 373 K

ΔE is internal energy charge

Δn_g is change in gaseous mole = 1 – 0 = 1

Means $\Delta n_q > 0$

$41 \times 10^{-3} = \Delta E + 1 \times 8.3 \times 373$

$\Delta E \approx (41 - 3.0959) = 38\ kJ\ mol^{-1}$

194. A system does 200 J of work and at the same time absorbs 150 J of heat. The magnitude of the change in internal energy is ....J. (Nearest integer)

[JEE Main 2021, 25 July Shift-II]

Ans. 50 : Given that–

W = –200 J, Q = +150

According to first law of thermodynamics–

$\Delta U = Q + W$

$\Delta U = 150 - 200 = -50J$

Hence, internal energy –50 J

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195. At 300 K and 1 atm, 15 mL of a gaseous hydrocarbon requires 375 mL air containing 20% O_2 by volume for complete combustion. After combustion, the gases occupy 330 mL. Assuming that the water formed is in liquid form and the volumes were measured at the same temperature and pressure, the formula of the hydrocarbon is

(a) C_3H_8 (b) C_4H_8
(c) C_4H_{10} (d) C_3H_6

[JEE Main 2016]

Ans. (a) : Combustion of hydrocarbon C_xH_y is given as,

$$C_xH_y(g)+\left(x+\frac{y}{4}\right)O_2(g)\rightarrow xCO_2(g)+\frac{y}{2}H_2O(l)$$

15 mL hydrocarbon requires $15\left(x+\frac{y}{4}\right)$mL oxygen

Volume of O_2 = 20% of 375

$$=\frac{200}{100}\times 375$$

$$\therefore \quad 15\left(x+\frac{y}{4}\right)=75$$

$$x+\frac{y}{4}=5 \qquad .....(i)$$

Final volume = 330 mL

Initial volume = 375 + 15 = 390 mL

H_2O formed = 390 – 330 = 60 mL

$$\Rightarrow \quad 15\times\frac{y}{2}=60$$

$$y = 8$$

Putting the value of y in equation (i), we get–

$$x = 3$$

∴ Hydrocarbon will be C_3H_8.

196. A gaseous hydrocarbon gives upon combustion, 0.72 g of water and 3.08 g of CO_2 The empirical formula of the hydrocarbon is

(a) C_2H_4 (b) C_3H_4
(c) C_6H_5 (d) C_7H_8

[JEE Main 2013]

Ans. (d) : $C_AH_B+\left(A+\frac{B}{4}\right)O_2\rightarrow ACO_2+\frac{B}{2}H_2O$

Moles of H_2O $=\frac{0.72}{18}=0.04$

Moles of CO_2 $=\frac{3.08}{44}=0.07$

$$\therefore \quad \frac{A}{\frac{B}{2}}=\frac{0.07}{0.08}$$

$$\Rightarrow \quad \frac{A}{B}=\frac{7}{8}$$

So, A = 7, B = 8

Empirical formula is C_7H_8

197. During spontaneous discharge of an electrochemical cell, Gibb's free energy will

(a) increase (b) decrease
(c) not change (d) be infinity

J & K CET-(2012)

Ans. (b) : During spontaneous discharge for electrochemical cell, Gibbs free energy will decreases.

$\Delta G^o = -nFE^o_{Cell}$ ($\Delta G < 0$)

$\Delta G^o < 0 \rightarrow$ –ve decreases

$E^o_{cell} > 0 \rightarrow$ +ve increases

198. The thermochemical property which always takes up negative values is

(a) Enthalpy of formation
(b) Lattice enthalpy
(c) Enthalpy of atomisation
(d) Enthalpy of combustion.

J & K CET-(2016)

Ans. (d) : Enthalpy of combustion is defined as the heat change (usually the heat evolved) when one mole of substance is completely burnt in oxygen with all the reactants and product in their standard state under standard conditions (298 K and 1 bar pressure).

Enthalpy of combustion is an exothermic reaction.

199. The enthalpy change accompanying a reaction is called

(a) reaction enthalpy
(b) standard enthalpy
(c) thermochemical equation
(d) enthalpy of atomization.

J & K CET-(2014)

Ans. (a) : Enthalpy of reaction is also known as the heat of reaction. It is the change in the enthalpy of a chemical reaction that occurs at a constant pressure. It is thermodynamic unit of measurement useful of calculating the amount of energy per mole either released or produced in a reaction.

The heat change during a chemical reaction is called enthalpy and the enthalpy change accompanying a reaction is called enthalpy or enthalpy of reaction.

200. Which one of the following options is correct for the spontaneity of the reaction?

(a) ΔG = Positive (+ ve); ΔH = positive (+ ve)
(b) ΔH = Positive (+ ve); ΔS = negative (– ve)
(c) ΔG = negative (– ve); ΔS = negative (– ve)
(d) ΔG = negative (– ve); ΔS = positive (+ ve)

J & K CET-(2017)

Ans. (d) : $\Delta G = \Delta H - T\Delta S$

Where, ΔG = Gibbs free energy change
ΔH = Enthalpy change
ΔS = Entropy change

$\Delta G < 0$, it means ΔG is always negative in spontaneous reaction and entropy change (ΔS) is always positive in spontaneous reaction.

So, option (d) are correct.

201. Thermodynamic properties are divided into two broad types: intensive properties and extensive properties. Which of the following is not an intensive property?

(a) Pressure (b) Volume
(c) Temperature (d) Density

J & K CET-(2017)

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Ans. (b) : Volume is extensive property because volume are dependent on mass. So, intensive property do not depends on the mass.

Example–Intensive property examples density temperature pressure.

202. What condition will facilitate the spontaneity of a reaction if ΔH and ΔS both are negative?

(a) Low temperature (b) High temperature
(c) Low pressure (d) High pressure

J & K CET-(2018)

Ans. (a) : Given that–

$\Delta H = -ve$ and $\Delta S = -ve$

$\Delta G = \Delta H - T\Delta S$ (If phase change, then $\Delta G = 0$)

For a spontaneous reaction we know that–

$\Delta G = -ve$

$\Delta G = -ve \Rightarrow (T = -ve)$

So, the reaction becomes spontaneous only when the temperature is very less.

203. Which of the following options is an intensive property of a system?

(a) Mass (b) Volume
(c) Potential energy (d) Temperature

J & K CET-(2019)

Ans. (d) : Temperature is an intensive property as it does not depend upon the quantity of matter present in the system.

Intensive → Independent of mass

204. PV value decreases with increases in P at constant temperature when

(a) There is no attractive or repulsive forces between molecules
(b) attractive and repulsive forces between molecules are equal
(c) attractive forces between molecules are predominant
(d) repulsive forces between molecules are predominant.

J & K CET-(2015)

Ans. (c) : It can be seen easily that at constant temperature, PV vs P plot for real gases is not a straight line. There is a significant deviation from ideal behaviour. Two types of curves are seen. In the curves for hydrogen and Helium, as the pressure increases the value of PV also increases. The second type of plot is seen in the case of other gas like carbon mono oxide and methane. In these plots, first there is a negative deviation from ideal behavior then, PV value decreases.

205. Among the following pairs, which one has both variables as intensive variable?

(a) T, V (b) m, P
(c) d, V (d) P, T

J & K CET-(2015)

Ans. (d) : The properties which do not depend upon the quantity or size of matter are called intensive properties e.g. pressure, temperature, density, concentration, surface tension, viscosity etc. and extensive are dependent on mass or quantity of matter.

206. For the process to occur under adiabatic condition, the correct condition is

(a) $\Delta T = 0$ (b) $\Delta U = 0$
(c) $\Delta P = 0$ (d) $\Delta q = 0$

J & K CET-(2015)

Ans. (d) : A system is said to be under adiabatic condition if there is no exchange of heat between the system and its surroundings. It means ($\Delta q = 0$).

Hence, under adiabatic condition, $\Delta q = 0$

207. In thermodynamics, a quantity whose value simply depends upon the initial and final states of the system is called

(a) a thermodynamic quantity
(b) a state function
(c) an adiabatic quantity
(d) a path function

J & K CET-(2013)

Ans. (b) : State Function–The properties which depends only on initial and final state, not on path or reaction intermediate are called state function.

e.g. Entropy, Gibb's free energy, etc.

208. If ΔH and ΔS are positive for a reaction, the reaction will be spontaneous only when

(a) $T\Delta S = \Delta H$ (b) $T\Delta S > \Delta H$
(c) $T\Delta S < \Delta H$ (d) $T\Delta S$ is negative

J & K CET-(2013)

Ans. (b) : $\Delta G = \Delta H - T\Delta S$

For spontaneous $\Delta G° < 0$

It means $\Delta H - T\Delta S$ is also negative–

So, $T\Delta S > \Delta H$

209. Which one among the following pairs does not represent example for intensive property?

(a) Temperature and density
(b) pressure and molar volume
(c) Molar heat capacity and density
(d) Heat capacity and enthalpy

J & K CET-(2011)

Ans. (d) : Pressure, temperature, density, specific heat surface tension, molar volume etc are intensive properties (independent of mass). Heat capacity and enthalpy are extensive properties since they depend upon the quantity of matter in the system.

210. We believe in the laws of thermodynamics because they are

(a) Theoretical
(b) Derived based on mathematical analysis
(c) Empirical and nobody disproved
(d) Mere statements

J & K CET-(2008)

Ans. (d): Only the laws of thermodynamics are mere statements, so they are believed. Many mathematical expression are divided on the basic of these laws.

211. All naturally occurring process proceed spontaneously in a direction, which leads to

(a) increases of enthalpy
(b) increase of free energy
(c) decrease of free energy
(d) decrease of entropy

J & K CET-(2013, 2007)

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Ans. (c): Conditions for spontaneity:-

Enthalpy : ΔH = negative
Entropy : ΔS = positive
$\Delta G = \Delta H - T\Delta S$
(–ve) (-ve) (+ve)

Therefore, all naturally occurring process proceed spontaneously in a direction, which leads to decrease of free energy.

212. For a chemical reaction, the free energy change (ΔG) is negative. The reaction is

(a) a spontaneous reaction
(b) an equilibrium reaction
(c) an equilibrium reaction
(d) characterised by $r_f = r_b$ (where r_f and r_b are rates of forward and backward and backward reactions respectively)

J & K CET-(2006)

Ans. (a) : ΔG is negative for spontaneous reaction Gibbs free energy relates enthalpy, entropy & temperature.

A spontaneous reaction will always occur when ΔH is negative & ΔS is positive.

$\Delta G = \Delta H - T\Delta S$.

When $\Delta H - T\Delta S$ is negative so ΔG is also negative.

213. ΔG for a spontaneous reaction is

(a) zero
(b) negative
(c) positive
(d) could be positive or negative

J & K CET-(2005)

Ans. (b) : ΔG gives a criteria for spontaneous at constant pressure and temperature.

(i) If ΔG is negative (< 0), the process is spontaneous.

Because, $\Delta G = \Delta H - T\Delta S$

Here, $\Delta H < 0$ and $\Delta S > 0$

So, $\Delta G < 0$

(ii) If ΔG is positive (> 0), the process is non-spontaneous.

(iii) If ΔG is zero then reaction is equilibrium.

214. Which of the following is not an endothermic reaction?

(a) dehydrogenation
(b) ethane to ethene
(c) combustion of propane
(d) change of chlorine molecule into chlorine atoms

J & K CET-(2005)

Ans. (c) : Propane releases its chemical energy by undergoing hydrocarbon combustion. Below is a hydrocarbon combustion animation showing the net reaction that occurs when propane combines with oxygen.

$C_3H_8 + 5O_2 \rightarrow 3CO_2 + 4H_2O + \text{Heat energy}$

The hydrogen combustion reaction releases heat energy and it is an example of an exothermic reaction. The reaction also has a negative enthalpy change (ΔH) value.

215. A process in which the system does not exchange heat with the surroundings is known as

(a) isothermal (b) isobaric
(c) isochoric (d) adiabatic

JIPMER-2013
J & K CET-(2005)

Ans. (d) Adiabatic Process–When a thermodynamic system undergoes a change in such a way that no exchange of heat takes place between systems and surroundings, the process is known as an adiabatic process. During the adiabatic process, there is no exchange of heat that takes place between the system and surroundings.

i.e. $\Delta Q = 0$

216. In a reversible process, $\Delta S_{sys} + \Delta_{Surr}$ is

(a) > 0 (b) < 0
(c) ≥ 0 (d) $= 0$

J & K CET-(2004)

Ans. (d): Entropy of the system and surrounding remains constant in a reversible equilibrium process.

i.e., $\Delta S_{total} = \Delta S_{system} + \Delta_{Surrounding} = 0$

217. For the reaction, $N_2 + 3H_2 \rightleftharpoons 2NH_3$; ΔH =?

(a) $\Delta E + 2RT$ (b) $\Delta E - 2RT$
(c) $\Delta E + RT$ (d) $\Delta E - RT$

J & K CET-(2004)

Ans. (b) : $N_2 + 3H_2 \longrightarrow 2NH_3$

$\Delta H = \Delta E + \Delta n_g RT$
$\Delta n_g = 2 - (3 + 1) = -2,$
$\boxed{\Delta H = \Delta E - 2RT}$

218. For the process $H_2O_{(l)} \rightleftharpoons H_2O_{(g)}$ at 100^0C, 1 atm pressure,

(a) $\Delta H = T\Delta S$ (b) $\Delta H = 0$
(c) $\Delta H = \Delta E$ (d) $\Delta E = 0$

J & K CET-(2002)

Ans. (a) : $H_2O\ (l) \rightleftharpoons H_2O\ (g)$

At this condition $H_2O(l)$ are converted in to H_2O (g)

$\therefore$ state change, $\Delta G = \Delta H - T\Delta S$

Phase state change,

$\therefore$ $\Delta G = 0$ (the process in equilibrium)

$0 = \Delta H - T\Delta S$

$\boxed{\Delta H = T\Delta S}$

219. A tightly closed dessicator in action is an example of

(a) open system (b) isolated system
(c) closed system (d) none of these

J & K CET-(2002)

Ans. (c) : If a system can exchange only energy with the surrounding but not matter, it is called a closed system.

220. In the reaction milk $\rightarrow$ cheese, ΔS is

(a) 0 (b) negative
(c) positive (d) none of these

J & K CET-(2001)

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Ans. (b): In this conversion of milk (liquid) is converted into cheese (solid) entropy decreases.
Therefore, ΔS is negative
$\Delta S = S_{final} - S_{initial}$
Thus, $\Delta S = -ve$

221. For the process : $CO_2(s) \to CO_2(g)$
(a) both ΔH and ΔS are +ve
(b) ΔH is –ve and ΔS is +ve
(c) ΔH is –ve and ΔS is –ve
(d) Both ΔH and ΔS are –ve

J & K CET-(2000)

Ans. (a) : $CO_2(s) \to CO_2(g)$
The reaction involves conversion of $CO_2(s)$ to $CO_2(g)$ i.e. randomness increases and hence entropy increases. i.e. ΔS = +ve. Further heat is absorbed in this reaction thus, ΔH = +ve.

222. The enthalpy of atomization of carbon and hydrogen are q_1 and q_2 respectively. If q_3 is the bond energy of C – H bond, then ΔH of the following reaction is
$C(s) + 2H_2(g) \to CH_4(g)$
(a) $4q_3 - q_1 - 2q_2$
(b) $q_1 + q_2 - q_3$
(c) $q_1 + 2q_2 - 4q_3$
(d) $q_1 + 4q_2 - 4q_3$

J & K CET-(1998)

Ans. (d) : $C(s) + 2H_2(s) \to CH_4(s) \quad \Delta H = ?$
$C(s) \to C(g); \quad \Delta H_1 = q_1$
$H_2(g) \to 2H(g); \quad \Delta H_2 = 2q_2$
$\Delta H = q_1 + 4q_2 - 4q_3$

223. In which of the following reactions would ΔE be equal to ΔH ?
(a) $2SO_2(g) + O_2(g) \rightleftharpoons 2SO_3(g)$
(b) $H_2(g) + 1/2O_2 \rightleftharpoons H_2O(l)$
(c) $H_2(g) + I_2(g) \rightleftharpoons 2HI(g)$
(d) $NO(g) \rightleftharpoons 2NO(g)$

J & K CET-(1999)

Ans. (c): $H_2(g) + I_2(g) \rightleftharpoons 2HI(g)$
$\Delta n_g = (1+1) - 2 = 0$
$\Delta H = \Delta E + \Delta n_g RT$
$\Delta H = \Delta E$

224. Which one of the following is a non-spontaneous reaction?
(a) dissolution of a salt in water
(b) expansion of a gas into vacuum
(c) melting of ice
(d) passage of a gas from a lower pressure to a higher pressure

J & K CET-(1999)

Ans. (d): A physical or chemical process which don't occurs its own are called non- spontaneous process.
Flow of heat from higher to lower (spontaneous).
∴ Passage of a gas from a lower pressure to a higher pressure (Non-spontaneous)

225. For which of the following reactions ΔH is not equal to ΔE ?
(a) $H_2(g) + I_2(g) = 2HI(g)$
(b) $HCl(aq) = NaOH(aq) = NaCl(aq) + H_2O$
(c) $C(s) + O_2(g) = CO_2(g)$
(d) $N_2(g) + 3H_2(g) = 2NH_3(g)$

J & K CET-(1998)

Ans. (d) : In this reaction Δn = 2 – 4 = –2
If $\quad \Delta n_g < 0$
Since $\quad \Delta H = \Delta E + \Delta n_g RT$

226. Which of the following is not a state function?
(a) q
(b) q + w
(c) E
(d) PΔV

J & K CET-(1997)

Ans. (d) (i) q→ Heat contains by any body at constant pressure is called enthalpy (H) and H are state function
(ii) q + w = U → state function
(iii) E→ state function
(iv) PdV = W → It is a path function

227. In an isothermal expansion of an ideal gas:
(a) W= 0
(b) △E = 0
(c) q = 0
(d) △V = 0

JCECE - 2003

Ans. (b): For isothermal process– T = Constant
or $\quad \Delta T = 0$
Here, $\quad \Delta E = 0$

228. Human body is an example of:
(a) open system
(b) closed system
(c) isolated system
(d) none of these

JCECE - 2004

Ans. (a) : Human body can exchange energy and matter with surrounding. This is an example of open system.

229. For a reaction to be spontaneous at all temperatures
(a) ΔG and ΔH should be negative
(b) ΔG and ΔH should be positive
(c) ΔG = ΔS = 0
(d) ΔH < ΔG

JCECE - 2009

Ans. (a) : For a reaction to be spontaneous ΔG should be negative
$\Delta G = \Delta H - T\Delta S$
For a reaction to be spontaneous at all temperature ΔG and ΔH should be negative.

230. Which one of the following is correct?
(a) $-\Delta G = \Delta H - T\Delta S$
(b) $\Delta H = \Delta G - T\Delta S$
(c) $\Delta S = \frac{1}{T}[\Delta G - \Delta H]$
(d) $\Delta S = \frac{1}{T}[\Delta H - \Delta G]$

JCECE - 2010

Ans. (d) : We know that,
Gibbs free energy is, $\Delta G = \Delta H - T\Delta S$
$T\Delta S = \Delta H - \Delta G$
$\Delta S = \frac{1}{T}[\Delta H - \Delta G)$

231. Which of the following conditions will always lead to a non-spontaneous change?
(a) +ve ΔH and +ve ΔS
(b) –ve ΔH and –ve ΔS
(c) +ve ΔH and –ve ΔS
(d) –ve ΔH and +ve ΔS

JCECE - 2011, J & K CET-(1997)

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Ans. (c) : For a process to be spontaneous, ΔG will be negative.

We know that,

$$\Delta G = \Delta H - T\Delta S$$

If $\Delta H = +$ ve and $\Delta S = -$ ve, ΔG will be positive at all temperatures. Thus, the process is non-spontaneous.

232. Which of the following pairs of a chemical reaction is certain to result in a spontaneous reaction?

(a) Exothermic and decreasing disorder
(b) Endothermic and increasing disorder
(c) Exothermic and increasing disorder
(d) Endothermic and decreasing disorder

JCECE - 2012, CG PET -2007
JIPMER-2007, NEET-2005

Ans. (c) : For a spontaneous reaction, $\Delta G = -$ve.

From Gibb's-Helmholtz equation–

$$\Delta G = \Delta H - T\Delta S$$

$\Delta G = -$ve, when $\Delta H = -$ve and $\Delta S = +$ve

For $\Delta H = -$ve, reaction should be exothermic and $\Delta S = +$ve for increase in disorder.

233. The value of compression factor, Z for critical constants is

(a) $\frac{1}{2}$ (b) $\frac{3}{4}$
(c) $\frac{2}{3}$ (d) $\frac{3}{8}$

JCECE - 2014

Ans. (d) : We know, $P_c = \frac{a}{27b^2}$, $V_c = 3b$

And, $T_c = \frac{8a}{27Rb}$

$$\frac{P_cV_c}{T_c} = \frac{a\times 3b\times 27Rb}{27b^2\times 8a} = \frac{3}{8}R$$

$$\frac{P_cV_c}{RT_c} = \frac{3}{8}$$

Compression factor, $Z = \frac{PV}{RT} = \frac{P_cV_c}{RT_c} = \frac{3}{8}$

234. The enthalpy change for a reaction does not depend upon the

(a) physical state of reactants and products
(b) use of different reactants for the same product
(c) nature of intermediate reaction steps
(d) difference in initial or final temperature of involved substances

JCECE - 2015
AIEEE-2003

Ans. (c) : Enthalpy change (ΔH) is a state function so, it does not depend on the path taken by the reaction, it depend only on the difference of final and initial values of enthalpy change.

235. ΔH and ΔS for the reaction,

$$\mathbf{Ag_2O(s) \rightarrow 2Ag(s) + \frac{1}{2}O_2(g), are\ 30.56\,kJ\,mol^{-1}}$$

and 66.00 JK^{-1} mol^{-1} respectively. The temperature at which the free energy change for the reaction will be zero, is

(a) 3528 K (b) 463 K
(c) 73 K (d) 144 K

JIPMER-2015

Ans. (b) : From the Gibb's – Helmholtz equation

$$\Delta G = \Delta H - T\Delta S$$

At equilibrium, $\Delta G = 0$

Hence, $\Delta H - T\Delta S = 0$ or $\Delta H = T\Delta S$

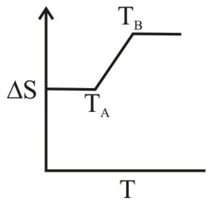
$$T = \frac{\Delta H}{\Delta S}$$

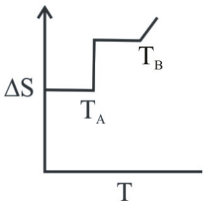
Given that, $\Delta H = 30.560$ kJ mol^{-1}

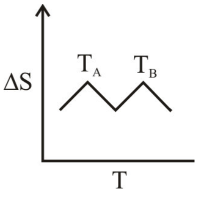
$= 30560 J\ mol^{-1}$

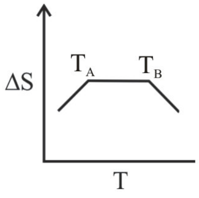
$$T = \frac{30560}{66.0} = 463\,K$$

236. If for a given substance, melting point is T_B and freezing point is T_A then correct variation of entropy by graph between entropy change and temperature is

(a)


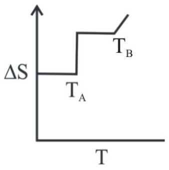
(b)


(c)


(d)


JIPMER-2015

Ans. (b) : For a pure substance T_A and T_B represent the same temperature.



237. 0.40 g of helium in a bulb at a temperature of T K had a pressure of p atm. When the bulb was immersed in water bath at temperature 50 K more than the first one, 0.08 g of gas had to be removed to restore the original pressure. T is.

(a) 500 K (b) 400 K
(c) 600 K (d) 200 K

JIPMER-2015

Ans. (d) : Since P and V is constant

$$n_iT_i = n_fT_f$$

$$\frac{0.4}{4}\times(T) = \frac{(0.4-0.08)}{4}\times(T+50)$$

$$5T = 4(T+50)$$

$$T = 200\ K$$

@apna_pdf

238. If the E^o_{cell} for a given reaction has a negative value then which of the following gives the correct relationships for the values of ΔG^0 and K_{eq} ?

(a) $\Delta G^0<0, K_{eq}>1$ (b) $\Delta G^0<0, K_{eq}<1$

(c) $\Delta G^0>0, K_{eq}<1$ (d) $\Delta G^0>0, K_{eq}>1$

JIPMER-2014

Ans. (c) : $\Delta G°$ = work done by cell

$E°_{cell} < 0$

$\Delta G° = -n \times F \times E°_{cell}$

$\Delta G° > 0$

$\Delta G° = -RT \ln K_{eq}$

$\ln K_{eq} < 0$

$\boxed{K_{eq} < 1}$

239. If a gas expands at constant temperature indicates that

(a) Kinetic energy of molecules decreases

(b) Pressure of the gas increases

(c) Kinetic energy of molecules remains as same

(d) number of the molecules of gas increase

JIPMER-2014

Ans. (c) : Kinetic energy of gas molecules is a function of temperature only gas expands at constant temperature kinetic energy of molecules remain the same.

240. Which of the following statement is correct?

(a) E_{cell} and Δ_rG of cell reaction both are extensive properties

(b) E_{cell} and Δ_rG of cell reaction both are intensive properties

(c) E_{cell} is the intensive property while Δ_rG of cell reaction is an extensive property

(d) E_{cell} is an extensive property while Δ_rG of cell reaction is an intensive property

JIPMER-2013

Ans. (c) : Extensive properties are the properties which depend upon the quantity of the matter contained in the system, e.g., mass, volume, Gibb's free energy, etc. Intensive properties are the properties which depend only upon the nature of the substance and are independent of the amount of the substance present in the system, e.g., heat, boiling point, emf of a cell, etc.

241. For the reaction,

$$H_2O(l) \rightleftharpoons H_2O(g)$$

at 373 K and 1 atm pressure

(a) $\Delta H=0$ (b) $\Delta E=0$

(c) $\Delta H=T\Delta S$ (d) $\Delta H=\Delta E$

JIPMER-2011

Ans. (c) : As in the given reaction, liquid water is in equilibrium with water vapor at 373K and 1 atm pressure

So, $\Delta G=0$

$\Delta G = \Delta H - T\Delta S$

$\Delta H = T\Delta S$

242. The change in entropy for the fusion of 1 mole of ice is [melting point of ice = 273 K, molar enthalpy of fusion for ice = 6.0 kJ mol^{-1}]

(a) 11.73 JK^{-1} mol^{-1} (b) 18.84 JK^{-1} mol^{-1}

(c) 21.97 JK^{-1} mol^{-1} (d) 24.47 JK^{-1} mol^{-1}

JIPMER-2008

Ans. (c) : Entropy change of fusion

$$\Delta S_f = \frac{\Delta H_f}{T}$$

$\Delta H_f = 6\times10^3$ J, mol^{-1} T=273K

$$\Delta S_f = \frac{6\times10^3}{273}$$

$=21.97\ JK^{-1}\ mol^{-1}$

243. A reaction occurs spontaneously if

(a) $T\Delta S < \Delta H$ and both ΔH and ΔS are + ve

(b) $T\Delta S > \Delta H$ and both ΔH and ΔS are + ve

(c) $T\Delta S = \Delta H$ and both ΔH and ΔS are + ve

(d) $T\Delta S > \Delta H$ and ΔH is + ve and ΔS is – ve

JIPMER-2007
NEET-2005

Ans. (b) : Gibb's energy equation is,

$\Delta G = \Delta H - T\Delta S$

ΔG = –ve for spontaneous reaction

Where, ΔS = + ve, ΔH = + ve,

and $T\Delta S > \Delta H$

244. The entropy values (in $JK^{-1}\ mol^{-1}$) of $H_2(g)$ = 130. 6, $Cl_2(g)$ = 223.0 and HCl(g) = 186.7 at 298 K and 1 atm pressure. The entropy change for the reaction:

$H_2(g)+Cl_2(g) \longrightarrow 2HCl(g)$ is:

(a) + 540.3 (b) +727.3

(c) –166.9 (d) +19.8

JIPMER-2006

Ans. (d) : $\Delta S° = 2S^\circ_{HCl} - (S^\circ_{H_2} + S^\circ_{Cl_2})$

$= 2\times186.7 - (130.6\ 0+223.0)$

$=19.8 JK^{-1}\ mol^{-1}$

245. In an isothermal process

(a) $\Delta H=\Delta E + P\Delta V$ (b) $\Delta H = W$

(c) $\Delta H =\Delta E$ (d) $\Delta H = S\Delta T$

JIPMER-2005

Ans. (b) : An isothermal process

T = constant or $\Delta T = 0$

According to Ist law of thermodynamics –

$T\Delta S = \Delta H - W$

$\Delta Q = \Delta H - W$

We know that, $\Delta Q = nC_p\Delta T$

$\Delta Q = 0$

So, $\boxed{\Delta H = W}$

246. The internal energy of a substance

(a) Decrease with increase in temperature

(b) Increase with increase in temperature

(c) Remains unaffected with change in temperature

(d) Calculated by $E = mc^2$

JIPMER-2005

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Ans. (b) : The internal energy of a substance always increases with increase in temperature, because internal energy is a function of temperature only.

247. The enthalpies of all elements in their standard states are

(a) Zero (b) > 0
(c) < 0 (d) unity

JIPMER-2004

Ans. (a) : The enthalpies of formation is the heat released or consumed during the formation of a compound from its substituent elements in standard state.

Example–

$C + O_2(g) \rightarrow CO_2(g)$

No contribution
to the enthalpy
of reaction

248. Conversion of oxygen into ozone is non-spontaneous at

(a) Low temperature (b) all temperature
(c) High temperature (d) room temperature

JIPMER-2018
Karnataka-CET-2014

Ans. (b) : $3O_2(g) \rightleftharpoons 2O_3(g)$; $\Delta H = +ve$;

$\Delta S = -ve$

Equation, $\Delta G = \Delta H - T\Delta S = +ve - (-ve)$

$\Delta G = +ve$:

Non – spontaneous at all temperature

So, conversion of oxygen into ozone is non-spontaneous process.

249. A hypothetical reaction $A \longrightarrow 2B$ proceeds through the following sequence of steps

I. $A \longrightarrow C$; $\Delta_r H = q_1$

II. $C \longrightarrow D$; $\Delta_r H = q_2$

III. $\frac{1}{2}D \longrightarrow B$; $\Delta_r H = q_3$

The heat of hypothetical reaction is

(a) $q_1 + q_2 - 2q_3$ (b) $q_1 + q_2 + 2q_3$
(c) $q_1 + 2q_2 - 2q_3$ (d) $q_1 - q_2 + 2q_3$

JIPMER-2016

Ans. (b) : Given,

$A \longrightarrow C, \Delta H = q_1$ .....(i)

$C \longrightarrow D, \Delta H = q_2$ .....(ii)

$\frac{1}{2}D \longrightarrow B, \Delta H = q_3$ .....(iii)

From equation (iii)–

$D \longrightarrow 2B, \Delta H = 2q_3$

According to Hess's law, the total heat changes occurring during a chemical reaction are independent of path.

So, adding equation (i) + (ii) + (iii)

$\Delta H = q_1 + q_2 + 2q_3$

250. The reaction in which $\Delta H > \Delta U$ is

(a) $N_2(g) + O_2(g) \rightarrow 2NO(g)$
(b) $CaCO_3(s) \rightarrow CaO(s) + CO_2(g)$
(c) $N_2(g) + 3H_2(g) \rightarrow 2NH_3(g)$
(d) $CH_4(g) + 2O_2(g) \rightarrow CO_2(g) + 2H_2O(l)$

Karnataka-CET-2019

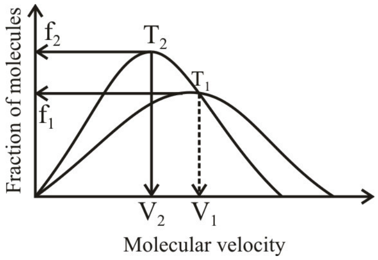
Ans. (b) : As $\Delta H = \Delta U + \Delta n_g RT$

For the reaction $CaCO_3(s) \rightarrow CaO(s) + CO_2(g)$

$\Delta n_g = 1$

$\therefore \Delta H > \Delta U$

251. Plot of Maxwell's distribution of velocities is given below.



Which of the following is correct about this plot?

(a) $T_1 < T_2$ (b) $f_1 > f_2$
(c) $T_1 > T_2$ (d) $V_1 < V_2$

Karnataka-CET-2015

Ans. (c) : $v = \sqrt{\frac{3RT}{M}}$

$V \propto \sqrt{T}, V \propto \frac{1}{\sqrt{M}}$

$V\uparrow, T\uparrow$, $V\uparrow$ no.of moleculer $\downarrow$

In increasing temperature, the molecule velocity increasing but fraction of molecules processing that velocity decreeing.

since, $V_1 > V_2$,

$T_1 > T_2$

252. For an ideal binary liquid mixture

(a) $\Delta S_{(mix)} = 0; \Delta G_{(mix)} = 0$
(b) $\Delta H_{(mix)} = 0; \Delta S_{(mix)} < 0$
(c) $\Delta V_{(mix)} = 0; \Delta G_{(mix)} > 0$
(d) $\Delta S_{(mix)} > 0; \Delta G_{(mix)} < 0$

Karnataka-CET-2014

Ans. (d): Entropy of universe always increases therefore, for an ideal binary liquid solution.

$\Delta H = 0$ & $\Delta V = 0$ from,

$\Delta G = \Delta H - T\Delta S$

$\Delta G = -ve$ Hence, $\Delta G < 0$ and $\Delta S > 0$

253. The value of entropy of solar system is

(a) increasing (b) decreasing
(c) constant (d) zero

Karnataka-CET-2013

Ans. (a) : All naturally occurring processes are spontaneous and are accompanied by a net increase of entropy.

254. The process is spontaneous at the given temperature, if

(a) ΔH is +ve and ΔS is –ve
(b) ΔH is –ve and ΔS is +ve

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(c) ΔH is +ve and ΔS is +ve
(d) ΔH is +ve and ΔS is equal to zero

Manipal-2017
NEET-I 2016, 2014
Karnataka-CET-2013

Ans. (b) : $\Delta G = \Delta H - T\Delta S$ (Gibbs energy equation)
A reaction is spontaneous when, $\Delta G = -ve$, $\Delta H = -ve$, $\Delta S = +ve$ and $T\Delta S = +ve$

255. Which of the following gases has the highest value of RMS velocity at 298 K?

(a) CH_4 (b) CO
(c) Cl_2 (d) CO_2

Karnataka-CET-2013

Ans. (a) : RMS-velocity of a gas $v_{rms} = \sqrt{\dfrac{3RT}{M}}$

Here, higher the molecular weight of a gas, lower will be its v_{rms}.

$$v_{rms} \propto \sqrt{\frac{1}{M}}$$

$\therefore$ CH_4(mol. weight = 16) has highest v_{rms}.

256. 2 moles of N_2O_4(g) is kept in a closed container at 298 K and under 1 atm pressure. It is heated to 596 K when 20% by mass of N_2O_4(g) decomposes to NO_2. The resulting pressure is

(a) 1.2 atm (b) 4.8 atm
(c) 2.8 atm (d) 2.4 atm

Karnataka-CET-2012

Ans. (d): Given,
Initialy,

$$n = 2, \quad T = 298K, \quad P = latm$$

$$V = \frac{nRT}{P} = \frac{2 \times 0.084 \times 298}{1} = 48.9L$$

Finally $T = 596K, P = ?, V = 48.9L$

$$N_2O_4(g) \rightleftharpoons 2NO_2(g)$$

	$N_2O_4(g)$	$2NO_2(g)$
T = 298 K	2	0
T = 596 K	$2 - \dfrac{20}{100} \times 2$ = 1.6 moles	0.8

Total moles = 1.6 + 0.8 = 2.4 moles

$$P = \frac{nRT}{V} = \frac{2.4 \times 0.084 \times 596}{48.9} = 2.4 \text{ atm}$$

257. Which of the following statements is true?

(a) The total entropy of the universe is continuously decreasing
(b) The total energy of the universe is continuously decreasing
(c) The total energy of the universe remains constant
(d) The total entropy of the universe remains constant

Karnataka-CET-2012

Ans. (c) : According to the first law of thermodynamics, the total energy of the universe remains constant.

258. For the reversible reaction, A (s) + B (g) $\rightleftharpoons$ C (g) + D (g), $\Delta G^o = -350$ kJ, which one of the following statements is true?

(a) The reaction is thermodynamically non-feasible
(b) The entropy change is negative
(c) Equilibrium constant is greater than one
(d) The reaction should be instantaneous

Karnataka-CET-2011

Ans. (c): $A(s) + B(g) \rightleftharpoons C(g) + D(g), \Delta G^o = -350 \text{ kJ}$

Relationship between ΔG^o and equilibrium constant is
$\Delta G^o = -RT \ln K_c$
Since, $\Delta G^o = -350kJ$
$\ln K_c > 0, K_c > 1$

259. 5 moles of SO_2 and 5 moles of O_2 are allowed to react. At equilibrium, it was found that 60% of SO_2 is used up. If the partial pressure of the equilibrium mixture is one atmosphere, the partial pressure of O_2 is

(a) 0.82 atm (b) 0.52 atm
(c) 0.21 atm (d) 0.41 atm

Karnataka-CET, 2009

Ans. (d) : $2SO_2(g) + O_2(g) \rightleftharpoons 2SO_3(g)$

	$2SO_2(g)$	$O_2(g)$	$2SO_3(g)$
Initially	5	5	0
At equilibrium	(5 – 3) = 2	(5 – 1.5) = 3.5	3

$$\therefore \; P_{O_2} = \frac{3.5 \times 1}{8.5} = 0.41 \text{atm}$$

260. For the reaction $H_2O(l) \rightleftharpoons H_2O(g)$ at 373 K and 1 atm pressure

(a) $\Delta H = 0$ (b) $\Delta E = 0$
(c) $\Delta H = T\Delta S$ (d) $\Delta H = \Delta E$

Karnataka-CET, 2009

Ans. (c) : $\Delta G = \Delta H - T.\,\Delta S$
For the reaction,

$$H_2O(l) \rightleftharpoons H_2O(g)$$

$\Delta G = 0$ (at equilibrium)

$\therefore$ $\Delta H = T.\,\Delta S$

261. For the reaction,
$A(g) + B(g) \rightleftharpoons C(g) + D(g); \Delta H = QkJ$
The equilibrium constant cannot be disturbed by

(a) addition of A
(b) addition of D
(c) increasing of pressure
(d) increasing of temperature

Karnataka-CET-2021

Ans.(c): For the given hypothetical reaction, $\Delta n = 0$, because no. of molecules of gaseous molecule on both side are equal. Thus, the equilibrium constant can not be disturbed by increasing of pressure.

262. Considering the reaction C(s) + O_2(g) $\longrightarrow CO_2(g) + 393.5$ kJ, the signs of ΔH, ΔS and ΔG respectively are

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(a) +, –, – (b) –, +, +
(c) –, –, – (d) –, +, –

Karnataka-CET-2007

Ans. (a) : ΔH = + ve (combustion reaction)
ΔS = – ve (spontaneous at all temperature)
ΔG = – ve (because reaction is spontaneous)

263. The relation between ΔH and ΔU is

(a) $\Delta H = \Delta U + RT$ (b) $\Delta H = \Delta U - \Delta nRT$
(c) $\Delta H = \Delta U + \Delta nRT$ (d) $\Delta U = \Delta H + \Delta nRT$

Karnataka-CET-2007

Ans. (c) : The relationship between ΔH and ΔU is
$\Delta H = \Delta U + \Delta nRT$

264. Entropy of the universe is

(a) constant
(b) zero
(c) continuously decreasing
(d) continuously increasing

Karnataka-CET-2007

Ans. (d) : According to second law of thermodynamics, the entropy of the universe always increases in the course of every spontaneous (natural) change.

265. Which of the following is an intensive property?

(a) temperature (b) viscosity
(c) surface tension (d) all of these

Karnataka-CET-2007

Ans. (d) : The properties of the system whose value is independent of the amount of substance present in the system are called intensive properties, e.g. viscosity, surface tension, temperature, pressure etc.

266. 56 g of nitrogen and 96 g of oxygen are mixed isothermally and at a total pressure of 10 atm. The partial pressures of oxygen and nitrogen (in atm) are respectively

(a) 4, 6 (b) 5, 5
(c) 2, 8 (d) 8, 2
(e) 6, 4

Kerala-CEE-2010

Ans. (e) : Partial pressure of component = Mole fraction × Total pressure

Given, mass of N_2 = 56g, mass of O_2 = 96g
Total pressure = 10 atm

$$n_{N_2} = \frac{56}{28} = 2, \qquad n_{O_2} = \frac{96}{32} = 3$$

$$x_{N_2} = \frac{2}{2+3} = 0.4, \qquad x_{O_2} = \frac{3}{2+3} = 0.6$$

$P_{N_2} = 0.4 \times 10 = 4$ atm

$P_{O_2} = 0.6 \times 10 = 6$ atm

267. Given that dE= Tds – pdV and H = E + pV. Which one of the following relations is true?

(a) $dH = TdS + Vdp$ (b) $dH = SdT + Vdp$
(c) $dH = -SdT + Vdp$ (d) $dH = dE + pdV$
(e) $dH = dE - TdS$

Kerala-CEE-2009

Ans. (a) : We know that,
$H = E + pV$

Differentiating both side, we get
$dH = dE + pdV + Vdp$
$dH = TdS - pdV + pdV + Vdp$
$dH = TdS + Vdp$

268. The lattice enthalpy and hydration enthalpy of four compounds are given below

Compound	**Lattice enthalpy (in kJ mol^{-1})**	**Hydration enthalpy (in kJ mol^{-1})**
P	**+780**	**– 920**
Q	**+ 1012**	**– 812**
R	**+ 828**	**– 878**
S	**+ 632**	**– 600**

The pair of compounds which is soluble in water is

(a) P and Q (b) Q and R
(c) R and S (d) Q and S
(e) P and R

Kerala-CEE-2008

Ans. (e): $NH_3(g) + HCl(g) \longrightarrow NH_4Cl(g)$
$\Delta n_g = -1, \qquad \Delta H = \Delta U + \Delta n_g RT$
Δn_g is – ve, $\qquad \Delta H < \Delta U$
A compound is soluble in water when its hydration enthalpy is greater than its lattice enthalpy.

269. Which of the following is true in respect of adsorption?

(a) $\Delta G < 0; \Delta S > 0; \Delta H < 0$
(b) $\Delta G < 0; \Delta S < 0; \Delta H < 0$
(c) $\Delta G > 0; \Delta S > 0; \Delta H < 0$
(d) $\Delta G < 0; \Delta S < 0; \Delta H > 0$
(e) $\Delta G > 0; \Delta S > 0; \Delta H > 0$

Kerala-CEE-2006

Ans. (b) : For adsorption process,
$\Delta G < 0, \Delta H < 0$ & $\Delta S < 0$
Note-Adsorption of gases on the solid surface is generally exothermic because entropy decreases. Adhering of gas molecules to the surface lower randomness.

270. For the reaction $CO(g) + \frac{1}{2}O_2(g) \longrightarrow CO_2(g)$, ΔH and ΔS are –283 kJ and –87 JK^{-1}, respectively. It was intended to carry out this reaction at 1000, 1500, 3000 and 3500 K. At which of these temperatures would this reaction be thermodynamically spontaneous?

(a) 1500 and 3500 K
(b) 3000 and 3500 K
(c) 1000, 1500 and 3000 K
(d) 1500, 3000 and 3500 K
(e) At all these temperatures

Kerala-CEE-2006

Ans. (c) : Given, ΔH = –283 kJ, ΔS = –87 JK^{-1}
By using the equation,
$\Delta G = \Delta H - T\Delta S$
At 1000K, $\Delta G = -283 - (1000 \times -0.087)$
$= -196$ kJ (spontaneous)

@apna_pdf

At 1500 K, $\Delta G = -283 - (1500 \times -0.087)$
$= -152.5$ kJ (spontaneous)
At 3000 K, $\Delta G = -283 - (3000 \times -0.0987)$
$= -22$ kJ (spontaneous)
At 3500 K, $\Delta G = -283 - (3500 \times -0.087)$
$= +21.5$ kJ (Non-spontaneous)

271. ΔH and ΔS for a reaction are $+30.558$ kJ mol^{-1} and 0.066 kJ mol^{-1} at 1 atm pressure. The temperature at which free energy change is equal to zero and the nature of the reaction below this temperature are:

(a) 483 K, spontaneous
(b) 443 K, non-spontaneous
(c) 443 K, spontaneous
(d) 463 K, non-spontaneous
(e) 463 K, spontaneous

Kerala-CEE-2005

Ans. (d) : $\Delta G = \Delta H - T\Delta S$
Where, $\Delta H = +30.558$ kJ mol^{-1}
$\Delta G = 0$
$\Delta S = 0.066$ kJ mol^{-1}
$0 = \Delta H - T\Delta S$
$\Delta H = T\Delta S$
$30.558 = T \times 0.066$
$T = \dfrac{30.558}{0.066}$
$T = 463K$

272. The enthalpy of a monoatomic gas at T Kelvin is:

(a) $\frac{7}{2}$ RT
(b) $\frac{3}{2}$ RT
(c) $\frac{1}{2}$ RT
(d) $\frac{1}{2}$ mv^2
(e) $\frac{5}{2}$ RT

Kerala-CEE-2004

Ans. (e) For Mono atomic gas, $E = \frac{3}{2}RT$

$$H = E + PV = E + RT$$
$$H = \frac{3}{2}RT + RT = \frac{5}{2}RT$$

273. Choose the reaction in which ΔH is not equal to ΔU.

(a) $C(graphite) + O_2(g) \rightarrow CO_2(g)$
(b) $C_2H_4(g) + H_2(g) \longrightarrow C_2H_6(g)$
(c) $2C(graphite) + H_2(g) \longrightarrow C_2H_2(g)$
(d) $H_2(g) + I_2(g) \longrightarrow 2HI(g)$
(e) $N_2(g) + O_2(g) \rightarrow 2NO(g)$

Kerala-CEE-2012

Ans. (b) : $\Delta H = \Delta U + \Delta n_g RT$
If, $\Delta n_g = 0$ then, $\Delta H = \Delta U$
By option–
For (a): $\Delta n_g = 0$; (b) $\Delta n_g = 1 - 2 = -1$
(c) $\Delta n_g = 0$ (d) $\Delta n_g = 2 - 2 = 0$
(e) $\Delta n_g = 2 - 2 = 0$

274. A certain reaction has ΔH of 12 kJ and a ΔS of 40 JK^{-1}. The temperature above which the reaction becomes spontaneous is

(a) 27 °C
(b) 27 K
(c) 300 °C
(d) 30 °C
(e) 30 K

Kerala-CEE-2013

Ans. (a) : $\Delta G = \Delta H - T\Delta S$
For the reaction to be spontaneous,
$\Delta G < 0$
$\Delta H - T\Delta S < 0$
$T < \dfrac{\Delta H}{\Delta S}$
Now, $T = \dfrac{\Delta H}{\Delta S} = \dfrac{12 \times 10^3}{40} = 300K$
$= 300 - 273 = 27°C$
Above 27°C, the reaction becomes spontaneous.

275. The enthalpy change for a reaction at equilibrium is -20.5kJ mol^{-1}. Then the entropy change for this equilibrium at 410 K is

(a) + 50 JK^{-1} mol^{-1}
(b) + 55 JK^{-1} mol^{-1}
(c) + 75 JK^{-1} mol^{-1}
(d) – 50 JK^{-1} mol^{-1}
(e) – 55 JK^{-1} mol^{-1}

Kerala-CEE-2015

Ans. (d) : At equilibrium, $\Delta S = \dfrac{\Delta H}{T}$
$\Delta H = -20.5$ kJ/mol
$\Delta H = -20500$ J/mol
$T = 410K$
$\Delta S = \dfrac{-20500}{410} = -50JK^{-1}mol^{-1}$

276. Critical density of a gas having molecular weight 39 g mol^{-1} is 0.1×10^3 g cm^{-3}. Its critical volume in L mol^{-1} is

(a) 0.390
(b) 3.90
(c) 0.039
(d) 39.0
(e) 390

Kerala-CEE-2016

Ans. (a) : The density of a substance at its thermodynamic critical point is called critical density.
Critical density = 0.1×10^3 g cm^{-3} = $100gL^{-1}$
Critical mass = Molecular weight = 39 g
Critical volume = $\dfrac{\text{Molecular weight}}{\text{Critical density}}$
$= \dfrac{39}{100} = 0.390\,Lmol^{-1}$

277. Thermal decomposition of ammonium dichromate gives

(a) N_2, H_2O and Cr_2O_3
(b) N_2, NH_3 and CrO
(c) $(NH_4)_2$ CrO_4 and H_2O
(d) N_2, H_2O and CrO_3
(e) N_2, H_2O and CrO

Kerala-CEE-2016

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Ans. (a) : Ammonium dichromate is a flammable inorganic compound with the chemical formula $(NH_4)_2Cr_2O_7$.

Thermal decomposition of ammonium dichromate $(NH_4)_2\ Cr_2O_7$ on heating gives N_2, Cr_2O_3 and H_2O as follows–

$$(NH_4)Cr_2O_7 \xrightarrow{\Delta} N_2 + Cr_2O_3 + 4H_2O$$

$(NH_4)_2Cr_2O_7$ has been used as a source of pure nitrogen in the laboratory and also as a catalyst in pyrotechniques.

278. The correct descending order of the heat liberated (in kJ) during the neutralisation of the acids CH_3COOH (*W*), HF(*X*), HCOOH (*Y*) and HCN (*Z*) under indentical conditions (K_a of $CH_3COOH = 1.8 \times 10^{-5}$, $HCOOH = 1.8\times10^{-4}$, $HCN = 4.9 \times 10^{-10}$ and $HF = 3.2 \times 10^{-4}$) is

(a) Y > X > Z > W (b) X > Y > W > Z
(c) W > X > Y > Z (d) Z > W > Y > X
(e) Z >Y > X > W

Kerala-CEE-2016

Ans. (b) : K_a for $CH_3COOH = 1.8 \times 10^{-5}$ (W)
K_a for $HCOOH = 1.8 \times 10^{-4}$ (Y)
K_a for $HCN = 4.9 \times 10^{-10}$ (Z)
K_a for $HF = 3.2 \times 10^{-4}$ (X)

Now, $K_a \propto$ Strength of acid or, $K_a \propto$ Heat liberated during neutralisation.

Thus, order of heat liberated during neutralisation is–

HF > HCOOH > CH_3COOH > HCN

i.e. X > Y > W > Z.

279. For the process A(*l*) (0.05 atm, 32°C) → A (g) (0.05 atm, 32°C).
The correct set of thermodynamic parameters is

(a) $\Delta G = 0$ and $\Delta S = -$ ve
(b) $\Delta G = 0$ and $\Delta S = +$ ve
(c) $\Delta G = +$ ve and $\Delta S = 0$
(d) $\Delta G = -$ ve and $\Delta S = 0$
(e) $\Delta G = 0$ and $\Delta S = 0$

Kerala-CEE-2017

Ans. (b) : A(*l*) (0.05 atm, 32°C) → A(g) (0.05 atm, 32°C)

Liquid A is changing into gaseous A, thus, randomness is increasing i.e. entropy change (ΔS) is positive.

$$K_p = \frac{P_{A_{(g)}}}{P_{A_{(l)}}} = \frac{0.05}{0.05} = 1$$

$$\Delta G = -RT\ lnK_p = -RT\ ln(1) = 0$$

Thus, the system is in equilibrium.

280. A gas will approach ideal behavior at

(a) Low temperature and low pressure
(b) Low temperature and high pressure
(c) High temperature and low pressure
(d) High temperature and high pressure
(e) low volume and high pressure

Kerala-CEE-2017

Ans. (c) : For ideal behavior, the gaseous molecules should be far apart this is possible by high temperature and low pressure.

281. In which one of the following reactions, entropy decreases?

(a) Sodium chloride is dissolved in water
(b) Water is heated from 303K to 353K
(c) Sodium bicarbonate is decomposed to $Na_2CO_3(s)$, $CO_2(g)$ and $H_2O(g)$
(d) Water crystallizes into ice
(e) Dihydrogen molecule is decomposed into hydrogen atoms

Kerala-CEE-2020

Ans. (d) : Entropy simply defines that it is nothing but disorderness or randomness of the system. Here, water crystallizes into ice. In this case phase converts into liquid to solid. So, entropy decreases.

282. In which of the following $\Delta E = \Delta H$?

(a) $N_2O_4(g) \rightleftharpoons 2NO_2(g)$
(b) $2SO_2(g) + O_2(g) \rightleftharpoons 2SO_3(g)$
(c) $H_2(g) + I_2(g) \rightleftharpoons 2HI(g)$
(d) $H_2(g) + \frac{1}{2}O_2(g) \rightleftharpoons H_2O(\ell)$

Manipal-2020

Ans. (c) : $H_2(g) + I_2(g) \longrightarrow 2HI(g)$

Δn_g = Gaseous moles of product – Gaseous moles of reactants

$\Delta n_g = 2 - 2 = 0$
$\Delta n_g = 0\ \ \Delta H = \Delta E$
$\Delta n_g > 0\ \ \Delta H > \Delta E$
$\Delta n_g < 0\ \ \Delta H < \Delta E$

283. The Electrophile involved in the Sulphonation of benzene is :

(a) SO_3^+ (b) SO_3^{2-}
(c) H_3^+O (d) SO_3

Manipal-2019

Ans. (d) : Sulphonation of benzene involves the formation of the electrophile SO_3 in the first step which subsequently attacks benzene ring and causes sulphonation.

$$2H_2SO_4 \rightleftharpoons H_3O^+ + HSO_4^- + \underset{\text{(eletrophile)}}{SO_3}$$

284. For a process to be spontaneous :

(a) ΔG must be –ve (b) ΔG should be +ve
(c) ΔH must be –ve (d) ΔS must be –ve

Manipal-2018

Ans. (a) : $\Delta G = \Delta H - T\Delta S$ (Gibbs energy equation)

A reaction is spontaneous when, ΔG = –ve, ΔH = –ve, ΔS = +ve and $T\Delta S$ = +ve

- ΔG = –ve for spontaneous reaction.
- ΔG = +ve for non-spontaneous reaction.
- ΔG = 0 for equilibrium reaction.

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285. C_p/C_v for noble gases is :

(a) 1.66 (b) 1.43

(c) 1.80 (d) 1.33

Manipal-2017

Ans. (a) : Inert gas exist as mono atomic molecules for there

$$C_p = \frac{5}{2}R$$

$$C_v = \frac{3}{2}R$$

$$\gamma = \frac{C_p}{C_v}$$

$$\gamma = \frac{\frac{5}{2}R}{\frac{3}{2}R}$$

$$\gamma = \frac{5}{3}$$

$$\gamma = 1.66$$

286. During the adsorption of krypton on activated charcoal at low temperature:

(a) $\Delta H < 0$ and $\Delta S > 0$ (b) $\Delta H > 0$ and $\Delta S > 0$

(c) $\Delta H < 0$ and $\Delta S < 0$ (d) $\Delta H > 0$ and $\Delta S < 0$

Manipal-2016

Ans. (c) : During adsorption, there is always a decrease in residual forces of the surface i.e. there is decreases in surface energy which appears as heat adsorption. Therefore, is invariably accompanied by evolution of heat.

So, during the adsorption of krypton on activated charcoal at low temperature. $\Delta H < 0, \Delta S < 0$.

287. A reaction is spontaneous at low temperature, but non-spontaneous at high temperature. Which of the following condition is true for the chemical reaction?

(a) $\Delta H > 0, \Delta S = 0$ (b) $\Delta H < 0, \Delta S < 0$

(c) $\Delta H < 0, \Delta S > 0$ (d) $\Delta H > 0, \Delta S > 0$

Manipal-2016

Ans. (b) : $\Delta G = \Delta H - T\Delta S$

When $\Delta H < 0$ and $\Delta S < 0$ then ΔG will be negative at low temperatures (positive at high temperature) and the reaction will be spontaneous.

288. Identify the invalid equation

(a) $\Delta H = \sum H_{products} - \sum H_{reactants}$

(b) $\Delta H = \Delta U + P\Delta V$

(c) $\Delta H^o_{reaction} = \Sigma H^o_{product\ bonds} - \Sigma H^o_{reactant\ bonds}$

(d) $\Delta H = \Delta U + \Delta nRT$

MHT CET-2017

Ans. (c) : Option (c) is invalid equation.

The correct equation is–

$$\Delta H^o_{(reaction)} = \Sigma H^o_{(reactant\ bond)} - \Sigma H^o_{(product\ bond)}$$

289. Identify an extensive property amongst the following.

(a) Viscosity (b) Heat capacity

(c) Density (d) Surface tension

MHT CET-2016

Ans. (b) : Extensive property–Volume, Internal energy, Entropy, Mass etc.

Intensive property– Viscosity, Density, Temperature, Pressure etc.

- Intensive property: Do not depend on amount of matter.
- Extensive property: Depend on amount of matter.

290. Mathematical equation of first law of thermodynamics for isochoric process is

(a) $\Delta U = q_v$ (b) $-\Delta U = q_v$

(c) $q = -W$ (d) $\Delta U = W$

MHT CET-2016

Ans. (a) : The first law of thermodynamics says,

$$\Delta U = q + w$$

In an isochoric process the work done is zero.

Since there is no change in Volume.

So, $\Delta U = q_v + 0 \Rightarrow \Delta U = q_v$

291. The relation between solubility of a gas in liquid at constant temperature and external pressure is stated by which law?

(a) Raoult's law

(b) Van't Hoff- Boyle's law

(c) Van't Hoff-Charles' law

(d) Henry's law

MHT CET-2016

Ans. (d) : Henry's law states that at a constant temperature, the solubility of a gas is directly proportional to the pressure of the gas.

The partial pressure of the gas in vapor phase (P) is proportional to the mole fraction of the gas (x) in the solution.

$$P = K_H x$$

K_H is the Henry's law constant,

More the value of K_H, lower is the solubility of gas.

292. The equation that represents general Van't Hoff equation is

(a) $\pi = \frac{n}{V}RT$ (b) $\pi = nRT$

(c) $\pi = \frac{V}{n}RT$ (d) $\pi = nVRT$

MHT CET-2016

Ans. (a) : Van't Hoff general equation is

$$\pi = \frac{n}{V}RT$$

Where, π is pressure

T is temperature

R is gas constant

N is number of moles

V is Volume

$$\therefore \quad \pi = \frac{n}{V}RT$$

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293. Which among the following is a feature of adiabatic expansion?

(a) $\Delta V < 0$ (b) $\Delta U < 0$
(c) $\Delta U > 0$ (d) $\Delta T = 0$

MHT CET-2015

Ans. (d) : For adiabatic expansion, there is no change in heat which means no change in temperature also.

$dq = 0, T = \text{Constant}$

$\therefore \quad dT = 0 \Rightarrow \Delta T = 0$

294. For which among the following reactions, change in entropy is less than zero?

(a) Sublimation of iodine
(b) Dissociation of hydrogen
(c) Formation of water
(d) Thermal decomposition of calcium carbonate

MHT CET-2015

Ans. (b) : For a non-spontaneous process, change in entropy is less than zero. Here, dissociation of hydrogen is a non-spontaneous process. Hence it has entropy less than zero. Therefore option (b) is correct.

295. If average velocity of a sample of gas molecules at 300 K is 5 cm s^{-1}, what is RMS velocity of same sample of gas molecules at the same temperature? (Given, α:u:v = 1:1.224:1.127)

(a) 6.112 cm/s (b) 4.605 cm/s
(c) 4.085 cm/s (d) 5.430 cm/s

MHT CET-2014

Ans. (d) : Given, that α (most probable velocity)
u(RMS velocity) : v (average velocity)
= 1: 1.224:1.127

$$v_{average} = \sqrt{\frac{8RT}{\pi M}}, \; v_{rms} = \sqrt{\frac{3RT}{M}}$$

$$v_{rms} = \sqrt{\frac{3\pi}{8}} \times v_{average}$$

$$\frac{u}{v} = \frac{1.224}{1.127}, \qquad \frac{u}{5} = \frac{1.224}{1.127}$$

$$u = \frac{1.224 \times 5}{1.127}$$

$u = 5.430$ cm/s

296. According to Hess's law, the heat of reaction depends upon

(a) initial condition of reactants
(b) initial and final conditions of reactants
(c) intermediate path of the reaction
(d) end conditions of reactants

MHT CET-2011

Ans. (b) : According to Hess's law of constant heat summation, the heat of a process does not depend on the path followed to obtain final state but it depends upon the initial and final states of reactant.

297. Find the correct equation

(a) $E_2–E_1–H_2+H_1 = n_2RT–n_1RT$
(b) $E_2–E_1–H_2–H_1 = n_2RT–n_1RT$
(c) $H_2–H_1– E_2+E_1 = n_2RT–n_1RT$
(d) $H_2+H_1– E_2+E_1 = n_2RT–n_1RT$

MHT CET-2010

Ans. (c) : We know that,

$\Delta H = \Delta E + \Delta n_g RT$

$H_2\text{-}H_1 = E_2 – E_1 + (n_2RT\text{-}n_1RT)$

298. Kirchhoff's equation is

(a) $\log\frac{k_2}{k_1} = \frac{E_a}{2.303R}\left[\frac{1}{T_1} - \frac{1}{T_2}\right]$

(b) $\log\frac{p_2}{p_1} = \frac{\Delta H_V}{2.303R}\left[\frac{T_2 - T_1}{T_1 \times T_2}\right]$

(c) $\Delta C_p = \frac{\Delta H_2 - \Delta H_1}{T_2 - T_1}$

(d) $\log\frac{k_2}{k_1} = \frac{\Delta H}{2.303R}\left[\frac{1}{T_1} - \frac{1}{T_2}\right]$

MHT CET-2009

Ans. (c) : Kirchhoff's equation–

$$\boxed{\frac{\Delta H_2 - \Delta H_1}{T_2 - T_1}} = \Delta C_p$$

$$\boxed{\Delta C_p = (\Sigma C_p)_{products} - (\Sigma C_p)_{reactants}}$$

299. In .... process, work is done at the expense of internal energy.

(a) Isothermal (b) Isochoric
(c) Adiabatic (d) Isobaric

MHT CET-2009

Ans. (c) : We know that,
An adiabatic process is a type of thermodynamic process that occurs without transferring heat or mass between the thermodynamic system and its environment.

$\Delta E = Q + W$

If heat supplied from the surrounding,

$Q = 0$

$\Delta E = W$

So, work is done at the expense of only internal Energy Q = 0 for adiabatic process.

300. Hess's law is based on

(a) Law of conservation of mass
(b) Law of conservation of energy
(c) First law of thermodynamics
(d) None of the above

MHT CET-2007

Ans. (b) : Hess' law states that, if a reaction can take place by more than one route and the initial and final conditions are the same. The total enthalpy change is the same.
Hess's law is based upon law of conservation of energy i.e. first law of thermodynamics.

301. Which of the following is a path function?

(a) Internal energy (b) Enthalpy
(c) Work (d) Entropy

MHT CET-2007

Ans. (c) : Internal energy, entropy and enthalpy are point functions but work and heat are path functions.

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302. 2 moles of ideal gas at 27°C temperature is expanded reversely from 2 lit. to 20 lit. Find entropy change. (R = 2 cal/mol K)

(a) 92.1 (b) 0

(c) 4 (d) 9.2

NEET-2002

Ans. (d) : Given, n = 2, R = 2 cal/mol K

$V_1 = 2$ lit., $V_2 = 20$ lit.

As we know that, $\Delta S = 2.303 n R \log \frac{V_2}{V_1}$

$$\Delta S = 2.303 \times 2 \times 2 \times \log \frac{20}{2} = 9.2 \text{ cal K}^{-1} \text{ mol}^{-1}$$

303. What is the entropy change (in J K^{-1} mol^{-1}) when one mole of ice is converted into water at 0°C? (The enthalpy change for the conversion of ice to liquid water is 6.0 kJ mol^{-1} at 0°C.)

(a) 20.13 (b) 2.013

(c) 2.198 (d) 21.98

NEET-2003

Ans. (d) : $\Delta S = \frac{\Delta H}{T} = \frac{6.0}{273} = 0.02198 \text{kJK}^{-1}\text{mol}^{-1}$

($\because$ T = 0°C = 0 + 273 K = 273 K)

$\Delta S = 0.02198 \times 1000 \text{ JK}^{-1}\text{mol}^{-1}$

$\Delta S = 21.98 \text{JK}^{-1}\text{mol}^{-1}$

304. The enthalpy and entropy change for the reaction:

$Br_2(l) + Cl_2(g) \rightarrow 2\,BrCl(g)$

are 30 kJ mol^{-1} and 105 JK^{-1} mol^{-1} respectively. The temperature at which the reaction will be in equilibrium is

(a) 300 K (b) 285.7 K

(c) 273 K (d) 450 K

NEET-2006

Ans. (b) : $Br_2(l) + Cl_2(g) \rightarrow 2\,BrCl(g)$

Given, $\Delta H = 30 \times 10^3 \text{ J mol}^{-1}$

$\Delta S = 105 \text{ JK}^{-1} \text{ mol}^{-1}$, T = ?

According to second law,

$$T = \frac{\Delta H}{\Delta S} = \frac{30 \times 10^3}{105} = 285.7\text{K}$$

305. For the gas phase reaction,

$PCl_5(g) \rightleftharpoons PCl_3(g) + Cl_2(g)$

which of the following conditions are correct?

(a) $\Delta H < 0$ and $\Delta S < 0$ (b) $\Delta H > 0$ and $\Delta S < 0$

(c) $\Delta H = 0$ and $\Delta S < 0$ (d) $\Delta H > 0$ and $\Delta S > 0$

NEET-2008

Ans. (d) : From enthalpy equation,

$\Delta H = \Delta E + n_g RT$

Δn_g = Product mole – Reactant mole

$\Delta n_g = 2 - 1 = 1$

Thus, the value of ΔH is +ve or > 0

$\Delta G = \Delta H - T\Delta S$

For a spontaneous reaction, ΔG must be –ve. Since in this reaction ΔH is +ve. So for the negative value of ΔG, ΔS must be positive or > 0.

Hence, $\Delta H > 0, \Delta S > 0$

306. The enthalpy of fusion of water is 1.435 kcal/mol. The molar entropy change for the melting of ice at 0°C is

(a) 10.52 cal/(mol K) (b) 21.04 cal/(mol K)

(c) 5.260 cal/(mol K) (d) 0.526 cal/(mol K)

NEET-2012

Ans. (c) : $\Delta S = \frac{\Delta H}{T}$ ($\because \Delta G = \Delta H - T\Delta S$)

At phase change ΔG = 0

The molar entropy change for the melting of ice

$$\Delta S = \frac{1.435}{273} = 5.26 \text{ cal/mol K}$$

307. If the enthalpy change for the transition of liquid water to steam is 30 kJ mol^{-1} at 27°C, the entropy change for the process would be

(a) 10 J mol^{-1} K^{-1} (b) 1.0 J mol^{-1} K^{-1}

(c) 0.1 J mol^{-1} K^{-1} (d) 100 J mol^{-1} K^{-1}

NEET-2011

Ans. (d) The transition under consideration is :

$H_2O(\ell) \rightarrow H_2O\,(g)$

We know that, $\Delta S_{vapour} = \frac{\Delta H_{vapour}}{T}$

Given, $\Delta H_{vapour} = 30 \text{ kJ mol}^{-1}$

$\Delta H_{vapour} = 30 \times 1000 \text{ J mol}^{-1}$

T = 27 + 273 = 300K

Thus, $\Delta S_{vapour} = \frac{\Delta H_{vapour}}{T} = \frac{30 \times 10^3}{300}$

$$\boxed{\Delta S_{vapour} = 100 \text{Jmol}^{-1}\text{K}^{-1}}$$

308. Standard entropies of X_2, Y_2 and XY_3 are 60, 40 and 50 J K^{-1} mol^{-1} respectively. For the reaction $1/2X_2 + 3/2\,Y_2 \rightleftharpoons XY_3$, ΔH= –30 kJ, to be at equilibrium, the temperature should be

(a) 750 K (b) 1000 K

(c) 1250 K (d) 500 K

NEET-2010

AIEEE-2008

Ans. (a) : $\frac{1}{2}X_2 + \frac{3}{2}Y_2 \rightarrow XY_3$, $\Delta H = -30\text{kJ} = -30 \times 10^3\text{J}$

$\Delta S_{reaction} = \sum \Delta S_{product} - \sum \Delta S_{reactant}$

$\Delta S = 50 - \left[\frac{1}{2} \times 60 + \frac{3}{2} \times 40\right]$

$= 50 - 90 = -40 \text{ JK}^{-1}$

$$T = \frac{\Delta H}{\Delta S} = \frac{-30 \times 10^3}{-40} = 750\text{K}$$

309. For a given reaction, ΔH = 35.5 kJ mol^{-1} and ΔS = 83.6 J K^{-1} mol^{-1}. The reaction is spontaneous at (Assume that ΔH and ΔS do not vary with temperature)

(a) T > 425 K (b) all temperature

(c) T > 298 K (d) T < 425 K

NEET-2017

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Ans. (a) : $\Delta H = 35.5 \text{ kJ mol}^{-1} = 35.5 \times 10^3 \text{ J mol}^{-1}$

$\Delta S = 83.6 \text{ JK}^{-1} \text{ mol}^{-1}$

According to Gibbs-Helmholtz equation,

$\Delta G = \Delta H - T\Delta S$

For a reaction to be spontaneous,

$\Delta G < 0$

$\therefore \quad \Delta G = \Delta H - T\Delta S < 0$

$$\Delta H < T\Delta S \Rightarrow T > \frac{\Delta H}{\Delta S} = \frac{35.5\times10^3}{83.6} = 425\text{K}$$

$$\boxed{T > 425\text{K}}$$

310. For a sample of perfect gas when its pressure is changed isothermally from p_i to p_f, the entropy change is given by

(a) $\Delta S = nR\ln\left(\frac{P_f}{P_i}\right)$ (b) $\Delta S = nR\ln\left(\frac{P_i}{P_f}\right)$

(c) $\Delta S = nRT\ln\left(\frac{P_f}{P_i}\right)$ (d) $\Delta S = RT\ln\left(\frac{P_i}{P_f}\right)$

NEET-II 2016

Ans. (b) : For measurable change between two states. i.e initial (i) and final (f)

$$\Rightarrow \quad \Delta S = \int_i^f \frac{dq}{T}$$

As the temperature is constant

$$\therefore \ \Delta S = \frac{1}{T}\int_i^f dq \text{ rev}$$

As we know that

$$dq_{rev} = -dw_{rev} = nRT\left(\frac{dV}{V}\right)$$

$$\therefore \ \Delta S = \frac{1}{T}\int_i^f nRT\left(\frac{dV}{V}\right)$$

$$\Rightarrow \Delta S = \frac{nRT}{T}\int_i^f \left(\frac{dV}{V}\right)$$

$$\Rightarrow \Delta S = nR \ln \frac{V_f}{V_i}$$

From Charle's law,

$P_f V_f = P_i V_i$

$$\frac{V_f}{V_i} = \frac{P_i}{P_f}$$

$$\therefore \quad \Delta S = nR \ln\left(\frac{P_i}{P_f}\right)$$

311. Consider the following liquid vapour equilibrium Liquid $\rightleftharpoons$ vapour

Which of the following relations is correct?

(a) $\frac{d \ln P}{dT^2} = \frac{-\Delta H_v}{T^2}$ (b) $\frac{d \ln P}{dT} = \frac{\Delta H_v}{RT^2}$

(c) $\frac{d \ln G}{dT^2} = \frac{\Delta H_v}{RT^2}$ (d) $\frac{d \ln P}{dT} = \frac{-\Delta H_v}{RT}$

NEET-I 2016

Ans. (b) : According to Clausius Clapeyron equation–

$$P = Ae^{\frac{-\Delta H}{RT}}$$

$$\ln P = \ln A + \ln e^{\frac{-\Delta H}{RT}} \Rightarrow \ln p = \ln A - \frac{\Delta H}{RT}\ln e$$

$$\text{or } \ln p = \ln A - \frac{\Delta H}{RT}$$

$$\frac{d}{dT}(\ln P) = 0 + \frac{-\Delta H}{R}\frac{d}{dT}(T^{-1})$$

$$\frac{d}{dT}(\ln P) = \frac{\Delta H_v}{RT^2}$$

312. For irreversible expansion of an ideal gas under isothermal condition, the correct option is

(a) $\Delta U \neq 0, \ \Delta S_{total} = 0$ (b) $\Delta U = 0, \ \Delta S_{total} = 0$

(c) $\Delta U \neq 0, \ \Delta S_{total} \neq 0$ (d) $\Delta U = 0, \ \Delta S_{total} \neq 0$

NEET-2021

Ans. (d) : For, isothermal

We know,

$\Delta U = nC_v\Delta T$

Here, $\Delta U = 0, \Delta T = 0$

$$\boxed{\Delta S_{total} = nR\ln\frac{V_1}{V_2} \Rightarrow \Delta S_{total} \neq 0}$$

313. For the reaction $2Cl_{(g)} \rightarrow Cl_{2(g)}$, the correct option is

(a) $\Delta_rH > 0$ and $\Delta_rS > 0$ (b) $\Delta_rH > 0$ and $\Delta_rS < 0$

(c) $\Delta_rH < 0$ and $\Delta_rS > 0$ (d) $\Delta_rH < 0$ and $\Delta_rS < 0$

NEET-2020

Ans. (d) : $2Cl(g) \rightarrow Cl_2(g)$

- Bond formation is exothermic process

$$\boxed{\Delta_rH < 0}$$

- 2 atoms gives one molecules,

– Randomness decreases, $\boxed{\Delta_rS < 0}$

314. Consider the following processes :

	ΔH (kJ/mol)
$1/2A \rightarrow B$	**+150**
$3B \rightarrow 2C + D$	**+125**
$E + A \rightarrow 2D$	**+350**

For $B + D \rightarrow E + 2C$, ΔH will be

(a) 525 kJ/mol (b) -175 kJ/mol

(c) -325 kJ/mol (d) 325 kJ/mol

NEET-2011

Ans. (b) : $1/2A \rightarrow B, \Delta H = +150$ kJ/mol .....(i)

$3B \rightarrow 2C + D, \Delta H = +125$ kJ/mol .....(ii)

$E + A \rightarrow 2D, \Delta H = +350$ kJ/mol .....(iii)

According to Hess's law.

From, 2(i)-(iii)+(ii)

$\Delta H = 2(150) - 350 - 125$

$= -175\text{kJ/mol}$

315. Three thermo chemical equations are given below :

(i) $C_{(graphite)} + O_2(g) \rightarrow CO_2(g); \Delta_rH^0 = x \text{ kJ mol}^{-1}$

@apna_pdf

(ii) $C_{(graphite)}+\frac{1}{2}O_2(g)\rightarrow CO(g);\Delta_rH^0 = y\,kJ\,mol^{-1}$

(iii) $CO(g)+\frac{1}{2}O_2(g)\rightarrow CO_2(g);\Delta_rH^0 = z\,kJ\,mol^{-1}$

Based on the above equations, find out which of the relationship given below is correct.

(a) z = x + y (b) x = y + z

(c) y = 2z - x (d) x = y - z

Karnataka NEET-2013

Ans. (b) :

$C_{(graphite)}+O_2(g)\rightarrow CO_2(g);\Delta_rH^0 = x\,kJ\,mol^{-1}$ .....(i)

$C_{(graphite)}+\frac{1}{2}O_2(g)\rightarrow CO(g);\Delta_rH^0 = y\,kJ\,mol^{-1}$ .....(ii)

$CO(g)+\frac{1}{2}O_2(g)\rightarrow CO_2(g);\Delta_rH^0 = z\,kJ\,mol^{-1}$ .....(iii)

From equation (i) – (ii),

$$\frac{1}{2}O_2 \rightarrow CO_2 - CO;(x-y) \qquad .....(iv)$$

$$CO+\frac{1}{2}O_2 \rightarrow CO_2;(z)$$

From equation (iii),

$$z = x - y \Rightarrow \boxed{x = y + z}$$

316. For the reaction,
$C_2H_5OH(l) + 3O_2(g) \rightarrow 2CO_2(g) + 3H_2O(l)$
which one is true?

(a) $\Delta H = \Delta E + RT$ (b) $\Delta H = \Delta E - RT$

(c) $\Delta H = \Delta E - 2RT$ (d) $\Delta H = \Delta E - 2RT$

NEET-2000

Ans. (b) : $\Delta H = \Delta E + P\Delta V$

Also PV = nRT (ideal gas equation)

or $P\Delta V = \Delta n_gRT$

Δn_g = change in number of gaseous moles

∴ $\Delta H = \Delta E + \Delta n_gRT$

$\Delta n_g = 2 - 3 = -1$

$\boxed{\Delta H = \Delta E - RT}$

317. In an endothermic reaction, the value of ΔH is

(a) negative (b) positive

(c) zero (d) constant

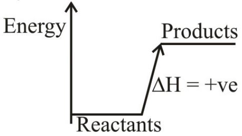
NEET-1999

Ans. (b) : Endothermic Reaction–

- In their reactions the value of ΔH is always positive

$\boxed{\Delta H > 0}$

- Is a reaction that absorb heat from the surrounding.
- Temperature of the surrounding decrease.
- Energy level diagram.



318. One mole of an ideal gas at 300 K is expanded isothermally from an initial volume of 1 litre to 10 litres. The ΔE for this process is (R = 2 cal mol^{-1} K^{-1})

(a) 138.1 cal (b) zero

(c) 163.7 cal (d) 9 L atm

NEET-1998

Ans. (b) : For isothermal process, ΔT = 0

$\Delta E = nC_v\Delta T \Rightarrow \Delta E = 0$

Hence, change in internal energy is zero during isothermal expansion of gas.

319. For the reaction, $N_2 + 3H_2 \rightleftharpoons 2NH_3, \Delta H = ?$

(a) ΔE + 2RT (b) ΔE – 2RT

(c) ΔH = RT (d) ΔE – RT

NEET-1991

Ans. (b) : $N_2 + 3H_2 \rightarrow 2NH_3$

$\Delta n_g = 2 - 4 = -2$

Δn_g = Negative

$\Delta H = \Delta E + \Delta n_gRT$

$\boxed{\Delta H = \Delta E - 2RT}$

320. For the reaction,
$C_3H_8(g) + 5O_2(g) \rightarrow 3CO_2(g) + 4H_2O(l)$
at constant temperature, ΔH – ΔE is

(a) + RT (b) –3RT

(c) +3RT (d) –RT

NEET-2003

Ans. (b) : $C_3H_8(g) + 5O_2(g) \rightarrow 3CO_2(g) + 4H_2O(l)$

$\Delta n_g = 3 - 6 = -3 \quad \because \Delta n_g > 0$

$\Delta H = \Delta E + \Delta n_gRT$

$\Delta H = \Delta E - 3RT$

$\Delta H - \Delta E = -3RT$

321. Assume each reaction is carried out in an open container. For which reaction will ΔH = ΔE?

(a) $2CO(g) + O_2(g) \rightarrow 2CO_2(g)$

(b) $H_2(g) + Br_2(g) \rightarrow 2HBr(g)$

(c) $C(s) + 2H_2O(g) \rightarrow 2H_2(g) + CO_2(g)$

(d) $PCl_5(g) \rightarrow PCl_3(g) + Cl_2(g)$

NEET-2004

Ans. (b) : $\Delta H = P\Delta V + \Delta U$

But for a physical or chemical change.

$\Delta H = \Delta U + \Delta n_g\,RT$

Where Δn_g = No. of gaseous moles of product reactant

So, for ΔH = ΔU or ΔH = ΔE

Δn_g has to 0

In (b) option, $\Delta n_g = 2 - 2 = 0$. Therefore, ΔH = ΔE.

322. Equal volumes of two monatomic gases, A and B at same temperature and pressure are mixed. The ratio of specific heats (C_P/C_V) of the mixture will be

(a) 0.83 (b) 1.50

(c) 3.3 (d) 1.67

NEET-2012

Ans. (d) : For monatomic gases

$$\gamma = \frac{C_p}{C_v} = \frac{5/2R}{3/2R} = 1.67$$

$\gamma_{diatomic} = 1.40$

$\gamma_{triatomic} = 1.33$

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323. Which one among the following is the correct option for right relationship between C_p and C_v for one mole of ideal gas?

(a) $C_v = RC_P$
(b) $C_p + C_v = R$
(c) $C_p - C_v = R$
(d) $C_p = RC_V$

NEET-2021

Ans. (c) : $\Delta U = q - W$

Where, $q = nC_p\Delta T$ & $\Delta U = nC_v\Delta T$

$nC_v\Delta T = nC_p\Delta T - nR\Delta T \quad [\because W = PdV = nR\Delta T]$

$C_v = C_p - R$

$\boxed{R = C_p - C_v}$

Hence, $C_p - C_v = R$ is correct option.

324. The correct option for free expansion of an ideal gas under adiabatic condition is

(a) $q = 0, \Delta T = 0$ and $w = 0$
(b) $q = 0, \Delta T < 0$ and $w > 0$
(c) $q < 0, \Delta T = 0$ and $w = 0$
(d) $q > 0, \Delta T = 0$ and $w > 0$

NEET-2020, 2011

Ans. (a) : For free expansion of ideal gas

$q = 0, w = 0$

$\Delta E = q + w$

$\Delta E = 0$

$\Delta E = nC_v\Delta T = 0$

$q = 0, \Delta T = 0, w = 0$

325. Which of the following are not state functions?

(I) q + w **(II) q**
(III) w **(IV) H – TS**

(a) I and IV
(b) II, III and IV
(c) I, II and III
(d) II and III

NEET-2008

Ans. (d) : State function or state variable depends only on the state of the system

$\left.\begin{array}{l} w = \text{work} \\ q = \text{Heat} \end{array}\right\}$ Both are not state functions

And $\Delta U = q + w$, $\Delta G = H - T\Delta S$ are state function.

326. In a closed insulated container a liquid is stirred with a paddle to increase the temperature, which of the following is true?

(a) $\Delta E = W \neq 0, q = 0$
(b) $\Delta E = W = q \neq 0$
(c) $\Delta E = 0, W = q \neq 0$
(d) $W = 0, \Delta E = q \neq 0$

NEET-2008, UP CPMT-2006

Ans. (a) : $\Delta E = q + W$

Closed, insulated $\boxed{q = 0}$

Paddle → Work done on the system $\boxed{W \neq 0}$

$T\uparrow, \Delta E\uparrow, \Delta E \neq 0$

$q = 0, \Delta E = W$

$\boxed{\Delta E \neq 0, W \neq 0, q = 0}$

Hence option (a) is correct.

327. 5 moles of nitrogen gas at 5 atm pressure shows 100 lit volume. The same gas assumes 200 lit volume upon absorbing 30.26 kJ heat against an external pressure of 2 atm. Calculate the internal energy changes of this process. [Given 1 lit-atm =101.32J]

(a) 50.52 kJ
(b) 60.66 kJ
(c) 0.14 kJ
(d) 10 kJ

Tripura JEE-2021

Ans. (d) : Temperature in both the states can be obtained using the ideal gas relation temperature in the first state $T_1 = \frac{P_1V_1}{nR}$, $T_1 = \frac{5 \times 100}{5 \times 0.082} = 1218\text{K}$

Temperature in the second state = $T_2 = \frac{P_2V_2}{nR}$

$T_2 = \frac{2 \times 200}{5 \times 0.082} = 974.42\text{K}$

$\Delta U = q - w = q - nR\Delta T$

$\Delta U = 30.26 - 5 \times 0.0821 \times (1218 - 974.42)$

$\Delta U = 30.26 - 20.26 = 10$ kJ.

328. The occurrence of reaction is impossible if

(a) ΔH is +ve, ΔS is also +ve
(b) ΔH is –ve, ΔS is also –ve
(c) ΔH is –ve, ΔS is +ve
(d) ΔH is +ve, ΔS is –ve

UP CPMT-2011
J & K CET-(2003)

Ans. (d) : ΔH = +ve and ΔS = –ve both oppose the reaction.

329. During isothermal expansion of ideal gas its

(a) internal energy increases
(b) enthalpy increase
(c) enthalpy reduces to zero
(d) enthalpy remains unchanged

UP CPMT-2007
NEET-1994, 1991

Ans. (d) : Isothermal process is done at constant temperature, $dT=0, \Delta E=0$

$\therefore \quad \Delta H = \Delta E + P\Delta V$

Here, ΔH = enthalpy change

ΔE = internal energy change

P = pressure

ΔV = change in volume during expansion of ideal gas

For isothermal expansion

$\Delta H = 0$

Hence, during isothermal expansion of ideal gas, its enthalpy remains unchanged.

330. Internal energy is sum of

(a) kinetic energy and potential energy
(b) all types of energy of the system
(c) energy of internal system
(d) None of the above

UP CPMT-2007

Ans. (b) : Every system having some quantity of matter is associated with a definite amount of energy. This energy is known as internal energy. It is sum of many type of energies, such as translation energy, rotational energy, vibrational energy, electronic energy and bonding energy of the molecule.

$E = E_{trans} + E_{rot} + E_{vib} + E_{bonding} + E_{electronic}$

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331. In exothermic reaction, heat is
(a) given out
(b) absorbed
(c) not involved
(d) given out or absorbed

UP CPMT-2005

Ans. (a) : In exothermic reaction heat is always given
ΔH = $\Sigma H_P - \Sigma H_R$ and for exothermic reaction $\Sigma H_R > \Sigma H_P$.
Energy release in burning 1 litre of gasoline is 30 MJ.

332. Difference in the melting and boiling point of inert gases is
(a) large (b) small
(c) no difference (d) None of these

UP CPMT-2005

Ans. (b) :	He	Ne	Ar	Kr	Xe	Rn
Melting point /K	0.95	24.6	83.8	115.9	161.3	202
Boiling point /K	4.2	27.1	87.2	119.7	165.0	211

∴ there is small difference in melting and boiling point of inert gases.

333. Suitable conditions for melting of ice
(a) high temperature and high pressure
(b) high temperature and low pressure
(c) low temperature and low pressure
(d) low temperature and high pressure

UP CPMT-2005

Ans. (a) : Use Le-Chatelier principle to find favourable conditions for melting of ice.

$$\text{ice} \rightleftharpoons \text{water}$$

According to Le-Chatelier principle at equilibrium if we change temperature or pressure of a reaction it will shift in such a way so as to undo the change.
∵ melting of ice is endotherimic process.
∴ supply of heat shifts equilibrium in forward direction
∵ volume of ice is more than volume of water.
∴ increase in pressure shifts equilibrium to right.
∴ high temperature and high pressure are favourable conditions of melting of ice.

334. Which is correct for an endothermic reaction?
(a) Δ H is positive (b) Δ H is negative
(c) Δ E is negative (d) Δ H= zero

UP CPMT-2003

Ans. (a) : In endothermic reaction heat is always absorbed

$$A + B \rightleftharpoons C + D \quad \Delta H = +ve$$

$\therefore \quad H_p > H_R$
$\therefore \quad \Delta H = H_p - H_R$
$\therefore \quad \Delta H$ is always positive.

335. $NH_4Cl(s) \rightarrow NH_3(g) + HCl(g)$. When the above reaction occurs, the entropy
(a) remains same (b) decreases
(c) increases (d) None of these

UP CPMT-2002

Ans. (c) : $NH_4Cl \rightarrow NH_3(g) + HCl(g)$
After dissociation of ammonium chloride two mole are formed. No. of mole of product is greater than reactant. So, entropy of above reaction increases.

336. The relation of ΔH and ΔE is represented as
(a) $\Delta H = \Delta E - P\Delta V$ (b) $\Delta E = \Delta H - P\Delta V$
(c) $\Delta H = \Delta E + \Delta nRT$ (d) $\Delta E = \Delta V + \Delta H$

UP CPMT-2002

Ans. (c) : The relation between ΔH (Heat of reaction at constant pressure) is significant, where gases are involved in a chemical reaction.

$$\Delta H = \Delta E + P.\Delta V$$

or $$\Delta H = \Delta E + \Delta n_g RT$$

Δn_g = No. of gaseous mole of product – No. of gaseous mole of reactant.

337. Which law states entropy of all pure crystalline solids is zero at absolute zero?
(a) First law of thermodynamics
(b) Second law of thermodynamics
(c) Third law of thermodynamics
(d) Hess's law

UP CPMT-2001

Ans. (c)
(a) **The first law of thermodynamics** states that energy can neither be created nor destroyed.
(b) **The second law of thermodynamics** states that entropy of universe is continuously increasing.
(c) **The third law of thermodynamics** states that entropy of all crystalline solids is zero at absolute zero temperature.
(d) **Hess's law** this law states that total amount of heat evolved or absorbed in a reaction is independent of path.

338. Consider the reaction $N_2 + 3H_2 \longrightarrow 2NH_3$ carried out at constant temperature and pressure. If ΔH and ΔU are the enthalpy and internal energy changes for the reaction, which of the following expressions is true?
(a) $\Delta H > \Delta U$ (b) $\Delta H < \Delta U$
(c) $\Delta H = \Delta U$ (d) $\Delta H = 0$

UPTU/UPSEE-2007

Ans. (b): $\Delta H = \Delta U + \Delta n_g RT$

$N_2 + 3H_2 \rightarrow 2NH_3$
∵ $\Delta n_g < 0$
$\Delta n_g = -ve$
ΔH = enthalpy change
(at constant pressure)
ΔU = internal energy change
(at constant volume)

$$\boxed{\Delta H < \Delta U}$$

Δn_g = moles of [Gaseous products – Gaseous reactions]

339. In an isochoric process, ΔH for a system is equal to:
(a) $P \cdot \Delta V$ (b) PV
(c) $E + P \cdot \Delta V$ (d) ΔE

UPTU/UPSEE-2006

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Ans. (d) : For an isochoric process (V is constant)

i.e. $\Delta V = 0$

Work done (W) = P.ΔV

$W = P.0 = 0$

We know, $\Delta H = \Delta E + W$

$\Delta H = \Delta E + 0$

$\Rightarrow \Delta H = \Delta E$

340. Considering entropy (s) as a thermodynamic parameter, the criterion for the spontaneity of any process, the change in entropy is

(a) $\Delta S_{system} > 0$ only

(b) $\Delta S_{surrounding} > 0$

(c) $(\Delta S_{system} + \Delta S_{surrounding}) > 0$

(d) $(\Delta S_{system} - \Delta S_{surrounding}) > 0$

UPTU/UPSEE-2017
NEET-2004

Ans. (c) : Entropy (S) is the measure of randomness or disorder of the molecules, it is an extensive property and a state function. A process is spontaneous if and only if the entropy of the universe increase. Therefore

$\Delta S_{Universe} > 0$

$\Delta S_{universe} = \Delta S_{system} + \Delta S_{surrounding}$

341. The densities of graphite and diamond at 298 K are 2.25 and 3.31 g cm^{-3} respectively. If the standard free energy difference is 1895 J mol^{-1}, the pressure at which graphite will be transformed into diamond is

(a) 9.92×10^8 Pa

(b) 9.92×10^7 Pa

(c) 9.92×10^6 Pa

(d) None of these

UPTU/UPSEE-2012

Ans. (d) : Volume of graphite $= \frac{\text{Mass}}{\text{Denisty}} = \frac{12}{2.25}$

Volume of diamond $= \frac{12}{3.31}$

Change in volume,

$$\Delta V = \left(\frac{12}{3.31} - \frac{12}{2.25}\right) \times 10^{-6} m^3 = -1.71 \times 10^{-6}$$

$\Delta G = W_{compress} = p\Delta V$

$$p = \frac{1895}{1.71 \times 10^{-6}} Pa$$

$= 1108 \times 10^6$ Pa

$= 11.08 \times 10^8$ Pa

342. For which reaction change of entropy will be positive?

(a) $H_2(g) + I_2(g) \rightleftharpoons 2HI(g)$

(b) $HCl(g) + NH_3(g) \rightleftharpoons NH_4Cl(s)$

(c) $NH_4NO_3(s) \rightleftharpoons N_2O(g) + 2H_2O(g)$

(d) $MgO(s) + H_2(g) \rightleftharpoons Mg(s) + H_2O(l)$

WB-JEE-2008

Ans. (c) Entropy of gas is greater than that of liquid and solid.

In option (c), solid is converted into gaseous phase.

Entropy of gas > liquid > solid.

343. Under which of the following conditions is the relation ΔH =ΔE+pΔV valid for a closed system?

(a) Constant pressure

(b) Constant temperature

(c) Constant temperature and pressure

(d) Constant temperature, pressure and composition.

WB-JEE-2009

Ans. (a) : $H = E + PV$

$\therefore \Delta H = \Delta E + P\Delta V + V\Delta P$

At constant P, $\Delta H = \Delta E + P\Delta V$

344. Which of the following thermodynamic relation is correct?

(a) $dG = VdP - SdT$

(b) $dE = PdV + TdS$

(c) $dH = -VdP + TdS$

(d) $dG = VdP + SdT$

WB-JEE-2010
TS-EAMCET (Engg.), 06.08.2021

Ans. (a) : We know that,

$G = H - TS$

Where,

G = Gibbs free energy

H = enthalpy

T = temperature

S = entropy

$\because H = U + PV$

$\therefore G = U + PV - TS$

On differentiation,

$dG = dU + PdV + VdP - TdS - SdT$ …(i)

$dQ = dU - dW$

If the work done is only due to expansion,

Then, $-dW = PdV$

$dQ = dU + PdV$

For a reversible process,

$dS = \frac{dQ}{T}$ or $TdS = dQ$ ….(ii)

and $dQ = dU + PdV$ ….(iii)

From equation (i), (ii) and (iii), we have

$dG = VdP - SdT$

345. Identify the correct statement from the following is a chemical reaction.

(a) The entropy always increases

(b) The change in entropy along with suitable change in enthalpy decides the rate of reaction

(c) The enthalpy always decreases

(d) Both the enthalpy and the entropy remain constant

WB-JEE-2012

Ans. (b) : The change in entropy along with suitable change in enthalpy decides the rate of reaction is correct statement because

$\Delta G_{(T,P)} = \Delta H - T\Delta S$, gives the free energy of system.

When $\Delta G_{(T,P)} < 0$, the reaction is spontaneous.

When $\Delta G_{(T,P)} > 0$, the reaction is non-spontaneous.

Hence, option (b) is correct.

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346. The standard Gibbs free energy change (ΔG^o) at 25°C for the dissociation of N_2O_4 (g) to NO_2 (g) is (given, equilibrium constant = 0.15, R = 8.314 J/mol K)

(a) 1.1 kJ (b) 4.7 kJ
(c) 8.1 kJ (d) 38.2 kJ

WB-JEE-2013

Ans. (b) : $\Delta G^o = - 2.303RT \log_{10}K$

$\because \Delta G \rightarrow$ Standard Gibbs free energy

$= - 2.303 \times 8.314 \times 298 \times \log 0.15$

$= - 2.303 \times 8.314 \times 298 \times (-0.8239)$

$= 4701.04 \text{ J} = 4.7\text{kJ}$

347. The condition of spontaneity of a process is

(a) lowering of entropy at constant temperature and pressure
(b) lowering of Gibbs free energy of system at constant temperature and pressure
(c) increase of entropy of system at constant temperature and pressure
(d) increase of Gibbs free energy of the universe at constant temperature and pressure

WB-JEE-2013

Ans. (b) : From Gibbs – Helmholtz equation,

$\Delta G = \Delta H - T\Delta S$

A process will be spontaneous if $\Delta G = -ve$

$\Delta H = -ve, \Delta S = +ve$

348. For isothermal expansion of an ideal gas, the correct combination of the thermodynamic parameters will be

(a) $\Delta U = 0, Q = 0, W \neq 0 \text{ and } \Delta H \neq 0$
(b) $\Delta U \neq 0, Q \neq 0, W \neq 0 \text{ and } \Delta H = 0$
(c) $\Delta U = 0, Q \neq 0, W = 0 \text{ and } \Delta H \neq 0$
(d) $\Delta U = 0, Q \neq 0, W \neq 0 \text{ and } \Delta H = 0$

WB-JEE-2013

Ans. (d) : For isothermal process, $\Delta T = 0$

From first law of thermodynamics,

$\Delta U = Q + W$

$\therefore \quad \Delta U = nC_v\Delta T = 0$

$\Delta H = nC_p\Delta T = 0$

As $\quad \Delta U = 0 \Rightarrow Q \neq 0$ and $W \neq 0$

Parameter are,

$\Delta U = 0 \Rightarrow Q \neq 0, W \neq 0$ and $\Delta H = 0$

349. For a spontaneous process, the correct statement(s) is (are)

(a) $(\Delta G_{system})_{T, p} > 0$
(b) $(\Delta G_{system}) + (\Delta S_{surroundings}) > 0$
(c) $(\Delta G_{system})_{T, p} < 0$
(d) $(\Delta U_{system})_{T, v} > 0$

WB-JEE-2014

Ans. (c): From second law of thermodynamics.

For a spontaneous process,

(i) $(\Delta G_{system})_{T,P} < 0, \; (\Delta G_{system})_{T,V} < 0$

(ii) $\Delta S_{total} = \Delta S_{univ} = \Delta S_{sys} + \Delta S_{surr} > 0$

This is kind of the mathematical expression of the second law of thermodynamics.

Hence, option (b,c) is correct.

350. The values of ΔH and ΔS of a certain reaction are –400 kJ mol^{-1} and –20 kJ mol^{-1} k^{-1} respectively. The temperature below which the reaction is spontaneous, is

(a) 100 K (b) 20°C
(c) 20 K (d) 120°C

WB-JEE-2014

Ans. (c) : Given, $\Delta H = -400 \text{ kJ mol}^{-1}$

$\Delta S = -20\text{kJ mol}^{-1}\text{K}^{-1}$

Gibbs Helmholtz equation is–

$\Delta G = \Delta H - T\Delta S$

For a reaction to be spontaneous, ΔG must be less than 0, i.e negative

$\because \quad \Delta H - T\Delta S < 0$

$T\Delta S < \Delta H$

The temperature below which the reaction is spontaneous is at phase change.

$$T < \frac{\Delta H}{\Delta S} < \frac{-400}{-20} < 20\text{K}$$

351. For the reaction, $X_2Y_4(l) \rightarrow 2XY_2(g)$ at 300 K, the values of ΔU and ΔS are 2 kcal and 20 cal K^{-1} respectively. The value of ΔG for the reaction is

(a) -3400 cal (b) 3400 cal
(c) -2800 cal (d) 2000 cal

WB-JEE-2015

Ans. (c) : Given, ΔU = 2kcal = 2000 cal

Entropy change, $\Delta S = 20 \text{ cal K}^{-1}$

Temperature (T) = 300 K

From the given reaction–

$\Delta n_g = n_g \text{ (product)} - n_g \text{ (reactant)}$

$= 2 - 0 = 2$

$R = 2 \text{ cal K}^{-1} \text{ mol}^{-1}$

$\Delta H = 2000 + (2 \times 2 \times 300)$

$\Delta H = \Delta U + \Delta n_gRT$

$= 3200$ cal

Now, We know Gibbs free energy change is,

$\Delta G = \Delta H - T\Delta S$

$\Delta G = 3200 - (300 \times 20)$

$\Delta G = - 2800$ cal

352. The condition for a reaction to occur spontaneously is

(a) ΔH must be negative
(b) ΔS must be negative
(c) $(\Delta H - T\Delta S)$ must be negative
(d) $(\Delta H + T\Delta S)$ must be negative

WB-JEE-2016

Ans. (c) : For a reaction to occur spontaneously,

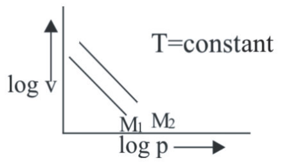
ΔG must be negative or $\Delta G < 0$

We know that, $\Delta G = \Delta H - T\Delta S$

$\therefore$ For a spontaneous reaction,

$\Delta H - T\Delta S$ must be negative

353.



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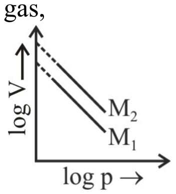
For same mass of two different ideal gases of molecular weights M_1 and M_2 plots of log V vs log p at a given constant temperature are shown. Identify the correct option.

(a) $M_1 > M_2$
(b) $M_1 = M_2$
(c) $M_1 < M_2$
(d) can be predicted only if temperature is known

WB-JEE-2017

Ans. (a) : For ideal gas,



$$\because \quad PV = \frac{w}{M}RT$$

$$PV = \frac{k}{M} \quad \text{.....(i)}$$

Let, wRT = k

Taking log on both the sides of equation (i)

$$\log P + \log V = \log\frac{k}{M}$$

$$\text{or} \quad \log V = -\log P + \log\frac{k}{M} \quad \text{.....(ii)}$$

On comparing equation (ii) with y = mx + C,

Intercept, $C = \log\dfrac{k}{M}$

$$\log\frac{k}{M_2} > \log\frac{k}{M_1}$$

or $M_1 > M_2$

354. At constant pressure, the heat of formation of a compound is not dependent on temperature, when

(a) $\Delta C_p = 0$ (b) $\Delta C_v = 0$
(c) $\Delta C_p > 0$ (d) $\Delta C_p < 0$

WB-JEE-2019

Ans. (a) : At constant pressure, the enthalpy of element or compound changes with temperature according to the Kirchhoff's equation–

$$\Delta H = C_p\Delta T \qquad (\because \Delta H = nC_p\Delta T)$$

So, If $\Delta C_p = 0$ then $\Delta H = 0$

Thus, the heat of formation of the compound becomes independent of temperature.

355. For the equilibrium, $H_2O(l) \rightleftharpoons H_2O(v)$, which of the following is correct?

(a) $\Delta G = 0, \Delta H < 0, \Delta S < 0$
(b) $\Delta G < 0, \Delta H > 0, \Delta S > 0$
(c) $\Delta G > 0, \Delta H = 0, \Delta S > 0$
(d) $\Delta G = 0, \Delta H > 0, \Delta S > 0$

WB-JEE-2019

Ans. (d) : We have $\Delta G = \Delta H - T\Delta S$

$$H_2O(l) \rightleftharpoons H_2O(v)$$

As the process is in equilibrium, $\Delta G = 0$

$\Delta H > 0$ (as the process is endothermic)

$\Delta S > 0$ (as entropy is increase from liquid to gas)

This process is spontaneous at temperature above 0°C so G is negative. Thus free energy changes (ΔG) will be less than zero at 1 atm and 298 K.

356. For spontaneous polymerization, which of the following is (are) not correct?

(a) ΔG is negative (b) ΔH is positive
(c) ΔS is positive (d) ΔS is negative

WB-JEE-2020

Ans. (d) : For spontaneous process,

$$\Delta G = \Delta H - T\Delta S$$
$$\Delta H < 0$$
$$\Delta S < 0$$
$$\Delta G < 0$$

2. First Law of Thermodynamics and Application

357. The work done when 2 moles of an ideal gas expands reversibly and isothermally from a volume of 1L to 10L at 300K is

$(R = 0.0083 \text{ kJ K}^{-1}\text{mol}^{-1})$

(a) 0.115 kJ (b) 58.5 kJ
(c) 11.5 kJ (d) 5.8 kJ

Karnataka CET-17.06.2022, Shift-II

Ans. (c) : Given, $n = 2\text{moles}, V_1 = 1L, \quad V_2 = 10L$

$$T = 300K, \; R = 0.0083 kJ\,K^{-1}mol^{-1}$$

For isothermally,

$$W = -2.303 \text{ nRT } \log\left(\frac{V_2}{V_1}\right)$$

$$= -2.303 \times 2 \times 0.0083 \times 300 \log\left(\frac{10}{1}\right)$$

$$= -2.303 \times 2 \times 0.0083 \times 300 \times 1$$

$$= -11.4689kJ \quad \approx -11.5kJ$$

358. Which one of the following is the correct relation between C_P and C_V for one mole of an ideal gas? (R is molar gas constant)

(a) $C_P = C_V - R$ (b) $C_P = C_V + R$
(c) $C_P = R - C_V$ (d) $C_P = C_V \times R$
(e) $C_P = C_V / R$

Kerala CEE -03.07.2022

Ans. (b) : According to first law of thermodynamics,

$$\Delta U = q - W$$
$$nC_v\Delta T = nC_p\Delta T - nR\Delta T$$
$$C_p - C_v = R$$
$$C_p = R + C_v$$

359. When 5 moles of He gas expand isothermally and reversibly at 300 K from 10 litre to 20 litre, the magnitude of the maximum work obtained is_____ J. [nearest integer] Given : $R = 8.3 \text{ JK}^{-1} \text{ mol}^{-1}$ and log 2 = 0.3010)

JEE Main-27.06.2022, Shift-II

@apna_pdf

Ans. (8630) : Given,

n = 5 moles, R = 8.3 $JK^{-1}mol^{-1}$, V_1 = 10 L, V_2 = 202

T = 300 K

For isothermally,

$$W = -2.303\ nRT\ \log\left(\frac{V_2}{V_1}\right)$$

$$= -2.303 \times 5 \times 8.3 \times 300\ \log\left(\frac{20}{10}\right)$$

$$= -2.303 \times 5 \times 8.3 \times 300 \times 0.301$$

$$= -8630.377\ J \approx -8630\ J$$

360. Consider following statements:

(a) The absolute value of internal energy cannot be evaluated.

(b) Entropy is a state function and extensive property

(c) Temperature is an extensive property

(d) The standard enthalpy of formation of an element (ΔH_f) is always considered to be zero

(e) For an adiabatic process $\Delta S > 0$

wrong statements are :

(a) (a) and (b) (b) (a) and (d)

(c) (c) and (e) (d) (b) and (d)

CG PET-22.05.2022

Ans. (c) : The temperature T is an intensive property, independent of the size of system. (i.e. mass)

In adiabatic process q=0

$$\because \quad \Delta S = \frac{q}{T}$$

$$\Delta S = 0$$

The change is the entropy for an adiabatic process equal to zero. So, from the given option (c) and (e) are wrong statement.

361. 4.0 L of an ideal gas is allowed to expand isothermally into vacuum until the total volume is 20 L. The amount of heat absorbed in this expansion is ——— L atm.

JEE Main-28.06.2022, Shift-I

Ans. (0) : In case of free expansion,

$$W = -P_{ext} \times \Delta V \quad (\because P_{ext} = 0)$$

$$\boxed{W = 0}$$

First law of thermodynamics,

$$\Delta U = q - W$$

For isothermally $\Delta U = 0$

$$0 = q - W$$

$$q = W = 0$$

Amount of heat absorbed = 0

362. Consider the following statements:

1. One kind of energy can be converted into an exactly equivalent amount of other kind of energy.

2. Continuous production of mechanical work is possible without the supply of equivalent quantity of heat.

Which of the statements given above is/are contrary to first law of thermodynamics?

(a) 1 only (b) 2 only

(c) Both 1 and 2 (d) Neither 1 nor 2

SCRA-2010

Ans. (a) : From first law of thermodynamics, also known as Law of conservation of energy, states that "Energy can neither be created nor destroyed, energy can only be transferred into one form to another".

The second law of the thermodynamics states that, "It is impossible in any system for heat transfer from a reservoir to completely convert into work in a cyclic process".

363. Work done by an ideal gas at a constant volume is ....

(a) $-\frac{\Delta p}{p}$ (b) $-V\Delta p$

(c) 0 (d) $\frac{nR}{p}$

AP EAMCET (Engg.) 21.09.2020, Shift-I

WB-JEE-2013

Ans. (c) : The first law of thermodynamics,

$$\Delta E = q + W$$

Where,

Work done (W) = $-p\Delta V$

$$W = -p \times \Delta V (\because \Delta V = 0)$$

The volume is constant,

$$W = 0$$

364. A system undergoes a process in which ΔU=+300J while absorbing 400 J of heat energy and undergoing an expansion against 0.5 bar. What is the change in volume (in L) ?

(a) 4 (b) 5

(c) 2 (d) 3

AP EAPCET-6 Sep. 2021, Shift-II

Ans. (c) : From first law of thermodynamics,

$$dU = Q+W$$

Since, expansion occurs and we know that in the case of expansion occurs and we know that in the case of expansion work done having negative sign. So,

$$\Delta U = \Delta Q + \Delta W \text{ or } dU = dq + dW$$

Here dq = 400 Joule, ΔU = 300 Joule

$$dq = dU + dW$$

$$400 = 300 + dW$$

$$dW = 100\ J$$

We know that, dW = PdV

$$dV = \frac{dW}{P}$$

$$= \frac{100}{0.5\times10^5} \quad (\because 1\ \text{bar} = 10^5\ \text{pascals})$$

$$= 20\times10^{-4}$$

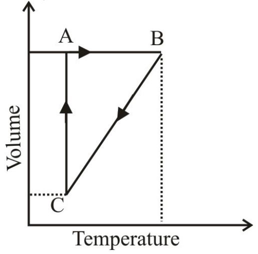
$$= 2\times10^{-3}$$

$$= \frac{2}{1000} \quad (\because 1000\ m^3 = 1\ \text{litre})$$

$$= 2\ \text{litre}$$

@apna_pdf

365. Five moles of a gas are put through a series of changes as shown graphically in a cyclic process. The processes A → B, B → C and C → A respectively are



(a) isochoric, isobaric, isothermal
(b) isobaric, isochoric, isothermal
(c) isothermal, isobaric, isochoric
(d) isochoric, isothermal, isobaric

COMEDK-2018

Ans. (a) : Process $A \rightarrow B$ is isochoric, i.e., volume remains constant.
Process $B \rightarrow C$ is isobaric, i.e., pressure remains constant. ($\because$ at constant $P, V \propto T$)
Process $C \rightarrow A$ is isothermal, i.e., temperature remains constant.

366. One mole of a perfect gas expands isothermally and reversibly from 10 dm^3 to 20 dm^3 at 300 K. Δu, q and work done in the process are [R= 8.3×10^{-3} kJ K^{-1} mol^{-1}]

(a) 0, 1.726 kJ, –1.726 kJ
(b) 0, 17.48 J, 1.726 J
(c) 0, 21.84 kJ, 21.84 kJ
(d) none of these.

COMEDK-2020

Ans. (a) : Given that : n=1, V_1=10 dm^3,
V_2= 20 dm^3, T=300 K, R=8.3×10^{-3} kJ K^{-1} mol^{-1}
Formula for maximum work,

$$W_{max} = -2.303nRT\log\frac{V_2}{V_1}$$

$$= -2.303\times1\times8.3\times10^{-3}\times300\times\log\frac{20}{10}$$

$=–2.303 \times 2.49 \times 0.3010=–1.726$kJ
According to first law,
$\Delta U = q + W$
Now, 0 = q + W
$\therefore +q = -W$ or $q = 1.726$kJ
For an isothermal expansion of a perfect gas at constant temperature, $\Delta U = 0$
$\Delta U = 0; W_{max} = -1.726$kJ and $q = 1.726$kJ

367. Based on the first law of thermodynamics, which one of the following is correct?

(a) For an isochoric process, $\Delta u = -q$
(b) For an adiabatic process, $\Delta u = -W$
(c) For an isothermal process, q=+ W
(d) For an cyclic process, q = – W

COMEDK-2019
Karnataka CET-2011

Ans. (d) : (a) For an isochoric process,
Work done by the gas= $-P\Delta V$
$\Delta U = q + W$
$\Delta U = q - P\Delta V$
When, $\Delta V = 0, \Delta U = q$ or qv
(b) For an adiabatic process, q=0, $\Delta U = W$
(c) For an isothermal process, $\Delta U = 0, q = -W$
(d) For a cyclic process, $\Delta U = 0$
$\therefore$ $\Delta U = 0 = q + W$ or $q = -W$

368. Assertion: In a process, if work = 0 then ΔU = q.
Reason: q is difference between initial state and final state of a system.

(a) If both Assertion and Reason are correct and Reason is the correct explanation of Assertion.
(b) If both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.
(c) If Assertion is correct but Reason is incorrect.
(d) If both the Assertion and Reason are incorrect.

AIIMS 26 May 2019 (Evening)

Ans. (c) At in a process
At W = 0
From thermodynamics Ist Law
$\Delta U = q + w$
At W = 0
$\Delta U = q$
$\because$ So, Assertion is correct
q → path function does not depend on initial and final state at is a path dependent

369. 1 mole of an ideal gas expands isothermally and reversibly from 2 lit to 4 lit and 3 moles of same gas expand from 2 lit to x lit and doing same work, what is 'x'?

(a) $(8)^{\frac{1}{3}}$	(b) $(4)^{\frac{2}{3}}$
(c) 2	(d) 4 lit

AIIMS-26 May, 2018 (M)

Ans. (b): $W = -nRT \ \ln\frac{V_2}{V_1}$

$$-\ RT\ln\frac{4}{2} = -3RT\ln\frac{x}{2}$$

$$\ln2 = \ln\left(\frac{x}{2}\right)^3$$

$x^3 = 16$
$x = (16)^{1/3} = (4)^{2/3}$

370. One mono-atomic gas is expanded adiabatically from 2L to 10L at 1 atm external pressure, find ΔU (in atm L)?

(a) –8	(b) 0
(c) –66.7	(d) 58.2

AIIMS-26 May, 2018 (M)

@apna_pdf

Ans. (a): Given that, $V_1 = 2$ L, $V_2 = 10$ L, P = 1 atm
At adiabatic process Q = constant
Process is adiabatic $\therefore \Delta Q = 0$

$$\therefore \quad \Delta U = W = -P_{ext.}\Delta V$$
$$= -1\ (10-2)\ \text{atm L}$$
$$= -8\ \text{atm L}$$

371. One mole of an ideal gas is allowed to expand reversibly and adiabatically from a temperature of 27ºC. If the work done during the process is 3 kJ, then final temperature of the gas is (C_v=20J/K)

(a) 100K (b) 150K
(c) 195K (d) 255K

AIIMS-2010

Ans. (b): Given number of moles = 1
Work done by the system = 3000J
Work done is negative because it is done by the system.
Initial temperature = 27°C = 300K
Heat capacity (c_v) = 20 J/K
We know that work done

$$W = -nc_v\ (T_2 - T_1)$$
$$3000 = -1 \times 20\ (T_2 - 300)$$
$$3000 = -20T_2 + 6000$$
$$20T_2 = 3000$$
$$T_2 = 150\text{K}$$

372. One mole of an ideal gas at 300 K is expanded isothermally from an initial volume of 1 litre to 10 litres. The value of ΔE for this process is (R=2 cal mol^{-1} K^{-1})

(a) 163.7 cal (b) zero
(c) 138.1 cal (d) 9 litre atm

AIIMS-2010

Ans. (b): $\Delta E = nC_v\Delta T$
For isothermal process, $\Delta T = 0$, $\Delta E = 0$
Hence, change in internal energy (ΔE) is zero during isothermal expansion of a gas.

373. 6 moles of an ideal gas expand isothermally and reversibly from a volume of 1 litre to a volume of 10 litres at 27ºC. What is the maximum work done?

(a) 47kJ (b) 100kJ
(c) 0 (d) 34.465 kJ

AIIMS-2009, VITEEE- 2006

Ans. (d): For isothermal change,

$$W = -2.303\ nRT\ \log\frac{V_2}{V_1}$$

Given, n =6, T = 27°C = 273+27 = 300K

$V_1 = 1$ L, $V_2 = 10$ L

$$W = -2.303 \times 6 \times 8.314 \times 300\ \log\frac{10}{1} = 34464.86\text{J}$$

= 34.465 kJ.

374. Calculate change in internal energy if $\Delta H = -92.2\text{kJ}, P = 40\,\text{atm and}\ \Delta V = -1\text{L}$

(a) –42kJ (b) –88kJ
(c) +88kJ (d) +42kJ

AIIMS-2007

Ans. (b): $\Delta H = 92.2$kJ
P = 40 atm
$\Delta V = -1$ L

Or
$$\Delta H = \Delta E + \Delta nRT$$
$$\Delta H = \Delta E + PdV$$
$$-92.2\text{kJ} = \Delta E + 40 \times -1$$
$$-92.2\text{kJ} = \Delta E - 40\text{atm L}$$
$$-92200\text{J} = \Delta E - 40 \times 101.325\ \text{J}$$
[$\because$ 1 atm L = 101.325J]
$$\Delta E = -92200\text{J} + 4053\ \text{J}$$
$$\Delta E = -88147\ \text{J} \approx -88\ \text{kJ}$$

375. The enthalpy change (ΔH) for the reaction, $N_2(g) + 3H_2(g) \rightarrow 2NH_3(g)$ is –92.38kJ at 298K. The internal energy change ΔU at 298 K is

(a) –92.38 kJ (b) –87.42 kJ
(c) –97.34 kJ (d) –89.9 kJ

AIIMS-2006

Ans. (b): We know that $N_{2(g)} + 3H_{2(g)} \Rightarrow NH_{3(g)}$
$$\Delta E = \Delta H - \Delta nRT$$
Here Δn = number of molecules of products –number of molecules of reactants
= 2 – 4 = –2
$$= -92.38 - \left(\frac{-2 \times 8.31 \times 298}{1000}\right) \because \Delta n_g < 0$$
$$= -92.38 + 4.95 = -87.42\ \text{kJ}$$

376. For the reaction of one mole of zinc dust with one mole of sulphuric acid in a bomb calorimeter , ΔU and W corresponds to

(a) ΔU <0, W=0 (b) ΔU <0, W<0
(c) ΔU >0, W=0 (d) ΔU >0, W>0

AIIMS-2005

Ans. (a): $Zn + H_2SO_4 \rightarrow ZnSO_4 + H_2$
$$\Delta n_{gas} = 0$$
$$\therefore \quad W = \Delta\ n_{gas}\ RT = 0$$
$$\Delta U = W + Q$$
In bomb calorimeter, there is no expansion in volume, so work done will be zero. This reaction is exothermic. So, some heat will evolved which will result in lowering of internal energy (Internal energy are the function of temperature).
Hence, ΔU < 0 and W = 0

377. Two moles of an ideal gas are compressed isothermally (100ºC) and reversibly from a pressure of 10 atm to 25 atm. Then the free energy change is:

(a) +15.482 kJ (b) +10.462 kJ
(c) +5.684 kJ (d) +3.3642 kJ

AIIMS-2001

Ans. (c): For isothermal reversible process:

$$W_{rev} = -2.303\ \ nRT\ \log\left(\frac{P_1}{P_2}\right) = -2.303nRT\log\frac{V_1}{V_2}$$

$$= -\ 2.303 \times 2 \times 8.314 \times 373 \times \log\left(\frac{10}{25}\right) = +\ 5684.08\text{J}$$

@apna_pdf

$W_{rev} = +5.684\text{kJ}$

Since, it is a measure of free energy

$\therefore \quad \Delta G = W_{rev} = W_{max}$

$\therefore \quad \Delta G = +5.684 \text{ kJ}$

378. A gas expands isothermally against a constant external pressure of 1 atm from a volume of 10 dm^3 to a volume of 20 dm^3. It absorbs 800 J of thermal energy from its surrounding. The ΔU is:

(a) -312J (b) $+123$J

(c) -213J (d) $+231$J

BCECE-2007, AIIMS-1999

Ans. (c): In general

$$W = -\int_{V_1}^{V_2} PdV = -P(V_2 - V_1)$$

$$W = -(1\text{atm})(20-10) = -10\,\text{dm}^3\text{ atm}$$

$$\left[\begin{array}{l}\because 1\text{dm}^3 = 1\text{L} \\ 1\text{atm L} = 101.325\text{J}\end{array}\right]$$

$= -10 \times 101.325 = -1013.25 \text{ J} \approx -1013 \text{ J}$

According to 1st law of thermodynamics,

$\Delta U = q + W = 800\text{J} + (-1013\text{J}) = -213\text{J}$

379. During isothermal expansion of one mole of an ideal gas from 10 atm to 1atm at 273 K, the work done is (gas constant=2):

(a) -895.8cal (b) -1172.6cal

(c) -1257.43cal (d) -1499.6cal

AIIMS-2000

Ans. (c): Work done in expansion of gas during Isothermal process,

$$W = -2.303 nRT \log\frac{P_1}{P_2}$$

$$W = -2.303 \times 1 \times 2 \times 273 \log\frac{10}{1}$$

$$W = -1257.43 \text{ cal.}$$

380. When the temperature of 2 moles of an ideal gas is increased by 20ºC at constant pressure. Find the work involved in the process.

(a) 5R (b) 40R

(c) 15R (d) 20R

AP EAPCET 19-08-2021, Shift-II

Ans. (b) : Given, n = 2 mole

T = 20ºC

P = Constant

$\Delta W = ?$

From ideal gas equation -

$\Delta W = P\Delta V = nR\Delta T$

$\therefore \ \Delta W = 2 \times R \times 20$

$\Delta W = 40R$

381. The work done in ergs for the reversible expansion of one mole of an ideal gas from a volume of 10 litres to 20 litres at 25°C is

(a) $2.303 \times 298 \times 0.082 \log 2$

(b) $298 \times 10^7 \times 8.31 \times 2.303 \log 2$

(c) $2.303 \times 298 \times 0.082 \log 0.5$

(d) $8.31 \times 10^7 \times 298 - 2.303 \log 0.5$

VITEEE-2019

Ans. (b) : Given that,

$V_1 = 10$ litre

$V_2 = 20$ litre

$T = 25° = 273 + 25 = 298$ K

1 Joule = 10^7 erg

Workdone, $W = -2.303 \text{ nRT} \log \dfrac{V_2}{V_1}$

$$= -2.303 \times 1 \times 8.314 \times 298 \times 10^7 \times \log\frac{20}{10}$$

$$= -2.303 \times 10^7 \times 8.314 \times 298 \log 2$$

$$= -298 \times 10^7 \times 8.31 \times 2.303 \log 2$$

382. Calculate the work done when a gas is compressed by an average pressure of 0.50 atm so as to decrease its volume from 400 cm^3 to 200 cm^3.

(a) 1.013J (b) 10.13J

(c) 101.3J (d) None of these

SRMJEEE – 2016

Ans. (b) : Given data :

P = 0. 50 atm

$V_1 = 400 \text{ cm}^3 = 0.4 \text{ L} \quad (\because 1\text{L} = 1000\,\text{cm}^3)$

$V_2 = 200 \text{ cm}^3 = 0.2$ L

W = ?

Now, $W = -P\Delta V$

$W = -P(V_2 - V_1)$

$W = -0.50\,(0.2 - 0.4)$

$W = 0.1 \text{ atm} \quad (\because 1\text{atm L} = 101.325\text{J})$

$\therefore \quad W = 0.1 \times 101.325$

W = 10.13 Joule

383. A system is provided with 50 J of heat and the work done on the system is 10 J. What is the change in internal energy of the system in joules?

(a) 60 (b) 40

(c) 50 (d) 10

AP-EAMCET- (Engg.) - 2010

Ans. (a) : Given,

q = 50 J

W = 10J

We know that,

The law of conservation of energy that the total is constant, energy con be transformed from one from to another, but can be neither created or destroyed.

$\Delta U = q + W$

$\Delta U = 50 + 10 = 60$J.

384. Calculate the maximum work done in expanding 16 g of oxygen at 300 K and occupying a volume of 5 dm^3 isothermally until volume becomes 25 dm^3.

(a) -2.01×10^3J (b) $+2.01 \times 10^3$J

(c) 2.01 J (d) 2.01×10^3 kJ

AMU-2017

Ans. (a) : Maximum work is obtained in isothermal reversible process.

The expansion for the maximum work is as Follow,

@apna_pdf

$$W = -2.303nRT\log\frac{V_2}{V_1}, W = -2.303nRT\log\frac{P_1}{P_2}$$

The number of moles of oxygen (n) =

$$\frac{\text{Weight}}{\text{Molecular Weight}} = \frac{16}{32} = 0.5$$

The temperature is T = 300K

The initial volume is $V_1 = 5dm^3$

The final volume is $V_2 = 25dm^3$

Substituting values in the above reaction we get,

$$W = -2.303\times0.5\times8.314\times300\times\log\frac{25}{5} = -2.01\times10^3 J$$

385. A sample of liquid in a thermally insulated container is stirred for 1 hr by a mechanical attachment to a motor in the surroundings, which of the following thermodynamic quantity for the system is zero?

(a) Work (W)

(b) Change in internal energy (ΔE)

(c) Change in enthalpy (ΔH)

(d) None of these

AMU-2012

Ans. (d) : For a thermally insulated container, $\Delta q = 0$.
But work (w), change in internal energy (ΔE) and change in enthalpy are non zero.
∵ So, this is the adiabatic process.

386. The incorrect statement of the first law of thermodynamics is

(a) $W = \Delta E - q$ (b) $q = \Delta E - W$

(c) $\Delta E = q + W$ (d) $q = \Delta E + W$

AMU-2004

Ans. (d) : Mathematically the first law of thermodynamics may be stated as –

$\Delta E = q + W$

Where, ΔE = Change in internal energy of system
q = Heat supplied to the system
W = Work done on the system

387. 1 g ice absorbs 335J of heat to melt at 0°C. The entropy change will be

(a) $1.2\ JK^{-1}\ mol^{-1}$ (b) $335\ JK^{-1}\ mol^{-1}$

(c) $22.1\ JK^{-1}\ mol^{-1}$ (d) $0.8\ JK^{-1}\ mol^{-1}$

BCECE-2010

Ans. (c) : $\Delta G = \Delta H - T\Delta S$

At phase / state change, $\Delta G = 0$

$$\Delta S_f = \frac{\Delta H_f}{T_f} = \left(\frac{335\times18}{273}\right) = 22.1 JK\,mol^{-1}$$

388. When 1 mole gas is heated at constant volume, temperature is raised from 298K to 308K. Heat supplied to the gas is 500J.Then which statement is correct?

(a) $q = W = 500J, \Delta U = 0$

(b) $q = \Delta U = 500J, W = 0$

(c) $q = W = 500J, \Delta U = 0$

(d) $\Delta U = 0, q = W = -500J$

BCECE-2012

Ans. (b) : From first law of thermodynamics

$\Delta U = q + W$

Given, q = 500J

$W = P\Delta V = 0, \Delta V = 0$

(At constant volume)

So, $\Delta U = q = 500J$ $\Delta V = 0$ then $W = 0$

389. In photoelectric effect, if the energy required to overcome the attractive forces on the electron, (work function) of Li, Na and Rb are 2.41 eV, 2.30 eV and 2.09 eV respectively, the work function of 'K' could approximately be in eV.

(a) 2.52 (b) 2.20

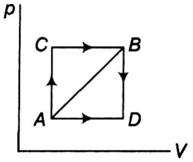
(c) 2.35 (d) 2.01

BCECE-2014

Ans. (b) : As the size of the atom (element) increases the energy required to overcome the attractive force on outer most electron decreases Li, Na, K, and Rb have the following order of size Li < Na < K < Rb
Thus, the energy in case of K is intermediate of Rb and Na i.e

2.30 > K >2.09 or the energy for K is 2.20eV.

390. A system is allowed to move from state A to B following path ACB by absorbing 80J of heat energy. The work done by the system is 30 J. The work done by the system in reaching state B from A is 10J through path ADB. Which statements are correct?



I. Increase in internal energy from state A to state B is 50 J.

II. If path ADB is followed to reach state B, $\Delta E = 50J$.

III. If work done by the system in path AB is 20J, the heat absorbed during path AB = 70J.

IV. The value $E_C - E_A$ is equal to $E_D - E_B$.

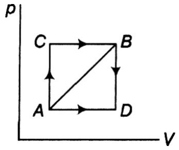
V. Heat absorbed by the system to reach B from A through path ADB is 60J.

(a) I, V (b) I, III, V

(c) I, II, III, V (d) I, IV, V

BCECE-2014

Ans. (c)



Given, Statement-(I) : ACB,

q = 80 J, W = –30 J

According to first law of thermodynamics,

$\Delta E = q + W = 80 - 30 = 50$ J

Statement-(III) : $A \rightarrow B$

W = –20 J, $\Delta E = 50$ J

Similarly, $\Delta E = q + W \Rightarrow q = \Delta E - W$

= 50 – (–20) J = 70 J

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Statement-(V) : ADB,

$W = -10$ J, $\Delta E = 50$ J

Similarly, $q = \Delta E - W = 50 - (-10) = 60$ J

In statement (IV) No. the value of $E_C - E_A$ is equal to $E_D - E_B$ are not possible internal energy (E) in cyclic process are zero.

Hence, correct statement is I, II, III and V.

391. Temperature of 5 moles of a gas is decreased by 2K at constant pressure. Indicate the correct statement

(a) Work done by gas is = 5 R
(b) Work done over the gas is = 10 R
(c) Work done by the gas = 10 R
(d) Work done = 0

BITSAT-2007

Ans. (b) : For 5 moles of gas at temperature T,

$PV_1 = 5RT$ .....(i)

For 5 moles of gas at temperature (T – 2),

$PV_2 = 5R(T-2)$ .....(ii)

$\therefore P(V_2 - V_1) = 5R(T-2-T);$

$P\Delta V = -10R, -P\Delta V = 10R$

When ΔV is negative, W is +ve.

392. Which of the following represents the first law of thermodynamics

(a) $\Delta U = q + W$
(b) $\Delta U = p\Delta V$
(c) $\Delta U = \Delta H + p\Delta V$
(d) $\Delta H = q + W$

CG PET-2012

Ans. (a) : The first law of thermodynamics state that the energy converted can be from one form to another with the interaction of heat, but it cannot be created or destroyed, under any circumstances.

It relates to change in energy with work and heat transfer.

$\Delta U = q + W$

393. Which of the following is a first order reaction?

(a) $NH_4NO_2 \rightarrow N_2 + 2H_2O$
(b) $2HI \rightarrow H_2 + I_2$
(c) $2NO_2 \rightarrow 2NO + O_2$
(d) $2NO + O_2 \rightarrow 2NO_2$

CG PET-2010

Ans. (a) : Order of Reaction–No. of reactant molecules taking part in the reaction/no. of reactant molecules that effects the rate of reaction.

$NH_4NO_2 \rightarrow N_2 + 2H_2O$

Rate of equation

$K[NH_4NO_2]^1$

∴ Order of this reaction is (1)

Hence, option (a) is correct.

394. Identify the correct statement regarding a spontaneous process.

(a) For a spontaneous process in an isolated system, the change in entropy is positive
(b) Endothermic processes are never spontaneous
(c) Exothermic processes are always spontaneous
(d) Lowering of energy in the reaction process is the only criterion for spontaneity

AIEEE-2007

Ans. (a) For a spontaneous process, $\Delta G < 0$

$\Delta G = \Delta H - T\Delta S < 0$

For isolated system, change in enthalpy is zero.

Hence, ΔS must be positive for spontaneous process.

Hence, option (a) is correct.

395. During which of the following processes, does entropy decrease?

A. Freezing of water to ice at 0°C.

B. Freezing of water to ice at –10°C.

C. $N_2(g) + 3H_2(g) \longrightarrow 2NH_3(g)$

D. Adsorption of CO(g) and lead surface.

E. Dissolution of NaCl in water.

(a) A, B, C and D
(b) B and C
(c) A and E
(d) A, C and E

JEE Main-2021, Shift-II

Ans. (a) : A,B→ freezing of H_2O will decreases entropy as particles more closer and forces of attraction will increases. Thus leads to decreases in randomness so entropy decreases.

C → No of molecule decreasing, so entropy decreases.

D→ Adsorption will lead to a decreases in the randomness of gaseous particles.

At the adsorption $\Delta H < 0$, $\Delta g < 0$, $\Delta S < 0$

396. The incorrect expression among the following is

(a) $\dfrac{\Delta G_{System}}{\Delta S_{Total}} = -T(\text{at constant P})$

(b) $\ln k = \dfrac{\Delta H° - T\Delta S°}{RT}$

(c) $k = e^{-\frac{\Delta G°}{RT}}$

(d) For isothermal process,

$W_{reversible} = -nRT \ln\dfrac{V_f}{V_i}$

JEE Main-2021, Shift-II

Ans. (b) : We know that,

$\Delta G^o = \Delta H° - T\Delta S°$

Where ΔG^o is standard Gibbs free energy change

ΔH° is standard Enthalpy change,

TΔS° is standard Entropy change,

T is temperature.

$\Delta G^o = -RT \times \ln(K)$, where K is the equilibrium constant

$-RT \times \ln(K) = \Delta H^o - T\Delta S°$

$\text{In}(K) = -\left[\dfrac{\Delta H° - T\Delta S°}{RT}\right]$

397. Given :

(a) $C_{graphite} + O_2(g) \rightarrow CO_2(g);$

$\Delta_r H^\ominus = x$ kJ mol^{-1}

(b) $C_{graphite} + \dfrac{1}{2}O_2(g) \rightarrow CO_2(g);$

$\Delta_r H^\ominus = y$ kJ mol^{-1}

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(c) $CO(g)+\frac{1}{2}O_2(g)\rightarrow CO_2(g)$;

$\Delta_rH^{\ominus} = z$ kJ mol^{-1}

Based on the above thermochemical equations, find out which one of the following algebraic relationships is correct?

(a) $y = 2z - x$ (b) $x = y - z$

(c) $z = x + y$ (d) $x = y + z$

[JEE Main-2019, 12 Jan Shift-II]

Ans. (d) : Given–

$C_{graphite} + O_2(g) \rightarrow CO_2(g)$; $\Delta_rH^o = x$ kJ/mol .....(i)

$C_{graphite} + \frac{1}{2}O_2(g) \rightarrow CO_2(g)$; $\Delta_rH^o = y$ kJ/mol .....(ii)

$CO(g) + \frac{1}{2}O_2(g) \rightarrow CO_2(g)$; $\Delta_rH^o = z$ kJ/mol .....(iii)

From reaction (i), (ii) and (iii)

(i) = (ii) + (iii)

$\boxed{x = y + z}$

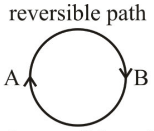
398. The internal energy change when a system goes from state A to B is 40 kJ/mol. If the system goes from A to B by a reversible path and returns to state A by an irreversible path, what would be the net change in internal energy?

(a) 40 kJ (b) > 40 kJ

(c) <40 kJ (d) zero

AIEEE-2003

Ans. (d) :



For a cyclic process the net change in the internal energy is zero because the change in internal energy does not depend on the path.

$\because$ $\Delta U = U_f - U_i$

$U_f = U_i$

When system returns to its initial state,

$\therefore$ $\Delta U = 0$

399. A piston filled with 0.04 mole of an ideal gas expands reversibly from 50.0 mL to 375 mL at a constant temperature of 37.0°C. As it does so, it absorbs 208 J of heat. The values of q and W for the process will be (R = 8.314 J/mol K. In 7.5 = 2.01)

(a) q = +208 J, W = –208 J

(b) q = –208, J, W = –208 J

(c) q = –208 J, W = +208 J

(d) q = +208 J, W = +208 J

[JEE Main-2013]

Ans. (a) : The process is isothermal expansion,

$\boxed{T = \text{Constant}}$

$\Delta U = 0$

$\Delta U = q + W \Rightarrow W = -q$

$\boxed{q = +208\,J}$

$\boxed{W = -280\,J}$

Here negative sign shows that system expand.

400. At constant volume, 4 mol of an ideal gas when heated from 300 K to 500 K changes its internal energy by 5000 J. The molar heat capacity at constant volume is

[JEE Main-2020, 8 Jan Shift-II]

Ans. (6.25 J/mol K) :

Given, n = 4, $\Delta T = (500 - 300) = 200$ K

$\Delta U = 5000$ J

We know that,

$$\Delta U = nC_v\Delta T \Rightarrow C_v = \frac{\Delta U}{n\Delta T} = \frac{5000}{4\times 200} = 6.25\,J/mol\,K$$

401. Which one of the following equations does not correctly represent the first law of thermodynamics for the given processes involving an ideal gas?

(Assume non-expansion work is zero)

(a) Cyclic process : $q = -W$

(b) Adiabatic process : $\Delta U = -W$

(c) Isochoric process : $\Delta U = q$

(d) Isothermal process : $q = -W$

[JEE Main 2019, 8 April Shift-I]

Ans. (b) : According to first law of thermodynamic,

$\Delta U = q + W$

Cyclic process: $\Delta U = 0 \Rightarrow q = -W$

Isothermal process : $\Delta U = 0 \Rightarrow q = -W$

Adiabatic process: $q = 0 \Rightarrow \Delta U = W$

Isochoric process : $W = 0 \Rightarrow \Delta U = q$

402. Five moles of an ideal gas at 1 bar and 298 K is expanded into vacuum to double the volume. The work done is

(a) $-RT\ In\ (V_2/V_1)$ (b) $-RT(V_2-V_1)$

(c) $C_v(T_2-T_1)$ (d) zero

[JEE Main 2020, 4 Sep Shift-II]

Ans. (d) : Expansion of a gas in vacuum ($P_{ext} = 0$) is called free expansion. No work is done during free expansion, since as the expansion is done in vacuum that is in absence of external pressure hence work will be,

$W = -P_{ext}\Delta V \Rightarrow W = 0$

Here, ($P_{ext} = 0$) because expansion takes place in vacuum.

403. At 25°C, 50g of iron reacts with HCI to form $FeCl_2$. The evolved hydrogen gas expands against a constant pressure of 1 bar. The work done by the gas during this expansion is .... J. (Round off to the nearest integer)

[Given, R = 8.314J mol^{-1}K^{-1}.

Assume, hydrogen is an ideal gas]

[Atomic mass off Fe is 55.85 u]

[JEE Main 2021, 16 March Shift-II]

Ans. (–2218 J) :

Given,

T = 298 K

R = 8.314 J/mol K

Chemical reaction is,

$Fe + 2HCl \longrightarrow FeCl_2 + H_2(g)$

50g P = 1 bar

@apna_pdf

$$= \frac{50}{55.85} \text{mol}$$

Work done for 1 mol gas $= -P \times \Delta V = \Delta n_g RT$

$= -1 \times 8.314 \times 298$

Work done for $\frac{50}{55.85}$ mol of gas

$$= -1 \times 8.314 \times 298 \times \frac{50}{55.85} \text{J}$$

$= -2218.059 \text{J} \approx -2218 \text{ J}$

404. Five moles of an ideal gas at 293K is expanded isothermally from an initial pressure of 2.1 MPa to 1.3 MPa against at constant external pressure 4.3 MPa. The heat transferred in this process is ....kJ mol^{-1}. (Rounded off to the nearest integer)
[$R = 8.314 \ Jmol^{-1}K^{-1}$]

[JEE Main 2021, 25 Feb Shift-II]

Ans. (3) : Given, $n = 5$, $T = 293$ K, $\Delta U = 0$,
$P_1 = 2.1$MPa, $P_2 = 1.3$ MPa, $P_{ext} = 4.3$ MPa
Isothermal irreversible (T = Constant),
We know that,

$$W = -P_{ext}(V_2 - V_1) = -P_{ext} nRT\left(\frac{1}{P_2} - \frac{1}{P_1}\right)$$

$$= -4.3 \times 5 \times 8.314 \times 293\left(\frac{1}{1.3} - \frac{1}{2.1}\right)$$

$= -15347.7$ J
Now from equation,
$\Delta U = q + W$
$\therefore \ q = -W$ (For isothermal process)
$q = -(-15347.7) = 15347.7$ J $= 15.35$ kJ (For 5 moles)

$$\therefore \ q/\text{mol} = \frac{15.35}{5} = 3 \text{kJ mol}^{-1}$$

405. One mole of an ideal gas expands isothermally and reversible from 2 lit. to 20 lit. at 300 K. If the final pressure of the gas is l bar, the work done by the gas is

(a) –300R ln10	(b) 300R ln10
(c) 18	(d) –18

J & K CET-(2015)

Ans. (a) : Given,
$V_1 = 2L$, $V_2 = 20L$
$T = 300K$, $P_2 = 1$ bar
Work done in isothermal process,

$$= -nRT \ln\frac{V_2}{V_1}$$

$$= -1 \times R \times 300 \ln\frac{20}{2}$$

$W = -300R \ln 10$

406. The compressibility factor for an ideal gas is:

(a) <1	(b) =1
(c) >1	(d) always 2

JCECE - 2003

Ans. (b): Compressibility factor (Z) $= \frac{PV}{nRT}$
For ideal gas,
$PV = nRT$
So, $Z = \frac{nRT}{nRT} = 1$
For ideal gas $\boxed{Z = 1}$
For real gas, $\boxed{Z < 1 \text{ or } Z > 1}$

407. In adiabatic conditions, 2 mole of CO_2 gas at 300 K is expanded such that its volume becomes 27 times. Then, the work done is
($C_v = 6$ cal mol^{-1} and $\gamma = 1.33$)

(a) 1400 cal	(b) 1000 cal
(c) 900 cal	(d) 1200 cal

JIPMER-2018

Ans. (d) : In adiabatic condition $\frac{T_2}{T_1} = \left(\frac{V_1}{V_2}\right)^{\gamma-1}$

$$\frac{T_2}{T_1} = \left(\frac{1}{27}\right)^{1.33-1} = \left(\frac{1}{27}\right)^{0.33} = \frac{1}{3}$$

$T_2 = 300 \times \frac{1}{3} = 100K$
Thus $T_2 < T_1$ hence cooling takes place due to expansion under adiabatic condition (q = 0).
$q = \Delta U + W$
$W = -\Delta U = U_1 - U_2 = C_v(T_1 - T_2)$
$= 6(300 - 100) = 1200$ cal/mol

408. The correct statement regarding entropy is
(a) at absolute zero temperature, entropy of a perfectly crystalline solid in zero
(b) at absolute zero temperature, the entropy of a perfectly crystalline substance is positive
(c) at absolute zero temperature, the entropy of all crystalline substances is zero
(d) at 0^oC, the entropy of a perfect crystalline solid in zero

Karnataka-CET-2016
NEET-1998

Ans. (a) : Entropy of perfectly crystalline solids will be zero at absolute zero. It is predicted in the third law of thermodynamics.

409. A gas expands from the volume of $1m^3$ to a volume of $2m^3$ against an external pressure of 10^5Nm^{-2}. The work done by the gas will be

(a) 10^2 kJ	(b) 10^2 J
(c) 10^3 J	(d) 10^5 kJ

Karnataka-CET-2012

Ans. (a) : Given,
$V_1 = 1 \ m^3, \ V_2 = 2m^3, \ P = 10^5 \ Nm^{-2}$
Since work done (W) $= P\Delta V$
$= P(V_2 - V_1)$

$$= 10^5 \frac{N}{m^2} \times (2-1) m^3$$

$W = 10^5 \ J = 10^2$ kJ

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410. Based on the first law of thermodynamics, which one of the following is correct?

(a) For an isochoric process = $\Delta E = -q$

(b) For an adiabatic process = $\Delta E = -w$

(c) For an isothermal process = $q = +w$

(d) For a cyclic process $q = -w$

Karnataka-CET, 2011, 2010

Ans. (d) : First law of Thermodynamics is

$$\Delta E = q + W$$

(a) For isochoric process, $\Delta V = 0$

$$W = P\Delta V = 0$$

$$\therefore \quad \Delta E = q$$

(b) For adiabatic process, $q = 0$

$$\Delta E = W$$

(c) For isothermal process, $\Delta T = 0$ & $\Delta E = 0$

$$\therefore \quad q = -W$$

(d) For cyclic process, state functions like

$$\Delta E = 0$$

$$q = -W$$

411. According to the first law of thermodynamics which of the following quantities represents the change in a state function?

(a) q_{rev}

(b) q_{rev}/W_{rev}

(c) W_{rev}

(d) W_{rev}

(e) $q_{rev} + W_{rev}$

JIPMER-2011
Kerala-CEE-2010

Ans. (e) : State Function– Those quantities which is depend upon the initial and final states not of path followed.

According to the first law of thermodynamics (q_{rev} + W_{rev}), represents the change in a state function.

$$\Delta E = q_{rev} + W_{rev}.$$

412. The first law of thermodynamic is expressed as:

(a) $q - W = \Delta E$

(b) $\Delta E = q - W$

(c) $q = \Delta E - W$

(d) $W = q + \Delta E$

(e) none of the these

Kerala-CEE-2006

Ans. (c) : The first law of thermodynamics can be expressed as –

$$\Delta E = q + W$$

$$q = \Delta E - W$$

413. If P, T, ρ and R represents pressure, temperature, density and universal gas constant respectively, then the molar mass of the ideal ga is given by :

(a) $\frac{\rho RT}{P}$

(b) $\frac{\rho T}{PR}$

(c) $\frac{P}{\rho RT}$

(d) $\frac{RT}{\rho P}$

Manipal-2019

Ans. (a) : If P, T, ρ and R represents pressure, temperature, density and universal gas constant then ideal gas equation.

$PV = nRT$ for n mole of gas

$PV = RT$ for 1 mole of gas

We know that,

$$M = V \times \rho \Rightarrow V = \frac{M}{\rho}$$

Put the value of V in gas equation,

$$P \times \frac{M}{\rho} = RT$$

Then molar mass of gas,

$$M = \frac{\rho RT}{P}$$

414. Deviation from the ideal gas behaviour of a gas can be expressed as :

(a) $Z = \frac{P}{VRT}$

(b) $Z = \frac{PV}{nRT}$

(c) $Z = \frac{nRT}{PV}$

(d) $Z = \frac{VR}{PT}$

Manipal-2018

Ans. (b) : According to ideal gas equation,

$PV = nRT$

n = number of mole of gas

Therefore compressibility factor $Z = \frac{PV}{nRT}$

For an ideal gas Z = 1 and for real gas, Z may be either greater than one or less than one.

415. Three moles of an ideal gas are expanded isothermally from a volume of 300 cm^3 to 2.5 L at 300 K against a pressure of 1.9 atm. The work done in joules is

(a) – 423.56 J

(b) + 423.56 J

(c) – 4.18 J

(d) + 4.8 J

MHT CET-02.05.2019, SHIFT-III

Ans. (a) : Given,

$$V_1 = 300 \text{ cm}^3 = 3\times10^{-4} \text{ m}^3$$

$$V_2 = 2.5 \text{ L} = 25\times10^{-4} \text{ m}^3$$

$$T = 300 \text{ K}$$

$$P = 1.9 \text{ atm} = 1.9\times1.01325\times10^5 \text{ N/m}^2$$

Now, work done during change in volume against constant pressure is

$$W = -P(V_2 - V_1)$$

$$= -1.9\times1.01325\times10^5 (25\times10^{-4} - 3\times10^{-4})$$

$$= -1.925\times10^5(22\times10^{-4}) \text{ Nm}$$

$$= -423.56 \text{ Nm}$$

$$W = -423.56 \text{ J}$$

416. A gas performs 0.320 kJ work on surrounding and absorbs 120 J of heat from the surrounding. Hence, change in internal energy is

(a) 200 J

(b) 120.32 J

(c) –200 J

(d) 440 J

MHT CET-03.05.2019, Shift-I

Ans. (c) : According to first law of thermodynamics,

$$\Delta U = q + W$$

Since, work is done on the surrounding

So, $\quad W = -0.320 \text{ kJ} = -320 \text{ J}$

$$q = 120 \text{ J}$$

$$\therefore \quad \Delta U = 120 - 320 = -200 \text{ J}$$

@apna_pdf

417. "The mass and energy both are conserved in an isolated system" is the statement of

(a) second law of thermodynamics
(b) third law of thermodynamics
(c) modified first law of thermodynamics
(d) first law of thermodynamics

MHT CET-03.05.2019, Shift-I

Ans. (c) : Modified first law of thermodynamics– According to this law, if a certain amount of one kind of energy is produced, an equal amount of some other kind of energy is consumed so that the total energy in the universe remains constant.

The modified first law of thermodynamics states that "In an isolated system, both mass and energy are conserved".

418. Calculate the work done during combustion of 0.138 kg of ethanol, $C_2H_5OH(l)$ at 300 K. Given: R = 8.314 JK^{-1} mol^{-1}, molar mass of ethanol = 46 g mol^{-1}.

(a) – 7482 J (b) 7482 J
(c) – 2494 J (d) 2494 J

MHT CET-2018

Ans. (b) :

$$C_2H_5OH(l)+3O_2(g)\longrightarrow 2CO_2(g)+3H_2O(l)$$

$$\text{No. of moles of ethanol}=\frac{\text{Mass of ethanol}}{\text{Molar mass of ethanol}}$$

$$=\frac{138}{46}=3$$

$$3C_2H_5OH+9O_2\longrightarrow 6CO_2+9H_2O$$

$\Delta n = 6 - 9 = -3$

Work (W) = $-\Delta nRT$

W = $-(-3) \times 8.314 \times 300$

W = 7482 J

419. Which among the following equations represents the first law of thermodynamics under isobaric conditions?

(a) $\Delta U = q_p - P_{ex}.\Delta V$ (b) $q_v = \Delta U$
(c) $\Delta U = W$ (d) $W = -q$

MHT CET-2018

Ans. (a) : The internal energy change $\Delta U = q_p + W$

At constant pressure (i.e. isobaric condition)

$\Delta U = q_p + (-P_{ex}.\ \Delta V)$ $(\because W = -P_{ex}.\ \Delta V)$

$\Delta U = q_p - P_{ex}.\ \Delta V$

420. The first law of thermodynamics for isothermal process is

(a) $q = -W$ (b) $\Delta U = W$
(c) $\Delta U = q_v$ (d) $\Delta U = -q_v$

MHT CET-2017

Ans. (a) : According to the first law of thermodynamics

$\Delta U = q + W$

For an isothermal process, $\Delta U = 0$

Hence, $q + W = 0$ or

$q = -W$

421. The work done during combustion of 9 × 10^{-2} kg of ethane, C_2H_6 (g) at 300 K is (Given R = 8.314 J deg^{-1} mol^{-1}, atomic mass C = 12, H = 1)

(a) 6.236 kJ (b) –6.236 kJ
(c) 18.71 kJ (d) –18.71 kJ

MHT CET-2017

Ans. (c) :

$$2C_2H_6(g)+7O_2(g)\longrightarrow CO_2(g)+6H_2O(l)$$

$\Delta n = 2 - (1 + 3.5) = -2.5$

Molar mass of ethane = 2 (12) + 6 (1) = 30 g/mol

9 × 10^{-2} kg ethane = 9 × 10^{-2} kg × 1000 g/kg = 90 g

$$90\text{ g ethane}=\frac{90\text{g}}{30\text{g/mol}}=3\text{ mol ethane}$$

For 1 mole of ethane, $\Delta n = -2.5$

For 3 mole of ethane, $\Delta n = -2.5 \times 3 = -7.5$

Work done, W = $-\Delta nRT$

W = $-(-7.5) \times 8.314 \times 300$

W = 18707 J

W = 18. 71 kJ

422. What is the amount of work done when 0.5 mole of methane, $CH_4(g)$, is subjected to combustion at 300 K? (Given R = 8.314 JK^{-1} mol^{-1})

(a) –2494 J (b) –4988 J
(c) +4988 J (d) +2494 J

MHT CET-2016

Ans. (d) : The balanced chemical equation for combustion reaction is,

$$CH_4(g)+2O_2(g)\longrightarrow CO_2(g)+2H_2O(1)$$

When 1 mole of methane undergoes combustion

$\Delta n = 1 - (1 + 2) = -2$ $\therefore \Delta n$ = Negative

When 0.5 mole of methane undergo combustion

$\Delta n = -2 \times 0.5 = -1$

At STP (1 atm and 273 K) 1 mole of a gas occupies a volume of 22.4 L.

$$\text{The Volume change }(\Delta V) = 22.4\text{ L}\times \Delta n \times \frac{300\text{K}}{273\text{K}}$$

$\Delta V = -24.62$ L

Work done (W) = $-P\Delta V$

W = –1atm × (–24.62 L)

W = + 24.6 L atm

1 L atm = 101.3 J

W = 24.62 atm × 101.3 J

Hence, the amount of work done is + 2494 J.

423. Given: R = 8.314 JK^{-1} mol^{-1}, the work done during combustion of 0.090 kg of ethane (molar mass = 30) at 300 K is

(a) – 18.7 kJ (b) 18.7 kJ
(c) 6.234 kJ (d) – 6.234 kJ

MHT CET-2015

Ans. (b) : The combustion of C_2H_6 is as,

$$C_2H_6+7/2O_2\longrightarrow 2CO_2+3H_2O$$

$$\text{No of moles of } C_2H_6=\frac{\text{Mass}}{\text{Molar mass}}$$

$= (0.090\text{ kg}) (.30 \times 10^{-3}\text{ kg mol}^{-1})$

Change in number of moles of gas is,

$\Delta n = \Sigma n_{g\,(produced)} - \Sigma n_{g\,(reactant)}$

$\Delta n = 2-(1+ 7/2) = -2.5$ $\therefore \Delta n$ = Negative

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Now, work done (W) = – P Δ V = ΔnRT

$W = -(-2.5 \times 8.314 \times 300)$

$= 6235.5$ J

For one mole combustion,

$W = 6235.5$ J

For 3 moles,

$W = 3 \times 6235.5$ J

$= 18706.5$ J = 18.7 kJ

424. The work done when two mole of an ideal gas is compressed form a volume of 5 m^3 to 1 dm^3 at 300 K, under a pressure of 100 kPa is

(a) 499.9 kJ
(b) –499.9 kJ
(c) –99.5 kJ
(d) 42495 kJ

MHT CET-2014

Ans. (a) : Work done,

$W = -P(V_2 - V_1)$

$P = 100\text{kPa}$

$V_1 = 5\text{m}^3$

$V_2 = 1\text{dm}^3 = 1 \times 10^{-3}\text{m}^3$

$W = -100 \times (10^{-3} - 5) = 100(0.001 - 5)$

$= 499.9$ kJ

425. The pressure of a gas is 100 kPa. If it is compressed from 1 m^3 to 10 dm^3 , find the work done.

(a) 990 J
(b) 9990 J
(c) 9900 J
(d) 99000 J

MHT CET-2010

Ans. (d) : Given, P = 100 kPa

$V_1 = 1\ m^3$

$V_2 = 10 \times 10^{-3} m^3 = 10^{-2} m^3$

Workdone, $W = -P\,dV = P(V_1 - V_2)$

$= 100 \times 10^3 (1 - 10^{-2})$

$= 100 \times 10^3 \times 0.99 = 99000$ J

426. At the same conditions of pressure, volume and temperature, work done is maximum for which gas if all gases have equal masses?

(a) NH_3
(b) N_2
(c) Cl_2
(d) H_2S

MHT CET-2009

Ans. (a) : When P, V and T are same and mass is also small work done depends only on molecular mass.

$W \propto \frac{1}{M}$ (Where, M = molecular mass)

$NH_3 \rightarrow 14 + 3 = 17$ g/mole

$N_2 \rightarrow 14 \times 2 = 28$ g/mole

$Cl_2 \rightarrow 35.5 \times 2 = 71$ g/mole

$H_2S \rightarrow 2 + 32 = 34$ g/mole

Among the given gases, NH_3 has lowest molecular mass. So work done is maximum.

427. 16 g of oxygen gas expands isothermally and reversible at 300K from 10 dm^3 to 100 dm^3 the work done is (in J)

(a) zero
(b) – 2875 J
(c) + 2875 J
(d) infinite

MHT CET-2009

Ans. (b) : $W = -2.303\ nRT \log \frac{V_2}{V_1}$

As we know that, work done in an isothermal reversible expansion is given as –

$$W = -2.303 \times \frac{16}{32} \times 8.314 \times 300 \log \frac{100}{10}$$

$= -2872\ J \approx -2875$ J

428. The work done during the expansion of a gas from a volume of 4 dm^3 to 6 dm^3 against a constant external pressure of 3 atm is (1 L atm = 101.32 J)

(a) –6 J
(b) –608 J
(c) +304 J
(d) –304 J

UPTU/UPSEE-2007
NEET-2004

Ans. (b) : Work done during expansion of a gas is ,

$W = -P\Delta V$

$W = -P(V_{\text{Final}} - V_{\text{initial}})$

$W = -3(6 - 4) \times 101.32$ ($\because$ 1 dm^3 = 1L)

$W = -6 \times 101.32 \approx -608$ J

429. Three moles of an ideal gas expanded spontaneously into vacuum. The work done will be

(a) infinite
(b) 3 Joules
(c) 9 Joules
(d) zero

NEET-2010

Ans. (d) : The work done is the product of pressure and change in volume.

$W = -P_{ext}\Delta V$

Since the ideal gas expands spontaneously into vacuum,

Free expansion $\boxed{P_{ext} = 0}$.

$W = -0 \times \Delta V = 0$

Hence work done is also zero in vacuum.

430. An ideal gas expands isothermally from 10^{-3} m^3 to 10^{-2} m^3 at 300 K against a constant pressure of 10^5 Nm^2. The work done on the gas is

(a) +270 kJ
(b) –900 J
(c) +900 kJ
(d) –900 kJ

NEET-Odisha 2019

Ans. (b) : For an isothermal irreversible expansion

Work done (W) = $-P(V_2 - V_1)$

V_1 = initial value

V_2 = final value

Given, P = 100000 Nm^{-2}

$V_1 = 10^{-3}\ m^3$

$V_2 = 10^{-2}\ m^3$

Then , $W = -100000(10^{-2} - 10^{-3})$

$= -100000 \times \frac{9}{1000}$

$= -900$J

431. A gas is allowed expand in a well insulated container against a constant external pressure of 2.5 atm from an initial volume of 2.50 L to a final volume of 4.50 L. The change in internal energy ΔU of the gas in joules will be

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(a) –500 J (b) –505 J
(c) +505 J (d) 1136.25 J

NEET-2017

Ans. (b) : Given, $P = 2.5$ atm, $V_1 = 2.5$ L, $V_2 = 4.5$ L
$\Delta V = 4.50 - 2.5$
$\Delta V = 2L$
For adiabatic process,
$q = 0$
The first law of thermodynamics $\Delta U = q + W$
When $q = 0$, then $\Delta U = W$
Now $W = -P\Delta V$
$\Delta U = -2.5 \times 2L$ atm
$\Delta U = -5L$ atm
We know that 1 L atm = 101.3 J
$\Delta U = -5 \times 101.3J = -506.5J \approx -505J.$

432. Under isothermal conditions, a gas at 300 K expands from 0.1 L to 0.25 L against a constant external pressure of 2 bar. The work done by the gas is [Given that 1 L bar = 100 J]
(a) 30 J (b) –30 J
(c) 5 kJ (d) 25 J

NEET-2019

Ans. (b) : Given,
$V_1 = 0.1$ L
$V_2 = 0.25$ L
$P = 2$ bar
$\therefore$ 1 L bar = 100 J
$W = -P_{ext}\,\Delta V$
$= -2 \text{ bar} \times (0.25 - 0.1)$ L
$= -2 \times 0.15$ L bar
$= -0.30$ L bar
$= -0.30 \times 100$ J
$= -30$ J

433. Which of the following is the correct equation?
(a) $\Delta U = \Delta W + \Delta Q$ (b) $\Delta U = \Delta Q - W$
(c) $\Delta W = \Delta U + \Delta Q$ (d) None of these

NEET-1996

Ans. (a) : First law of thermodynamics,
$\Delta U = \Delta Q + \Delta W$
Where, ΔU = Change in internal energy
ΔQ = Heat absorbed by the system
ΔW = Workdone by the system

434. Work done by 1 mole of an ideal gas for its adiabatic reversible change when temperature attains T_2 from T_1 is'
(a) $(C_P - C_V)(T_2 - T_1)$ (b) $C_P(T_1 - T_2)$
(c) $C_V(T_2 - T_1)$ (d) $(C_P - C_V)(T_1 + T_2)$

Tripura JEE-2022

Ans. (c): For Adiabatic Process,
$q = 0$
$\Delta U = q + W$
$\Delta U = w$
$nC_VdT = W$
$1 \times C_V(T_2 - T_1) = W$
$\boxed{C_v(T_2 - T_1) = W}$

435. In which of the following changes entropy decreases ?
(a) Crystallization of sucrose from solution
(b) Dissolving sucrose in water
(c) Melting of ice
(d) Vapourisation of camphor

UPTU/UPSEE-2018

Ans. (a) : During the crystallization of sucrose solution liquid state is changing into solid state hence entropy decreases.

$\boxed{\text{Gas} > \text{Liquid} > \text{Solid}}_{\text{Entropy}}$

436. 1 mole of gas occupying 3L volume is expanded against a constant external pressure of 1 atm to a volume of 15L. The work done by a system is equal to
(a) -1.215×10^3J (b) -12.15×10^3J
(c) $+1.215 \times 10^3$J (d) $+12.15 \times 10^3$J

UPTU/UPSEE-2015

Ans. (a) :
$W = -P_{ext}\,\Delta V$
$W = -1\,(15 - 3)$
$W = -12$ L atm
$= -12 \times 101.27J$ ($\because$ 1L atm = 101.270J)
$= -1215.24$ J
$W = -1.215 \times 10^3$ J

437. When 1 mole of a gas is heated at constant volume, temperature is raised form 298 K to 308K. Heat supplied to the gas is 500J. Then, which statement is correct?
(a) $q = -W = 500$ J, $\Delta E = 0$
(b) $q = W = 500$J, $\Delta E = 0$
(c) $q = \Delta E = 500$ J, $W = 0$
(d) $\Delta E = 0$; $q = W = -500$ J

UPTU/UPSEE-2014

Ans. (c) : We know that,
$\Delta H = \Delta E + P\Delta V$
From the first law of thermodynamics,
$\Delta U = q + W$
$W = -P\Delta V$
$\Delta V = 0$ {Given in question}
$W = -P \times 0 = 0$
$q = 500J$
So, $\Delta U = q = 500$ J

438. Pressure-volume (PV) work done by an ideal gaseous system at constant volume is (where E is internal energy of the system)
(a) $-\Delta P/P$ (b) zero
(c) $-V\Delta P$ (d) $-\Delta E$

WB-JEE-2013

Ans. (b) : From the first law of thermodynamics
$\Delta E = q + W$
$W = -P\Delta V$
$\therefore \Delta V = 0$ since the volume is constant
$W = 0$

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3. Second Law of Thermodynamics and Entropy

439. Among the following for spontaneity of chemical reaction there should be:
(a) decrease in entropy and increase in free energy
(b) decrease in entropy and free energy both
(c) increase in entropy and decrease in free energy
(d) increase in entropy and free energy both

MPPET - 2012

Ans. (c) : From Gibbs – Helmholtz equation,
$\Delta G = \Delta H - T\Delta S$
For a spontaneous reaction at any temperature. ΔG = –ve and it is possible when ΔH = –ve and ΔS = +ve
Thus, for a spontaneous reaction, there must be increase in entropy and decrease in free energy.

440. The enthalpy of vaporization of a compound is 840 J/mole and its boiling point is 170 K. Its entropy of vaporization is

(a) 4.94 J/mol/K	(b) 12 J/mol/K
(c) 200 J/mol/K	(d) 49 J/mol/K

TS EAMCET 10.08.2021, Shift-I

Ans. (a) : Given that $\Delta H_{vap.}$ = 840 J/mol, $T_{B.P}$ = 170K

We know that, $\Delta S_{vap.} = \frac{\Delta H_{vap.}}{T_{B.P}} = \frac{840}{170} = 4.94$ J/mol/K

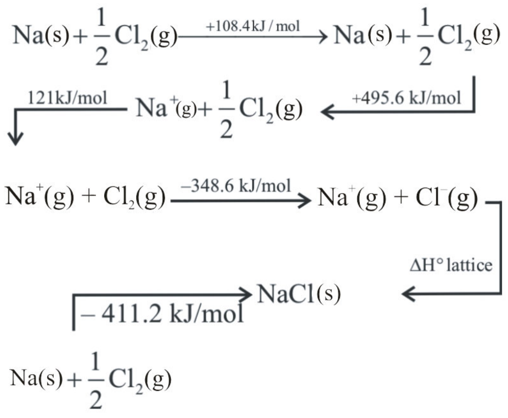
441. For an adiabatic change in a system, the condition which is applicable will be

(a) $w = 0$	(b) $q = -w$
(c) $q = w$	(d) $q = 0$

COMEDK-2015

Ans. (d) : In adiabatic system there is neither heat exchange nor leaves the system (i.e. heat remains constant)
$\Delta Q = \Delta U + \Delta W$
ΔQ = Constant or $\Delta Q = 0$

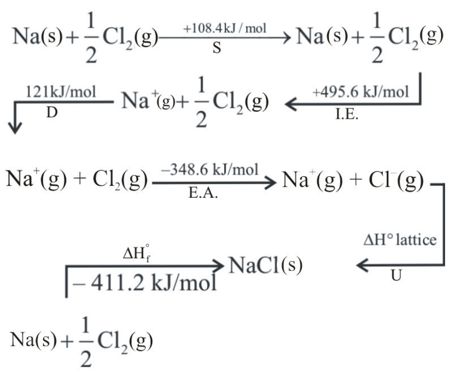
442. For one mole of NaCl(s) the lattice enthalpy is



(a) –788 kJ/mol	(b) +878 kJ/mol
(c) +788 kJ/mol	(d) –878 kJ/mol

COMEDK-2015

Ans. (a) :



$\Delta_f H^\circ = S + D + I.E. + E.A + U$
$-411.2 = 108.4 + 121 + 495.6 - 348.6 + U$
$U = -787.6 \text{kJ/mol} \approx -788 \text{kJ/mol}$

443. A process is spontaneous at a given temperature if

(a) $\Delta H = 0, \Delta S < 0$	(b) $\Delta H > 0, \Delta S < 0$
(c) $\Delta H < 0, \Delta S > 0$	(d) $\Delta H > 0, \Delta S = 0$

COMEDK-2017, 2016

Ans. (c) : $\Delta G = \Delta H - T\Delta S$
A process is spontaneous if ΔG is –ve, ΔH is –ve and ΔS is positive.

444. For the gas phase reaction,
$PCl_5(g) \rightleftharpoons PCl_3(g) + Cl_2(g)$
Which of the following condition are correct?

(a) $\Delta H < 0$ and $\Delta S < 0$	(b) $\Delta H > 0$ and $\Delta S < 0$
(c) $\Delta H = 0$ and $\Delta S < 0$	(d) $\Delta H > 0$ and $\Delta S > 0$

COMEDK-2018

Ans. (d) : $PCl_5(g) \rightleftharpoons PCl_3(g) + Cl_2(g)$
One mole of PCl_5 is dissociated into two moles of PCl_3 and Cl_2 in the same phase hence, the process is endothermic i.e., $\Delta H > 0$. Also ΔS > 0 as one mole of gaseous reactant gives two moles of gaseous products and randomness increases.

445. A piece of ice kept at room temperature melts of its own. This reaction is governed by which law?
(a) Zeroth law of Thermodynamics
(b) Third law of Thermodynamics
(c) First law of Thermodynamics
(d) Second law of Thermodynamics

GUJCET-2008

Ans. (d) : When ice changes into water spontaneously at room temperature, the randomness increases, so entropy increases which is in accordance with the second law of thermodynamics.
- The zeroth law of thermodynamics states that if two bodies are each in thermal equilibrium with some third body, then they are also in equilibrium with each other.
- The third law of thermodynamics state that the entropy of a system become constant at absolute zero temperature.

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446. Which of the following is not an intensive property?

(a) Entropy (b) Melting point
(c) Specific gravity (d) Refractive index

TS EAMCET 05.08.2021, Shift-I

Ans. (a) : Intensive property – An intensive property is one that does not depend on the mass of the substance or system.

Example– Temperature, pressure, density etc.

Extensive property – An extensive property is a property that depends on the amount of matter or mass in a sample.

Example– Enthalpy, entropy, internal energy etc.

447. Calculate the change of entropy for the process, water (liquid) to water (vapour) involving $\Delta H_{vap} = 40850$ J mol^{-1} at 373 K.

(a) $\Delta S_{vap} = 98.5$ J K^{-1} mol^{-1}
(b) $\Delta S_{vap} = 109.52$ J K^{-1} mol^{-1}
(c) $\Delta S_{vap} = 89$ J K^{-1} mol^{-1}
(d) $\Delta S_{vap} = 72$ J K^{-1} mol^{-1}

SRMJEEE – 2015

Ans. (b) :

Given : $\Delta H_{vap} = 40850\ \text{Jmol}^{-1}$

$\Delta T_b = 373$ K

Now, $$\Delta S_{vap} = \frac{\Delta H_{vap}}{T_b}$$

$$\Delta S_{vap} = \frac{40850\,\text{Jmol}^{-1}}{373\text{K}}$$

$$\Delta S_{vap} = 109.52\ \text{JK}^{-1}\ \text{mol}^{-1}$$

448. The temperature of K at which ΔG = 0, for a given reaction with ΔH = –20.5 kJ mol^{-1} and ΔS = –50.0 JK^{-1}mol^{-1} is

(a) –410 (b) 410
(c) 2.44 (d) – 2.44

AP-EAMCET (Engg.) - 2014

Ans. (b) : Given, ΔG = 0, ΔH = –20.5 kJ mol^{-1}

ΔS = –50JK^{-1} mol^{-1}

According to Gibb's equation–

$$\Delta G = \Delta H - T\Delta S$$

$$0 = -20.5\times10^3 - T\times(-50)$$

$$T = \frac{-20.5\times10^3}{-50}$$

T = 410 K

449. What is the entropy change in JK^{-1} during the melting of 27.3 g of ice at 0°C? (Latent heat of fusion of ice = 330 Jg^{-1})

(a) 330 (b) 12.1
(c) 3.3 (d) 33

AP-EAMCET- (Engg.)-2011

Ans. (d : We know that,

$$\Delta S_f = \frac{\Delta H_f}{T_f}$$

Given that, Latent heat of fusion of ice = 330 Jg^{-1}

T = 0°C = 273K

So,

$$\Delta S_f = \frac{330\times27.3}{273}$$

$$= 33\ \text{JK}^{-1}$$

450. If S^0 CH$_4$(g) = 186.2JK^{-1}mol^{-1}, S^0 H$_2$O(g) = 188.7JK^{-1}mol^{-1}, S^0 H$_2$(g) = 130.6 JK^{-1}mol^{-1} and S^0 CO(g) = 197.91 JK^{-1}mol^{-1}, then entropy change for $CH_4(g) + H_2O(g) \rightarrow 3H_2(g) + CO(g)$ will be :

(a) –214.8 JK^{-1}mol^{-1} (b) 214.8 JK^{-1}mol^{-1}
(c) –218.4 JK^{-1}mol^{-1} (d) 218.4 JK^{-1}mol^{-1}

AMU–2006

Ans. (b) : $CH_4(g) + H_2O(g) \rightarrow 3H_2(g) + CO(g)$

Change entropy, $\Delta S = \Delta S_{(product)} - \Delta S_{(reactant)}$

$$\Delta S^0 = (3\times130.6+197.91) - (186.2+188.7)$$

$$= 214.81\ \text{JK}^{-1}\text{mol}^{-1}$$

451. The enthalpy of vaporization of a liquid is 35.2 kJ mol^{-1} at 110.6°C. The entropy change for the process will be

(a) 9.18 JK^{-1}mol^{-1} (b) 31.83 JK^{-1}mol^{-1}
(c) 91.76 JK^{-1}mol^{-1} (d) 318.3 JK^{-1}mol^{-1}

AMU–2006

Ans. (d) : We know that,

$$\text{Entropy of vaporisation} = \frac{\text{Enthalpy of vaporisation}}{\text{Boiling point}}$$

$$(\Delta S)_{vap} = \frac{(\Delta H)_{vap}}{T_{b.p}}$$

$$\text{or, Entropy of vaporisation}(\Delta S) = \frac{35.2}{110.6}\,\text{J mol}^{-1}\text{K}^{-1}$$

$= 0.3183$ J mol^{-1}K^{-1} = 318.3 J mol^{-1}K^{-1}

452. Enthalpy change when 1g water is frozen at 0°C is :

$(\Delta H_{fus} = 1.435\ \text{kcal mol}^{-1})$

(a) 0.0797 kcal (b) –0.0797 kcal
(c) 1.435 kcal (d) –1.435 kcal

BCECE-2003

Ans. (b) : Given that, $(\Delta H)_{fusion} = 1.435$ kcal/mol

- For 1 mole heat given 1.435 kcal
- For water $\frac{1}{18}$ mole $= 1.435\times\frac{1}{18}$ kcal heat

$= 0.07972$ kcal

Since heat will be released ⇒ ΔH = –0.07972 kcal

453. For which of the process, ΔS is negative?

(a) $H_2(g) \rightarrow 2H(g)$
(b) $N_2(g)(1\text{atm}) \rightarrow N_2(g)(8\text{atm})$
(c) $2SO_3(g) \rightarrow 2SO_2(g) + O_2(g)$
(d) $C_{(diamond)} \rightarrow C_{(graphite)}$

BITSAT 2008

Ans. (b) : The higher is the pressure lower become entropy. When the pressure increase on the gases molecule kinetic energy of the particle decrease with respect to the pressure. This is due to the particle comes closer and intermolecular distance decreases the entropy.

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Entropy is a state function that is often referred to as the state of disorder of a system.

- $H_2(g) \rightarrow 2H(g)$ entropy increases because no. of atoms increases.
- $N_2(g, 1\ atm) \rightarrow N_2(g, 8\ atm)$ entropy decreases as pressure increase and randomness decreases.
- $2SO_3(g) \rightarrow 2SO_2(g) + O_2(g)$ entropy increases because no. of atoms increases.
- $C_{(diamond)} \rightarrow C_{(graphite)}$ entropy increases as the compactness of system decreases and randomness increases.

454. For a given reaction, $\Delta H = 35.5$ kJ mol^{-1} and $\Delta S = 83.6$ JK^{-1} mol^{-1}. The reaction is spontaneous at : (Assume that ΔH and ΔS do not vary with temperature)

(a) T>425 K (b) All temperature
(c) T>298 K (d) T<425 K

BITSAT 2017

Ans. (a) : Given that

$\Delta H = 35.5$ kJ/mol = 35500 J/mol

$\Delta S = 83.6$ J/K/mol

We know that,

$\Delta G = \Delta H - T\Delta S$

For spontaneous $\Delta G < 0$

$\Delta H - T\Delta S < 0$

$$T > \frac{\Delta H}{\Delta S}$$

$$T > \frac{35500}{83.6}$$

$T > 425$ K

So, the given reaction will be spontaneous at T > 425 K.

455. Identify the correct statement for change of Gibbs energy for a system $\left(\Delta G_{system}\right)$ at constant temperature and pressure

(a) If ΔG_{system} =0, the system has attained equilibrium
(b) If ΔG_{system} =0, the system is still moving in a particular direction
(c) If ΔG_{system} =0, the process is not spontaneous
(d) if ΔG_{system} =0, the process is spontaneous

CG PET -2007

Ans. (a) : We know that,

$\Delta G = \Delta S - T\Delta S$

If $(\Delta G)_{system} < 0$ the process is spontaneous

If $(\Delta G)_{system} > 0$ the process is non-spontaneous

If $(\Delta G)_{system} = 0$ the process is in equilibrium.

456. At 27ºC latent heat of fusion of a compound is 2930 J/mol, then entropy change is

(a) 9.77 J/mol-K (b) 10.77 J/mol-K
(c) 9.07 J/mol-K (d) 0.977 J/mol-K

CG PET -2007

Ans. (a) : $\Delta S_{\ system} = \frac{Q_{rev}}{T} = \frac{2930}{300}$

$= 9.77$ J / mol-K

457. Which of the following does not result in an increase in entropy?

(a) Crystallisation of sucrose from a solution
(b) Rusting of iron
(c) Conversion of ice of water
(d) Vaporisation of camphor

CG PET -2005

Ans. (a) : In crystallization of sucrose from solution, the liquid is converted into solid. As result in decrease in randomness because of which the entropy will decrease.

458. Entropy of a perfectly crystalline solid at 0 K is

(a) positive (b) negative
(c) zero (d) either positive or negative

J & K CET-(2012)

Ans. (c) : Entropy of a perfect crystalline solid at absolute zero temperature is zero. This is the statement of third law of thermodynamics.

459. Entropy change in a process where 1 litre of liquid. He is poured into ice cold water is

(a) finite and positive (b) finite and negative
(c) zero (d) infinity.

J & K CET-(2012)

Ans. (a) : Entropy change in a process where 1L of liquid is poured into ice cold water is finite and negative because randomness decreases.

Entropy = gas > liquid > solid

460. What will be the entropy change of the system when expansion of 1 mole of a gas takes place from 3 L to 6 L under isothermal conditions? Consider, R=2 cal K^{-1} mol^{-1} and log 2=0.301.

(a) 2.84 cal K^{-1} (b) 1.386 cal K^{-1}
(c) 0.37 cal K^{-1} (d) 5.26 cal K^{-1}

J & K CET-(2018)

Ans. (b) $\Delta S = 2.303\ n\ R\ \log_{10}\left(\frac{V_f}{V_i}\right)$

$$\Delta S = 2.303 \times 1 \times 2 \log_{10}\left(\frac{6}{3}\right)$$

$= 2.\ 303 \times 2 \times 0.301$

$=1.386$ cal K^{-1}

461. Pick out the wrong statement.

(a) The standard free energy of formation of elements is zero.
(b) A process that leads to increase in free energy will be spontaneous.
(c) A process accompanied by decreases in entropy will be non-spontaneous under normal conditions.
(d) Enthalpy of combustion is always negative.

J & K CET-(2011)

Ans. (b) : ΔG gives a criteria for spontaneity at constant temperature and pressure.

If $\Delta G < 0$ = Negative

Then the process are spontaneous

If $\Delta G > 0$ = Positive

Then the process are non–spontaneous

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462. The values of ΔH and ΔS for a reaction are respectively 30 kJ mol^{-1} and 100 JK^{-1} mol^{-1}. Then the temperature above which the reaction will become spontaneous is

(a) 300 K (b) 30 K
(c) 100 K (d) 300^0C

J & K CET-(2011)

Ans. (a): Given that $\Delta H = 30$ kJ $mol^{-1} = 30\times10^3$ $Jmol^{-1}$

$\Delta S = 100\ JK^{-1}$

$\Delta G = \Delta H - T\Delta S$

For spontaneous reaction, $\Delta G < 0$

$\Delta H - T\Delta S < 0$

$(30 \times 10^3) - T \times (100) < 0$

$30000 < 100\ T$

$300 < T$

$T > 300$ K

463. When water is cooled to its entropy

(a) increases (b) decreases
(c) remains same (d) becomes zero

J & K CET-(2010)

Ans. (b) : When water is cooled to ice randomness or disorderness decreases i.e. entropy decrease.

464. The incorrect statement among the following is

(a) the entropy of the universe remains constant.
(b) heat cannot be completely converted into work.
(c) the absolute entropy of a perfectly crystalline solid at absolute zero temperature is zero.
(d) the total energy of an isolated system remains constant.

J & K CET-(2009)

Ans. (a) : The Entropy of Universe are increasing spontaneously, $\Delta S_{universe} > 0$

465. What are the units of entropy?

(a) cal.K (b) $cal.K^{-1}$
(c) $cm.\ K^{-1}$ (d) cm. K

J & K CET-(2006)

Ans. (b) : Entropy, $\Delta S = \dfrac{q_{rev}}{T}$

$\because$ unit of Entropy is cal K^{-1}

466. One mole of a perfect gas expands isothermally to ten times its original volume. The change in entropy is

(a) 0.1 R (b) 2.303 R
(c) 10.0 R (d) 100. O R

J & K CET-(2004)

Ans. (b) : Given, n = 1 mole, $V_i = V$, $V_f = 10$ V

For reversible isothermal process,

$$\Delta S = nR\ln\left(\frac{V_f}{V_i}\right) = 2.303\ nR\ \log_{10}\left(\frac{V_f}{V_i}\right)$$

$$\Delta S = 2.303 \times R \times \log_{10}\left(\frac{10V}{V}\right)$$

$\Delta S = 2.303$ R $\qquad [\because \log_{10}10 = 1]$

467. The entropy of crystalline substances at absolute zero going by the third law of thermodynamics should be taken as

(a) 100
(b) 50
(c) Zero
(d) different for different substances

J & K CET-(2005)

Ans. (c) : Third law of thermodynamics states that the entropy of a perfectly crystalline substance at absolute zero K temperature is zero.

468. When the same quantity of heat is absorbed by a system at two different temperatures T_1 and T_2, such that $T_1 > T_2$, change in entropies are ΔS_1 and ΔS_2 respectively. Then

(a) $\Delta S_1 < \Delta S_2$ (b) $\Delta S_1 = \Delta S_2$
(c) $S_1 > S_2$ (d) $\Delta S_2 < \Delta S_1$

Karnataka-CET-2020

Ans. (a) : Entropy change occur due to transfer of heat.

$\Delta S = q / T \qquad [q = \text{constant}]$

So, $\Delta S \propto \dfrac{1}{T}$

Given , $T_1 > T_2$

So, actual relation between the entropies will be

$(\Delta S_2 > \Delta S_1)$

469. The enthalpy of vaporization of benzene is +35.3 kJ/mol at its boiling point of 80^oC. The entropy change in the transition of vapour to liquid at its boiling point is..... in $Jmol^{-1}K^{-1}$

(a) – 100 (b) + 100
(c) + 342 (d) – 342

Karnataka-CET-2011

Ans. (a): Given that,

$\Delta H_{vap.} = +35.3$ kJ/mol

$T = 80^oC = 80 + 273 = 353$ K

$$\text{Entropy, } \Delta S_{vap.} = \frac{\Delta H_{vap.}}{T} = \frac{+35.3}{353} = 0.1 kJ/mol/K$$

$\Delta S_{vap.} = 0.1 \times 10^3 = 100$ J/mol/K

Entropy change in the transition of vapour to liquid is negative, $\Delta S_{vap.} = -100$ J mol^{-1} K^{-1}

470. If one mole of ammonia and one mole of hydrogen chloride are mixed in a closed container to form ammonium chloride gas, then

(a) $\Delta H > \Delta U$ (zb) $\Delta H = \Delta U$
(c) $\Delta H < \Delta U$ (d) there is no relationship

KARNATAKA-CET, 2008

Ans. (c): We can write the given reaction is-

$$\underset{1\,mol}{NH_3(g)} + \underset{1\,mol}{HCl(g)} \rightarrow \underset{1\,mol}{NH_4Cl(g)}$$

$\Delta H = \Delta U + \Delta n_gRT$

Δn_g = Number of moles of product – number of moles of reactant

$= 1 - 2 = -1$

$\Delta H = \Delta U - RT$

$\therefore \quad \Delta H < \Delta U$

471. In the reaction; $A_2(g) + 3B_2(g) \longrightarrow 2AB_3(g)$ the standard entropies in (JK^{-1} mol^{-1}) of $A_2(g)$, $B_2(g)$ and $AB_3(g)$ are respectively 190, 130 and 195 and the enthalpy change for the reaction is

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-95 kJ mol^{-1}. The temperature (in K) at which the reaction attains equilibrium is (assuming both the standard entropy change and standard enthalpy change for this reaction are constant over a wide range of temperature)

(a) 500 (b) 400
(c) 300 (d) 600
(e) 700

Kerala-CEE-2012

Ans. (a): In the reaction-

$A_2(g) + 3B_2(g) \longrightarrow 2AB_3(g)$

Entropy change $\Delta S^0 = \Sigma S_{(product)} - \Sigma S_{(reactant)}$

$\Delta S^0 = 2 \times S_{AB_3} - [S_{A_2} + 3S_{B_2}]$

$= 2 \times 195 - [190 + 3 \times 130]$

$= 390 - [190 + 390]$

$= -190 \text{ J K}^{-1}\text{ mol}^{-1}$

Given, $\Delta H^0 = -95 \text{ kJ mol}^{-1}$

At equilibrium, $\Delta G^0 = 0$

$\Delta G^0 = \Delta H^0 - T\Delta S^0$

$0 = \Delta H^0 - T\Delta S^0$

$T\Delta S^0 = \Delta H^0$

$$T = \frac{\Delta H^0}{\Delta S^0} = \frac{-95 \times 10^3 \text{ Jmol}^{-1}}{-190 \text{JK}^{-1}\text{mol}^{-1}} = \frac{95000 \text{Jmol}^{-1}}{190 \text{JK}^{-1}\text{mol}^{-1}}$$

$T = 500\text{K}$

472. For a process, entropy change of a system is expressed as

(a) H – TS (b) $\frac{q_{rev}}{T}$
(c) $\frac{T}{q_{rev}}$ (d) $q_{rev} \times T$

MHT CET-02.05.2019, SHIFT-III
WB-JEE-2013

Ans. (b): Entropy is a function of the state of the system , so the change in entropy of a system is determined by its initial and final states.

$$\Delta S_{system} = \frac{q_{rev}}{T}$$

Here, the system absorbs q amount of heat from surrounding at temperature T.

473. The second law of thermodynamics says that in a cyclic process

(a) work cannot be converted into heat
(b) heat cannot be converted into work
(c) work cannot be completely converted into heat
(d) heat cannot be completely converted into work

WB-JEE-2009

Ans. (d): According to second law of thermodynamics–

- No cyclic process that converts heat entirely into work is possible.
- Work can never be equal to Q.
- Some energy must always be transferred as heat to the system's surrounding.

474. The enthalpy of vaporization of a certain liquid at its boiling point of 35°C is 24.64 kJ mol^{-1}. The value of change in entropy for the process is

(a) 704 JK^{-1} mol^{-1} (b) 80 JK^{-1} mol^{-1}
(c) 24.64 JK^{-1} mol^{-1} (d) 7.04 JK^{-1} mol^{-1}

WB-JEE-2014

Ans. (b): ΔS = ? (change in entropy)

Boiling point (T) = 35°C = 35 + 273 = 308K

Enthalpy of vaporization $(\Delta H_v) = 24.64 \text{ kJ mol}^{-1}$

$= 24.64 \times 10^3 \text{J mol}^{-1}$

$$\text{Entropy of vaporization} = \frac{\text{Enthalpy of vap}(\Delta H_v)}{\text{Boiling point }(T)}$$

$$\therefore \quad \Delta S = \frac{24.64 \times 10^3 \text{ J mol}^{-1}}{308 \text{ K}}$$

$= 80 \text{ JK}^{-1}\text{ mol}^{-1}$

4. Heat of Reaction

475. 2.2 g of nitrous oxide (N_2O)gas is cooled at a constant pressure of 1 atm from 310 K to 270 K causing the compression of the gas from 217.1mL to 167.75 mL. The change in internal energy of the process, ΔU is '-x' J. The value of 'x' is ____.
[Nearest integer]
(Given : atomic mass of N = 14 g mol^{-1} and of O = 16 g mol^{-1} Molar heat capacity of N_2O is 100 JK^{-1} mol^{-1})

JEE Main-29.06.2022, Shift-II

Ans. (195) : Given that, $T_1 = 310$ K, $T_2 = 270$ K

$\Delta T = T_2 - T_1 = 270 - 310 = -40\text{K}$

$P = 1 \text{ atm} = 1 \times 101.3 \text{ kPa}$

$V_1 = 217.\ 1\text{mL} = 217.1 \times 10^{-6} \text{ m}^3$

$V_2 = 167.75 \text{ mL} = 167.75 \times 10^{-6} \text{ m}^3$

$\Delta V = V_2 - V_1 = 16.7.75 \times 10^{-6} - 217.1 \times 10^{-6}$

$= -49.35 \times 10^{-6} \text{ m}^3$

$C_p = 100 \text{ J K}^{-1}\text{mol}^{-1}$

$$(n)_{N_2O} = \frac{2.2}{44} = \frac{1}{2} = 0.5$$

$\Delta H = nC_p\Delta T = 0.5 \times 100 \times (-40) = -200 \text{ J}$

$\Delta H = \Delta U + W = \Delta U + (P\ \Delta V)$

$\Delta V = \Delta H - P\Delta V$

$= -200 - 101.3 \times 10^3 \times (-49.35 \times 10^{-6})$

$= -200 + 4.999$

$= -197.00 \text{ J}$

476. The dissociation energy of CH_4 is 360 kcal mol^{-1} and that of ethane is 620 kcal mol^{-1}. The bond energy of C – C bond is :

(a) 260 kcal (b) 980 kcal
(c) 90 kcal (d) 80 kcal

CG PET-22.05.2022

Ans. (d) :

$CH_4(g) \longrightarrow C(g) + 2H_2(g)\ ;\ \Delta H = 360 \text{ kcal mol}^{-1}$

So, bond dissociation energy of one C –H bond

$$= \frac{360}{4} = 90 \text{ kcal/mol}$$

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$C_2H_6\,(g) \longrightarrow 2C\,(g) + 3H_2(g)$; $\Delta H = 320$ kcal/mol
$\Delta H = \Sigma\,(\text{Bond energy})_R - \Sigma\,(\text{Bond energy})_P$
$620 = [6 \times (B.E)_{C-H} + 1 \times (B.E)_{C-C}]$
$620 = 6 \times 90 + (B.E)_{C-C}$
$(B.E)_{C-C} = 620 - 540 = 80$ kcal /mol

477. What is the amount of heat liberated (in kcal). When one mole of aqueous NaOH reacted with one mole of aqueous HCl solution?

(a) 22.4 (b) 13.7
(c) 2.303 (d) 0.693

AP-EAMCET (Med.)-1999

Ans. (b) : When one mole of strong acid reacts with one mole of strong base, a fixed amount 13.7 kcal/mol heat is liberated.

$HCl + NaOH \rightarrow NaCl + H_2O, \quad \Delta Q = 13.7$ kcal/mole

478. What is the amount of heat is released when 8.17 g of Al (s) is converted to Al_2O_3(s) at 25°C and 1 atm via the reaction $4\,Al(s) + 3\,O_2\,(g) \rightarrow 2\,Al_2O_3(s)$?
[For the reaction, $\Delta H = -\ 1676$ kJ/mol, atomic mass of Al = 27]

(a) 134 kJ (b) 254 kJ
(c) 268 kJ (d) 1.01×10^3 kJ

SCRA 2012

Ans. (b) : $\Delta H_f^o = -1676$kJ mol

Note that the minus sign is used here to illustrate that the heat is being given off.

This value tells us that when 1 mole of aluminium oxide is formed at standard conditions from its constituent elements in their most stable form, 1676 kJ of heat are being given off.

In other words, we know that standard enthalpy change for this reaction

$$2Al(s) + \frac{3}{2}O_2(g) \rightarrow Al_2O_3(s)$$

is equal to

$$\Delta H_f^o = -1676\text{kJ}$$

This implies that this reaction

$$4Al(s) + 3O_2(g) \rightarrow 2Al_2O_3(s)$$

will have

$$\Delta H^o_{rxn} = 2.\Delta H_f^o\,,\quad \Delta H^o_{rxn} = 3352\text{ kJ}$$

So, when 2 moles of aluminium oxide are formed under standard conditions, the reaction given off 3352 kJ of heat.

Use the molar mass of aluminium to calculate the number of moles present in sample

$$8.17\text{ g } \cdot \frac{1\text{ mol Al}}{26.98\text{ g}} = 0.30282\text{ moles Al}$$

According to the balanced chemical equation, the reaction will produce

$$0.30282\text{ moles Al } \cdot \frac{1\text{ mol }Al_2O_3}{4\text{ moles Al}} = 0.15141\text{ moles }Al_2O_3$$

We can say that when 8.17 g of aluminium undergo complete combustion, the reaction will give off

$$0.15141\text{ moles }Al_2O_3 \cdot \frac{3352\text{kJ}}{2\text{ moles }Al_2O_3} = 254\text{ kJ}$$

479. The enthalpy change of a reaction does not depend on

(a) Initial and final state of the reaction
(b) State of the reactants and products
(c) Nature of the reactants
(d) Different intermediate states

SCRA-2015

Ans. (d): The enthalpy change of the reaction depend upon the initial and final state of the reaction, state of reactant and products and nature of the reactants. It is not depend upon the different intermediates states.

480. The bond enthalpy of H–H, Cl – Cl and H – Cl are 435, 243 and 431 kJ mol^{-1} respectively. The enthalpy of formation of HCl(g) would be:

(a) 92 kJ mol^{-1} (b) –92 kJ mol^{-1}
(c) 184 kJ mol^{-1} (d) –184 kJ mol^{-1}

MPPET - 2012

Ans. (b): For the reaction,

$$\frac{1}{2}H_2(g) + \frac{1}{2}Cl_2(g) \rightarrow HCl(g)$$

For reactants–

Bond Energy of H–H bond = 435 kJ mol^{-1}

Bond Energy of Cl–Cl bond = 243 kJ mol^{-1}

For products–

Energy of formation of H–Cl bond = 431kJ mol^{-1}

Thus, ΔH of the above reaction is–

$$\Delta H = \frac{1}{2}\left(\Delta H_{H_2} + \Delta H_{Cl_2}\right) - \Delta H_{HCl}$$
$$= \frac{1}{2}(435 + 243) - 431$$
$$= \frac{1}{2}(678) - 431$$
$$= 339 - 431$$
$$= -92\text{ kJ mol}^{-1}$$

481. Consider the following reactions:

$$\mathbf{C + O_2 \rightarrow CO_2;\quad \Delta H = -400\,kJ\,mol^{-1}}$$
$$\mathbf{2H_2 + O_2 \rightarrow 2H_2O;\quad \Delta H = -570\,kJ\,mol^{-1}}$$
$$\mathbf{CO_2 + 2H_2O \rightarrow CH_4 + 2O_2 \Delta H = 890\,kJ\,mol^{-1}}$$

The heat of formation of methane is

(a) –180 kJ mol^{-1} (b) –1060 kJ mol^{-1}
(c) –720 kJ mol^{-1} (d) –80 kJ mol^{-1}

(A.P.EAMCET-1994)

Ans. (d) : Given that,

$C + O_2 \longrightarrow CO_2; \Delta H = -400\text{kJ/mole}$ ....(i)
$2H_2 + O_2 \longrightarrow 2H_2O$; $\Delta H = -570$ kJ/mole ....(ii)
$CO_2 + 2H_2O \longrightarrow CH_4 + 2\,O_2$; $\Delta H = 890$ kJ/mole .(iii)

Adding equation (i), (ii) and (iii) we get,

$C + 2H_2 \rightarrow CH_4$; $\Delta H = -400 + (-570) + 890$
$\Delta H = -80\text{kJ/mole}$.

482. Given that,

$$\textbf{(i)}\ \mathbf{CH_3CHO + \frac{5}{2}O_2 \rightarrow 2CO_2 + 2H_2O;}$$
$$\mathbf{\Delta H = -1168\,kJ\,mol^{-1}}$$

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(ii) $CH_3COOH + 2O_2 \rightarrow 2CO_2 + 2H_2O$

$\Delta H = -876\ kJ\ mol^{-1}$

ΔH for the reaction,

$CH_3CHO + \frac{1}{2}O_2 \rightarrow CH_3COOH$, is

(a) $-292\ kJ\ mol^{-1}$ (b) $378\ kJ\ mol^{-1}$
(c) $195\ kJ\ mol^{-1}$ (d) $-2044\ kJ\ mol^{-1}$

(A.P.EAMCET-1994)

Ans. (a) : Given that,

$CH_3CHO + \frac{5}{2}O_2 \longrightarrow 2CO_2 + 2H_2O$;

$\Delta H = -1168$ kJ/mole .....(i)

$CH_3COOH + 2O_2 \longrightarrow 2CO_2 + 2H_2O$; $\Delta H = -876$ kJ/mol

or reverse the reaction:-

$2CO_2 + 2H_2O \rightarrow CH_3COOH + 2O_2$; $\Delta H = 876$ kJ/mole .....(ii)

Adding both equation (i) + (ii) we get–

$CH_3CHO + \frac{1}{2}O_2 \longrightarrow CH_3COOH$

$\therefore \Delta H = -1168 + 876$

$\Delta H = -292 kJ / mole$

483. Calculate the heat of formation (ΔH) of CO (in kcal) from the following data.

I. $C_{(graphite)} + O_2(g) \longrightarrow CO_2(g)$;

$\Delta H = -94\ kcal$

II. $CO(g) + \frac{1}{2}O_2(g) \longrightarrow CO_2(g)$;

$\Delta H = -68\ kcal$

(a) –1.3 (b) –26
(c) –162 (d) –82

(A.P.EAMCET-2000)

Ans. (b): Given that,

$C(s) + O_2(g) \longrightarrow CO_2(g)$; $\Delta H = -94$ kcal ....(i)

$CO(g) + \frac{1}{2}O_2(g) \longrightarrow CO_2(g)$; $\Delta H = -68$ kcal

Reverse of the reaction is:-

$CO_2 \longrightarrow CO + \frac{1}{2}O_2$; $\Delta H = 68$ kcal ....(ii)

Adding the equation (i) and (ii) we get –

$C + \frac{1}{2}O_2 \longrightarrow CO$;

$\Delta H = -94 + 68$

$\Delta H = -26$ kcal

484. In which of the following reactions heat liberated is known as standard heat of formation of CO_2?

(a) $2CO(g) + O_2(g) \rightarrow 2CO_2(g) + 135.5$ kcal

(b) $C_{(diamond)} + O_2(g) \rightarrow 2CO_2(g) + 19.5$ kcal

(c) $C_{(graphite)} + O_2(g) \rightarrow CO_2(g) + 94.05$ kcal

(d) $CH_4(g) + 2O_2(g) \rightarrow CO_2(g) + 2H_2O(\ell)$ +212.8 kcal

(A.P.EAMCET-1999)

Ans. (c) : $C_{graphite} + O_2(g) \longrightarrow CO_2(g) + 94.05$ kcal

The standard enthalpy of formation or standard heat of formation of a compound is the change of enthalpy during the formation of 1 mole of the substance from its constituent elements, with all substances in their standard states.

485. The heat of combustion of CH_4, C(graphite) and $H_2(g)$ are respectively 20 kcal, – 40 kcal and –10 kcal. The heat of formation of CH_4 is

(a) –40 kcal (b) + 40 kcal
(c) 80 kcal (d) None of these

(A.P.EAMCET-1998)

Ans. (a) : Given,

Heat of combustion,

$CH_4(g) + 2O_2 \longrightarrow CO_2 + 2H_2O$; $\Delta H = -20$ kcal .....(1)

$C_{(graphite)} + O_2 \longrightarrow CO_2$; $\Delta H = -40$ kcal .....(2)

$H_2(g) + \frac{1}{2}O_2 \longrightarrow H_2O$; $\Delta H = -10$ kcal .....(3)

From equation (2) + (3) – (1), we get–

$C + 2H_2 \rightarrow CH_4$

$\Delta H = -40 + 2(-10) - (-20)$

$= -40$ kcal

486. Calculate the heat of combustion (in kJ) of methane from the following data.

(I) $C_{(graphite)} + 2H_2(g) \longrightarrow CH_4(g)$;

$\Delta H = -74.8\ kJmol^{-1}$

(II) $C_{(graphite)} + O_2(g) \longrightarrow CO_2(g)$;

$\Delta H = -393.5\ kJmol^{-1}$

(III) $H_2(g) + \frac{1}{2}O_2(g) \longrightarrow H_2O(\ell)$

$\Delta H = -286.2\ kJmol^{-1}$

(a) –891.1 (b) –816.3
(c) –965.9 (d) –1040.7

(A.P.EAMCET-2002)

Ans. (a) : Given that,

$C_{(graphite)} + 2H_2(g) \longrightarrow CH_4(g)$; $\Delta H = -74.8 kJ\ mol^{-1}$

or $CH_4(g) \longrightarrow C + 2H_2$; $\Delta H = 74.8\ kJmol^{-1}$ .... (i)

$C + O_2(g) \longrightarrow CO_2(g)$; $\Delta H = -393.5\ kJmol^{-1}$ ...... (ii)

$H_2(g) + \frac{1}{2}O_2(g) \rightarrow H_2O(\ell)$; $\Delta H = -286.2\ kJmol^{-1}$ .....(iii)

Multiply by 2 in equation (iii) we get

$2H_2(g) + O_2(g) \longrightarrow 2H_2O(\ell)$; $\Delta H = -572.4$ kJ ....(iv)

Adding equation (i), (ii) and (iv), we get

$CH_4 + 2O_2 \longrightarrow CO_2 + 2H_2O$;

$\Delta H = 74.8 + (-393.5) + (-572.4)$

$\Delta H = -891.1$ kJ

487. When 10 g of methane is completely burnt in oxygen, the heat evolved is 560 kJ. What is the heat of combustion (in kJ mol^{-1}) of methane?

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(a) –1120 (b) – 968
(c) – 896 (d) – 560

(A.P.EAMCET-2003)

Ans. (c) :

$$\underset{10g}{CH_4} + 2O_2 \longrightarrow CO_2 + 2H_2O,\ \Delta H = -560\text{ kJ}$$

$\therefore$ Heat of combustion of 10 g $CH_4 = \dfrac{-560\text{ kJ}}{10}$

So, the heat of combustion of 16 gm $CH_4 = \dfrac{-560}{10} \times 16$

$= -896$ kJ/mole

$\therefore$ Heat of combustion = – 896 kJ/mole

488. Which of the following is not correct?

(a) Dissolution of NH_4Cl in excess of water is an endothermic process
(b) Neutralisation process is always exothermic
(c) The absolute value of enthalpy (H) can be determined experimentally
(d) The heat of reaction at constant volume is denoted by ΔE

(A.P.EAMCET-2005)

Ans. (c) : The absolute value of enthalpy (H) cannot be determined. Only the change in enthalpy (ΔH) during a process can be determined. Hence, statement is false.

For other options,

(a) Dissolution of NH_4Cl in excess of water is an endothermic process because when NH_4Cl dissolves in water, the absorption of heat occurs shows the reaction is an endothermic reaction. Hence, statement is true.

(b) Neutralization reaction is always exothermic because the formation of two very strong covalent bonds between hydrogen and hydroxide ion is responsible for the neutralization reaction's exothermic character. Hence, statement is true.

(d) The heat of reaction at constant volume is denoted by ΔE because difference between the sum of internal energies of products and the sum of internal energies of reactants at a given temperature and constant volume is called the heat of reaction.

489. Calculate ΔH in kJ for the following reaction

$$C(g) + O_2(g) \longrightarrow CO_2(g)$$

Given that,

$$H_2O(g) + C(g) \longrightarrow CO(g) + H_2(g);\quad \Delta H = +131\text{ kJ}$$

$$CO(g) + \frac{1}{2}O_2(g) \longrightarrow CO_2(g)\quad \Delta H = -282\text{ kJ}$$

$$H_2(g) + \frac{1}{2}O_2(g) \longrightarrow H_2O(g)\ \ \Delta H = -242\text{ kJ}$$

(a) – 393 (b) + 393
(c) + 655 (d) – 655

(A.P.EAMCET-2008)

Ans. (a) : Given that,

$H_2O(g) + C(g) \rightarrow CO(g) + H_2(g)$, $\Delta H = +131$ kJ .....(i)

$CO(g) + \frac{1}{2}O_2(g) \longrightarrow CO_2(g)$, $\Delta H = -282$ kJ ....(ii)

$H_2(g) + \frac{1}{2}O_2(g) \longrightarrow H_2O(g)$, $\Delta H = -242$kJ ....(iii)

Adding equation (i), (ii) and (iii) we get

$C(g) + O_2(g) \longrightarrow CO_2(g)$

$\therefore \Delta H = (131 - 282 - 242)$ kJ

$\Delta H = -393$ kJ

490. Calculate enthalpy for formation of ethylene from the following data.

(I) $C_{(graphite)} + O_2(g) \longrightarrow CO_2(g);$

$\Delta H = -393.5\text{ kJmol}^{-1}$

(II) $H_2(g) + \frac{1}{2}O_2(g) \longrightarrow H_2O(l);$

$\Delta H = -286.2\text{ kJmol}^{-1}$

(III) $C_2H_4(g) + 3O_2(g) \rightarrow 2CO_2(g) + 2H_2O(l);$

$\Delta H = -1410.8\text{ kJmol}^{-1}$

(a) 54.1 kJ (b) 44.8 kJ
(c) 51.4 kJ (d) 48.4 kJ

(A.P.EAMCET-2007)

Ans. (c): Given that,

$C(graphite) + O_2(g) \rightarrow CO_2(g);\ \Delta H = -393.5\text{ kJmol}^{-1}$

Multiply the above equation by 2, we get,

$2C(graphite) + 2O_2 \rightarrow 2CO_2;\ \Delta H = -787.0\text{ kJmol}^{-1}$ ..(i)

$H_2(g) + \frac{1}{2}O_2(g) \longrightarrow H_2O(l);\ \Delta H = -286.2\text{ kJmol}^{-1}$

Multiply the above equation by 2, we get

$2H_2(g) + O_2(g) \rightarrow 2H_2O(l);$

$\Delta H = -572.4\text{ kJmol}^{-1}$ …...(ii)

and $C_2H_4(g) + 3O_2(g) \rightarrow 2CO_2(g) + 2H_2O(l)$

$\Delta H = -1410.8\text{ kJmol}^{-1}$ ....(iii)

Adding equation (i) and (ii) then subtracted by equation (iii) we get–

$2C(graphite) + 2H_2 \longrightarrow C_2H_4(g)$;

$\Delta H_f = -787.0 - 572.4 - (-1410.8)$

$\Delta H_f = -1359.4 + 1410.8$

$\Delta H_f = 51.4\text{ kJmol}^{-1}$

491. The enthalpies of combustion of carbon and carbon monoxide are –393.5 kJ and –283 kJ mole^{-1} respectively. The enthalpy of formation of carbon monoxide is :

(a) 110.5 kJ mole^{-1} (b) 676.5 kJ mole^{-1}
(c) –676.5 kJ mole^{-1} (d) –110.5 kJ mole^{-1}

MPPET-2013

Ans. (d): The balanced chemical equations for the combustion of carbon and carbon mono oxide are as given below.

$C + O_2 \rightarrow CO_2;\ \Delta H = -393.5$kJ …..(i)

$CO + \frac{1}{2}O_2 \rightarrow CO_2;\ \Delta H = -283$kJ …..(ii)

Subtract equation (ii) from equation (i).

@apna_pdf

$$C+\frac{1}{2}O_2 \rightarrow CO;\ \Delta H=-110.5\,kJ$$

Thus, the enthalpy of formation of carbon monoxide per mole is –110 kJ.

Hence, the correct option is (a).

492. Given that $N_2(g) + 3H_2(g) \rightarrow 2NH_3(g)$; $\Delta_rH° = -92$ kJ, the standard molar enthalpy of formation in kJ mol^{-1} of $NH_3(g)$ is

(a) –92 (b) +46

(c) +92 (d) –46

TS-EAMCET-2016

Ans. (d) : Given that,

$$N_2(g) + 3H_2(g) \rightarrow 2NH_3(g);\quad (\Delta_rH°) = -92\ kJ$$

∴ The standard molar enthalpy of formation of NH_3 is

$$=\frac{1}{2}\Delta_rH°$$

$$\frac{1}{2}N_2(g)+\frac{3}{2}H_2(g)\rightarrow NH_3(g);$$

$$\Rightarrow \Delta_rH°=\left(-\frac{92}{2}\right)=\Delta_rH°=-46\,kJ/mole$$

493. The enthalpy of formation (ΔH_f) of methanol, formaldehyde and water are –239, – 116 and – 286 kJ mol^{-1} respectively. The enthalpy change for the oxidation of methanol to formaldehyde and water in kJ is

(a) –136 (b) –173

(c) 163 (d) –163

AP EAMCET-2017

Ans. (d): Given that

$\Delta H_{f(CH_3OH)} = -239$ kJ/mol …….(i)

$\Delta H_{f(HCHO)} = -116$ kJ/mol …….(ii)

$\Delta H_{f(H_2O)} = -286$ kJ/mol …….(iii)

$$2CH_3OH + O_2 \longrightarrow 2HCHO + 2H_2O$$

$$\Delta H_R = \frac{1}{2}[2\times eq^n.(ii) + 2\times eq^n.(iii) - 2\times eq^n.(i)]$$

$$\therefore \Delta H_R = \frac{1}{2}[2\times(-116) + 2\times(-286) - 2\times(-239)]$$

$$= \frac{1}{2}[-232-572+478]$$

$$= \frac{1}{2}[-804+478]$$

$$\Delta H_R = -163\ kJ$$

494. Standard enthalpy (heat) of formation of liquid water at 25^0C is around

$$H_2(g)+\frac{1}{2}O_2(g)\rightarrow H_2O(l)$$

(a) –237 kJ/mol (b) 237 kJ/mol

(c) –286 kJ/mol (d) 286 kJ/mol

TS EAMCET-2017

Ans. (c): The standard enthalpy of formation of liquid water at 25^0C is around –286 kJ/mole.

$$\left(\Delta H_f^\circ\right)_{water} = \left[\Delta H^\circ_{H_2O(l)} - \left(\Delta H^\circ_{H_2(g)} + 0.5\Delta H^\circ_{O_2(g)}\right)\right]$$

$$= -286 - [0 + 0.5\times 0]$$

$$= -286\ kJ/mole$$

495. The heat liberated when 1.89 g of benzoic acid is burnt in a bomb calorimeter at 25^oC increases the temperature of 18.94 kg of water by 0.632°C. If g the specific heat of water at 25^oC is 0.998 cal / (g^oC). then find the heat of combustion of benzoic acid.

(a) 881.1 kJ mol^{-1} (b) 771.2 kJ mol^{-1}

(c) 981.1 kJ mol^{-1} (d) 871.2 kJ mol^{-1}

AP EAPCET 24.08.2021 Shift-II

AIIMS-1994

Ans. (b): Given that:-

Weight of benzoic acid = 1.89gm

Temperature of bomb colorimeter = 25°C

= 25 + 273

= 298K

Mass of water (m) = 18.94 kg = 18940 gm

Increase in temperature (ΔT) = 0.632°C

Specific heat of water (c_w) = 0.998 cal/g°C

Heat gained by water (Q) = $mc_w\Delta T$

= 18940 × 0.998 × 0.632

= 11946.14 cal

Since,

1.89 gm of acid liberates 11946.14 cal of heat.

Therefore, heat liberated by 122gm of acid (molecular weight of benzoic acid)

$$=\frac{11946.14\times 122}{1.89}$$

= 771126.5 cal

= 771.12 kcal

496. The enthalpy of formation of two compounds X and Y are –36 kJ and –72 kJ respectively, which one of the following statement is correct?

(a) Compound X is more stable than compound Y.

(b) Compound Y is more stable than compound X.

(c) Both compound X and Y are endothermic compounds.

(d) Both X and y are unstable.

COMEDK-2011

Ans. (b) : X→ $\Delta H_t^\circ = -36kJ$

Y→ $\Delta H_t^\circ = -72kJ$

Here, –ve sign are indicate that energy release.

∵ Less the energy more the stability.

∵ Y releases more energy (y > x).

So, compound Y are more stable.

497. The enthalpy change for reaction $H_2(g)$ $+Cl_2 \rightarrow 2HCl(g)$ is –194 kJ. The heat of formation of HCl is

(a) –194 (b) +194 kJ

(c) –97 kJ (d) +97 kJ

COMEDK-2011

Ans. (c): $H_{2(g)} + Cl_{2(g)} \rightarrow 2HCl_{(g)};\Delta H_r = -194\,kJ$

Heat of formation for 1 mole of HCl

$$\Delta H_r = \frac{-194}{2} = -97kJ$$

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498. The enthalpy of neutralization of HCl and NaOH is x kJ. The heat evolved when 500 mL of 2 N HCl is mixed with 250 mL of 4 N NaOH will be

(a) x
(b) x/2
(c) x/4
(d) 2x/3

COMEDK-2012

Ans. (a) : The enthalpy of neutralization of any strong acid with a strong base or vice-versa is always the same.

No. of gram equivalents HCl =

$$\frac{500\times2}{1000}=1$$

No. of gram equivalents NaOH =

$$\frac{250\times4}{1000}=1$$

499. Standard molar enthalpies of formation of $CaCO_3$(s), CaO(s) and CO_2(g) are –1206.92 kJ mol^{-1} ’-635.09 kJ mol^{-1} and –393.51 kJ mol^{-1} respectively. The ΔH_r for decomposition of $CaCO_{3(s)}$ is

(a) 178.3 kJ mol^{-1}
(b) –178.3 kJ mol^{-1}
(c) 1448.5 kJ mol^{-1}
(d) –1448.5 kJ mol^{-1}

COMEDK-2014

Ans. (a) : $CaCO_3(s)\rightarrow CaO(s)+CO_2(g)$

$$\Delta H_r^o=\left[\Delta H^o_{f(CaO)}+\Delta H^o_{f(CO_2)}\right]-\left[\Delta H^o_{f(CaCO_3)}\right]$$

$$=\left[(-635.09)+(-393.51)\right]-(-1206.92)$$

$$=178.32 \text{ kJ mol}^{-1}$$

500. When 5 liters of a gas mixture of methane and propane is perfectly combusted at 0°C and 1 atmosphere, 16 liters of oxygen at the same temperature and pressure is consumed. The amount of heat released from this combustion is ($\Delta H_{comb.}CH_4$ = 890 kJ mol^{-1}, $\Delta H_{comb.}(C_3H_8)$ = 2220 kJ mol^{-1})

(a) 38
(b) 317
(c) 477
(d) 32

KARNATAKA NEET-2013

Ans. (b) : The balanced equations of combustion reactions are:

$$CH_4(g)+2O_2(g)\rightarrow CO_2(g)+$$
$$2H_2O(l),\ \Delta H_{CH_4(g)}=890 \text{ kJ/mol}$$

$$C_3H_8(g)+5O_2(g)\rightarrow 3CO_2(g)+$$
$$4H_2O(l),\ \Delta H_{C_3H_8(g)}=2220 \text{ kJ/mol}$$

Let here xL CH_4 and (5 – x)L C_3H_8 in 5L gas mixture at STP

So total volume of oxygen consumed as per stoichiometry of the reaction involved will be

$$\Rightarrow 2x+5(5-x)=16$$
$$\Rightarrow 2x+25-5x=16$$
$$\Rightarrow 3x=9$$
$$\Rightarrow x=3L$$

So volume of CH_4(g) = 3L

And volume of C_3H_8(g) = 2L at STP

$$n_{CH_4(g)}=\frac{3}{22.4}\text{mol}$$

$$n_{C_3H_8(g)}=\frac{2}{22.4}\text{mol}$$

So

$$\Delta H_{mixture}=\frac{3}{22.4}\Delta H_{CH_4(g)}+\frac{2}{22.4}\Delta H_{C_3H_8(g)}$$

$$\Delta H_{mixture}=\frac{3\times890+2\times2220}{22.4}\approx317\,\text{kJ}$$

501. 100 cm^3 of 0.1 M HCl and 100 cm^3 of 0.1 M NaOH solutions are mixed in a calorimeter. If the heat liberated is "Q" kcal, the heat of neutralization (ΔH) (in kcal) of HCl (aq) and NaOH(aq) is

(a) –10Q
(b) –100Q
(c) –1000Q
(d) –Q

AP-EAMCET (Medical), 2008

Ans. (b) : During the process, following reaction occur-

$$NaOH+HCl\longrightarrow NaCl+H_2O$$

$\therefore$ When 1 mole of NaOH is neutralised by 1 mole of HCl then the heat liberated is Q kcal.

Or ΔH = Q kcal

$\therefore$ 10 moles of NaOH are neutralised by 10 moles of HCl.

Heat liberated = $-10\times10\times$ Q kcal = –100 Q kcal.

502. The average S-F bond energy in kJ mol^{-1} of SF_6 is _____ (Rounded off to the nearest integer) [Given: The values of standard enthalpy of formation of SF_6(g), S(g) and F(g) are-1100, 275 and 80 kJ mol^{-1} respectively.]

JEE Main 26.02.2021,Shift-II

Ans.: Given,

$$SF_6(g)\rightarrow S(g)+6F(g)$$

$$\Delta H^\circ_{SF_6}=-1100\text{kJ/mole}$$

$$\Delta H^\circ_S(g)=275\text{kJ/mole}$$

$$\Delta H^\circ_F=80\text{kJ/mole}$$

$$\Delta H^\circ_{reaction}=6\times E_{S-F}=\Delta H^\circ_S(g)+6\times\Delta H^\circ_F(g)-\Delta H^\circ_{SF_6}(g)$$

$$E_{S-F}=\frac{275+6\times80+1100}{6}$$

$$E_{S-F}=\frac{1855}{6}=309.167\,\text{kJ/mole}$$

$$E_{S-F}\approx309\ \text{kJ/mole}$$

503. The ionization enthalpy of Na$^+$ formation from $Na_{(g)}$ is 495.8 kJ mol^{-1} , while the electron gain enthalpy of Br –325.0 kJ mol^{-1}. Given the lattice enthalpy of NaBr is –728.4 kJ mol^{-1} . The energy for the formation of NaBr ionic solid is (-) ____ × 10^{-1} kJ mol^{-1}.

JEE Main 25-02-2021, Shift-I

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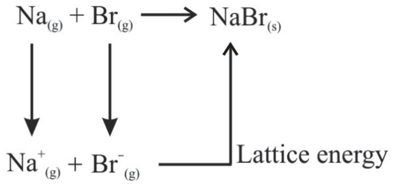
Ans. : 5576



$Na_{(g)} + Br_{(g)} \longrightarrow NaBr_{(s)}$
$Na^+_{(g)} + Br^-_{(g)}$
Lattice energy

Given : Ionisation energy of $Na^+ = 495.8\ kJmol^{-1}$

Electron gain enthalpy for Br = $-325\ kJmol^{-1}$

Lattice enthalpy of NaBr = $-728.4\ kJmol^{-1}$

ΔH for of NaBr ionic solid = $IE_1 + \Delta H_{eg} + L.E$

$= 495.8 + (-325) + (-728.4)$

$= 495.8 - 1053.4$

$= -557.6\ kJmol^{-1}$

$= -5576 \times 10^{-1}\ kJmol^{-1}$

504. Which of the following compounds has the highest hydration energy?

(a) $BeSO_4$ (b) $CaSO_4$

(c) $SrSO_4$ (d) $BaSO_4$

TS-EAMCET 09.08.2021, Shift-I

Ans. (a) : Hydration energy is the energy released when one mole of ions undergo hydration and lattice energy is the energy released when the ions make bonds between them.

In second group metal sulphate, $BeSO_4$ is most water soluble compound among all of them because hydration energy is higher than the lattice energy.

Note-The hydration enthalpies of $BeSO_4$ and $MgSO_4$ are quite high because of small size of Be^{2+} and Mg^{2+} ions. These hydration enthalpy values are higher than their corresponding lattice enthalpies and therefore, $BeSO_4$ and $MgSO_4$ are highly soluble in water.

505. Assertion: The enthalpy of formation of gaseous oxygen molecules at 298 K under a pressure of one atm is zero.

Reason: The entropy of formation of gaseous oxygen molecules under the same conditions is zero.

(a) If both Assertion and Reason are true and the Reason is a correct explanation of the Assertion

(b) If both Assertion and Reason are true but Reason is not a correct explanation of the Assertion

(c) If Assertion is true but the Reason is false

(d) If both Assertion and Reason are false

AIIMS-1996

Ans. (c): The standard state of oxygen element is gaseous diatomic molecule (O_2). Thus, the standard enthalpy of formation for an element in its standard state is zero. Entropy of formation of given elementary substances at 298 K and one atmosphere is not zero. Thus, Assertion is true Reason is false.

506. $C+O_2(g) \rightarrow CO_2$.......(i) $\Delta H = -393\ kJ\ mol^{-1}$

$H_2 + 1/2\ O_2 \rightarrow H_2O$,..... (ii) $\Delta H = -287.3\ kJ\ mol^{-1}$

$2CO_2+3H_2O \rightarrow C_2H_5OH + 3O_2$....(iii) $\Delta H = 1366.8\ kJ\ mol^{-1}$

Find the standard enthalpy of formation of $C_2H_5OH(l)$

(a) $281.1\ kJ\ mol^{-1}$ (b) $-281.1\ kJ\ mol^{-1}$

(c) $562.2\ kJmol^{-1}$ (d) $-562.2\ kJ\ mol^{-1}$

AIIMS 26 May 2019 (Morning)

Ans. (b): We have:-

$C+O_2(g) \rightarrow CO_2$.......(i) $\Delta H = -393\ kJ\ mol^{-1}$

$H_2 + 1/2\ O_2 \rightarrow H_2O$,..... (ii) $\Delta H = -287.3\ kJ\ mol^{-1}$

$2CO_2+3H_2O \rightarrow C_2H_5OH + 3O_2$....(iii) $\Delta H = 1366.8\ kJ\ mol^{-1}$

Now,

$\Delta H_r = \sum \Delta H_f(\text{product}) - \sum \Delta H_f(\text{reactant})$

$= \Delta H_{f(C_2H_5OH)} + \Delta H_{f(O_2)} - 2\Delta H_{f(CO_2)} - 3\Delta H_{f(H_2O)}$

(∵ from (iii))

$\Rightarrow 1366.8 = \Delta H_{f(C_2H_5OH)} + 0 - 2(-393) - 3(-287.3)$

$\Delta H_{f(C_2H_5OH)} = 1366.8 + 2(-393) + 3(-287.3)$

$= 1366.8 + (-786) - 861.9$

$= 1366.8 - 1647.9$

$= -281.1\ kJ\ mol^{-1}$

507. $C_3H_6 + H_2 \rightarrow C_3H_8\ \Delta H_1 = -124kJ$

$C_3H_8 + 5O_2 \rightarrow 3CO_2 + 4H_2O\ \Delta H_2 = -2027kJ$

$H_2 + \frac{1}{2}O_2 \rightarrow H_2O\ \ \Delta H_3 = -286kJ$

Calculate enthalpy of combustion of propene?

(a) −1020kJ (b) −2085kJ

(c) −2020kJ (d) None

AIIMS-27 May, 2018 (M)

Ans. (d): We have,

$C_3H_6 + H_2 \rightarrow C_3H_8\ \Delta H_1 = -124kJ$

$C_3H_8 + 5O_2 \rightarrow 3CO_2 + 4H_2O\ \Delta H_2 = -2027kJ$

$H_2 + \frac{1}{2}O_2 \rightarrow H_2O\ \ \Delta H_3 = -286kJ$

Now, adding (i) and (ii) and subtracting with (iii) :- we get

$$C_3H_6 + \frac{9}{2}O_2 \longrightarrow 3CO_2 + 3H_2O$$

$$\Delta H = [\Delta H_1 + \Delta H_2 - \Delta H_3]$$

$$= -124 + (-2027) - (-286)$$

$$= -2151 + 286$$

$$= -1865kJ$$

508. The standard enthalpies of combustion of C_6H_6 (*l*), $C_{(graphite)}$ and H_2 (g) are respectively –3270 kJ mol^{-1}, –394kJ^{-1} and – 286 kJ mol^{-1} . What is the standard enthalpy of formation of C_6H_6 (l) in kJ mol^{-1}?

(a) –48 (b) +48

(c) –480 (d) +480

AIIMS-2016

Ans. (b): Given

(I) $C_6H_6 + \frac{15}{2}O_2 \longrightarrow 6CO_2 + 3H_2O, \Delta H = -3270\,kJ\ mol^{-1}$

(II) C (graphite) $O_2 \longrightarrow CO_2 . \Delta H = -394\,kg\,mol^{-1}$

@apna_pdf

(III) $H_2+\frac{1}{2}O_2 \longrightarrow H_2O, \Delta H=-286\,kJ\,mol^{-1}$

Multiplication eq^n. (II) by 6 and eq^n. (III) by 3 gives

(IV) $6C(s)+6O_2 \longrightarrow 6CO_2,\ \Delta=-394\times 6\,kJ\,mol^{-1}$

$= -2364\ kJ\ mol^{-1}$

(V) $3H_2+\frac{3}{2}O_2 \longrightarrow 3H_2O,\ \Delta H=-286\times 3\,kJ\,mol^{-1}$

$= -858\ kJ\ mol^{-1}$

reverse equation (I) we get:-

(VI)

$6CO+3H_2O \longrightarrow C_6H_6+\frac{15}{2}O_2,\ \Delta H=+3270\,kJ\ mol^{-1}$

Addition of (IV), (V) & (VI) Equation:-

$6C+3H_2 \longrightarrow C_6H_6$,

$\Delta H = +3270 + (-2364 - 858) = +48\ kJ\ mol^{-1}$

509. The molar heat capacity of water at constant pressure is 75 J K mol^{-1}. When 1kJ of heat is supplied to 100 g of water, which is free to expand, the increase in temperature of water is

(a) 6.6 K (b) 1.2 K

(c) 2.4 K (d) 4.8 K

AIIMS-2017

Ans. (c): Relation between heat supplied, molar heat capacity at constant volume and temperature change is

$q = n\,C_p\Delta T$, $q = 1\ kJ = 1000\ J$

$= \text{No . of moles} = n = \frac{\text{mass}}{\text{molecular weight}} = \frac{100}{18}$

Put this value in $q = n\,C_p\,\Delta T$

$$1000 = \frac{100}{18}\times 75\times\Delta T$$

$\Delta T = 2.4\ K$

510. Enthalpy of combustion of CH_4, C_2H_6 and C_3H_8 are–210.8, –368.4 and –526.2 k cal mol^{-1} respectively. Enthalpy of combustion of hexane can be predicted as

(a) -840 k cal mol^{-1} (b) -684 k cal mol^{-1}

(c) -1000 k cal mol^{-1} (d) none of these

AIIMS-2011

Ans. (c): (ΔH_c = Reactant – Product)

Enthalpy of combustion of $CH_4 = -210.8$ kJ

Enthalpy of combustion of $C_2H_6 = -368.4$ kJ

Enthalpy of combustion of $C_3H_8 = -526.2$ kJ

∵ For 3 Carbon, – 526.5 kJ

For 6 Carbon, $2\times -526.2 = -1052.4$ kJ

For hexane, enthalpy of combustion can be approximated to –1000 kJ

511. The standard enthalpy of combustion at 25ºC of hydrogen, cyclohexene (C_6H_{10}) and cyclohexane (C_6H_{12}) are –241, –3800 and –3920kJ/mol respectively. Calculate the heat of hydro-genation of cyclohexene.

(a) –111 kJ/mol (b) –121 kJ/mol

(c) –118 kJ/mol (d) –128 kJ/mol

AIIMS-2009

Ans. (b) : The required reaction is

$C_6H_{10}+H_2 \rightarrow C_6H_{12},\quad \Delta H_1 = ?$ …..(i)

Let us write the given facts

$H_2+\frac{1}{2}O_2 \rightarrow H_2O$

$\Delta H_2 = -241$ kJ/mole …….(ii)

$C_6H_{10}+\frac{17}{2}O_2 \rightarrow 6CO_2+5H_2O,$

$\Delta H_3 = -3800$ kJ/mole …….(iii)

$C_6H_{12}+9O_2 \rightarrow 6CO_2+6H_2O,$

$\Delta H_4 = -3920$ kJ/mole …….(iv)

The-required-reaction (i) can be obtained by adding equations (ii) and (iii), and subtracting (iv) from the sum of (ii) and (iii).

$C_6H_{10}+H_2 \rightarrow C_6O_{12}$

$\Delta H_1 = (\Delta H_2+\Delta H_3)-\Delta H_4$

$= [-241 + (-3800)] - (-3920)$

$= (-241 - 3800) - (-3920)$

$= -4041 + 3920 = -121$ kJ/mole

512. What will be the heat of formation of methane, if the heat of combustion of carbon is '–x' kJ, heat of formation of water is '–y'kJ and heat of combustion of methane is 'z' kJ?

(a) $(-x-y+z)$kJ (b) $(-z-x+2y)$kJ

(c) $(-x-2y-z)$kJ (d) $(-x-2y+z)$kJ

AIIMS-2008

Ans. (d): For given data, we have

$C+O_2 \longrightarrow CO_2 - x\,kJ$ ——(i)

$H_2+\frac{1}{2}O_2 \longrightarrow H_2O - y\,kJ$ ——(ii)

$CH_4+2O_2 \longrightarrow CO_2+2H_2O+z\,kJ$ ——(iii)

The required equation is,

$C+2H_2 \longrightarrow CH_4+Q$ (Q = Heat formation of the CH_4)

By multiplying equation

(i) + 2 × (ii)——(iii) we get

$C + 2H_2 \rightarrow CH_4 + (-x -2y +z)$kJ

Thus, heat of formation of methane is (–x –2y +z) kJ

513. Which of the following is arranged in the increasing order of enthalpy of vaporisation?

(a) NH_3, PH_3, AsH_3 (b) AsH_3, PH_3, NH_3

(c) NH_3, Ash_3, PH_3 (d) PH_3, AsH_3, NH_3

AIIMS-2004

Ans. (d): As Molecular mass increase , enthalpy of vaporization increases, However NH_3 has exceptionally high enthalpy of vaporization due to inter molecular hydrogen bonding,

$PH_3 < AsH_3 < NH_3$

→In hydrogen bonded molecule enthalpy of vaporization increases Ex :- HF, H_2O, NH_3

514. How much energy is released when 6 moles of octane is burnt in air ? Given ΔH_f^o for $CO_2(g)$, H_2O (g) and $C_8H_{18}(l)$ respectively are –490, –240 and +160 J/mol.

@apna_pdf

(a) −6.2kJ (b) −37.4kJ
(c) −35.5kJ (d) −20.0kJ

AIIMS-2004

Ans. (c): Given-

$C + O_2 = CO_2, \Delta H = -490$ J/mol ——(i)

$H_2 + \frac{1}{2}O_2 = H_2O, \Delta H = -240\,J/mol$ ———(ii)

$8C + 9H_2 = C_8H_{18}, \Delta H = +160\,J/mol$ ———(iii)

The given reaction of the burning of octane can be obtained by

⇒2 × (iii) – 16 (i) – 18 (ii)

$16C + 18H_2 - 16C - 16O_2 - 18H_2 - 9O_2$

$\rightarrow 2C_8H_{18} - 16CO_2 - 18H_2O$

$2C_8H_{18} + 25O_2 \rightarrow 16CO_2 + 18H_2O$

$\Delta H = [2\times160 - 16\times(-490) - 18\times(-240)]$

$\Delta H = -11840$ J = – 11.840 kJ For 2 mole of octane

∴ Energy released for 6 moles of octane.

$= -11.840 \times 3 = -35.5$ kJ

515. ΔH_f^o (298K) of methanol is given by the chemical equation:

(a) $CH_4(g) + \frac{1}{2}O_2(g) \rightarrow CH_3OH(g)$

(b) $C(\text{graphite}) + \frac{1}{2}O_2(g) + 2H_2(g) \rightarrow CH_3OH(l)$

(c) $C(\text{diamond}) + \frac{1}{2}O_2(g) + 2H_2(g) \rightarrow CH_3OH(l)$

(d) $CO(g) + 2H_2(g) \rightarrow CH_3OH(l)$

AIIMS-2005

Ans. (b): Heat of formation is defined as the heat exchange when one mole of a compound is formed from its constituent elements at STP.

In Case of allotropes, most stable allotrope is taken into account. Among graphite and diamond, graphite is stable.

Hence, heat of formation of CH_3OH is represented by

$C\text{ (graphite)} + \frac{1}{2}O_2(g) + 2H_2(g) \longrightarrow CH_3OH(l)$

516. The heat of neutralisation of a strong base and a strong acid is 57 kJ. The heat released when 0.5 moles of HNO_3 solution is added to 0.20 moles of NaOH solution, is

(a) 11.4kJ (b) 34.7kJ
(c) 23.5kJ (d) 58.8kJ

AIIMS-2002

Ans. (a):

One mole of H^+ and one mole of OH^- give 57 kJ.

$$H^+ + OH^- \rightarrow H_2O + \text{Heat}$$

When 0.5 moles of H^+ react with 0.2 mole of OH^-

0.2 mole of OH^+ is neutralized by 0.2 mole of OH^- and 0.3 mole of H^+ remain unreached.

$$\underset{0.2\text{mole}}{H^+} + \underset{0.2\text{mole}}{OH^-} \rightarrow H_2O$$

So, Heat evolved = $\frac{57\times0.2}{1} = 11.4\,kJ$

517. One gram sample of NH_4NO_3 is decomposed in a bomb calorimeter, the temperature of the calorimeter increases by 6.12 K. The heat capacity of the system is 1.23 kJ/g-deg. What is the molar heat of decomposition for NH_4NO_3?

(a) −7.53 kJ/mol (b) −398.1 kJ/mol
(c) −16.1 kJ/mol (d) −602 kJ/mol

AIIMS-2003

Ans. (d): We know that,

$q = ms\Delta T$

When 1g of ammonium nitrate decomposes, heat evolved q = 1×1.23×6.12

When 1 mole of NH_4NO_3 decomposes, heat evolved is

q = 1×1.23×6.12×80

= 602. 21 kJ/mol.

518. The heat of reaction for:

$$C_{10}H_8(s) + 12O_2(g) \rightarrow 10CO_2(g) + 4H_2O(l)$$

at constant volume is –1228.2k cal at 25°C. The heat of reaction at constant pressure and same temperature is :

(a) −1228.2 k cal (b) −1229.3 k cal
(c) −1232.9 k cal (d) −1242.6 k cal

AIIMS-2001

Ans. (b): $C_{10}H_8(s)+12O_2(g) \rightarrow 10CO_2(g)+4H_2O(l)$

$\Delta n_g = n_p - n_R$

$\Delta n_q = 10-12 = -2\ (\Delta n_q<0)$

We known that $\Delta H = \Delta E + \Delta n_q RT$

$\Delta E = -1228.2$ kcal

$\Delta H = -1228.8 - 2\times2\times10^{-3}\times298$

$= -1229.3$ kcal

519. The heat of combustion of yellow phosphorous is –9.91kJ and of red phosphorous is –8.7kJ. The heat of transition of yellow phosphorus to red phosphorus is:

(a) −9.91kJ (b) −8.78kJ
(c) −9.34kJ (d) −1.13kJ

AIIMS-1998

Ans. (d):

$P(\text{red}) + \frac{5}{2}O_2 \rightarrow P_2O_5; \Delta H = -8.78$

$P(\text{yellow}) + \frac{5}{2}O_2 \rightarrow P_2O_5; \Delta H = -9.91$

Subtracting eq^n. (i) and (ii)

$P(\text{red}) + \frac{5}{2}O_2 - P(\text{yellow}) - \frac{5}{2}O_2 \rightarrow P_2O_5 - P_2O_5$

P (Red) – P (yellow) = O

$\Delta H = -8.78 + 9.91 = +1.13$

P (Red)→P (yellow), $\Delta H = +1.13$

P (yellow) → P (Red), $\Delta H = -1.13$ kJ

520. $S + O_2 \rightarrow SO_2 + x$ **kcal ......(1)**

$SO_2 + \frac{1}{2}O_2 \rightarrow SO_3 + y$ **kcal ....(2)**

The heat of formation of SO_3 in the above reaction is

@apna_pdf

(a) $(x+y)$ (b) $(x-y)$
(c) $(2x-y)$ (d) $(2x+y)$

AIIMS-1997

Ans. (a): $S + O_2 \rightarrow SO_2$, $\Delta H_1 = x$ k cal ......(i)

$SO_2 + \frac{1}{2} O_2 \rightarrow SO_3$, $\Delta H_2 = y$ k cal ......(ii)

Adding eq^n. (i) & (ii),

$S + \frac{3}{2}O_2 \rightarrow SO_3$

∴ From Hess's law,

$\Delta H_1 + \Delta H_2 = \Delta H_3$

$\therefore \Delta H_3 = x + y$

521. The enthalpy change for a given reaction at 298 K is – x J mol^{-1}. For the reaction to be spontaneous at 298 K, the entropy change at that temperature

(a) Can be negative, but numerically greater than $\frac{x}{298}Jk^{-1}$
(b) Can be negative, but numerically smaller than $\frac{x}{298}Jk^{-1}$
(c) Can not be negative
(d) Can not be positive

JEE Main, 2019

Ans. (b) : We know that,

$\Delta G = \Delta H - T\Delta S$

For spontaneity $\Delta G < 0$

so, $\Delta H - T\Delta S < 0$

Given, $\Delta H = -$ x cal/mol (i.e.→ – ve)

Therefore, For $\Delta G < O$,

ΔS can be negative but the numerical value must be less than $\frac{x}{298}kJ^{-1}$.

522. The standard molar heat of formation of ethane, CO$_2$ and water (l) are respectively –21.1, –94.1 and –68.3 kcal. The standard molar heat of combustion of ethane will be

(a) –372 kcal (b) 162 kcal
(c) –240 kcal (d) 183.5 kcal

VITEEE-2014

Ans. (a) : Given,

(i) $2C + 3H_2 \rightarrow C_2H_6; \Delta H = -21.1$ kcal

(ii) $C + O_2 \rightarrow CO_2; \Delta H = -94.1$ kcal

(iii) $H_2 + \frac{1}{2}O_2 \rightarrow H_2O; \Delta H = -68.3$ kcal

Now, eq^n 2 × (ii) + 3 × (iii) – (i),

we get ⇒ $C_2H_6 + \frac{3}{2}O_2 \rightarrow 2CO_2 + 3H_2O$

Heat of combustion of ethane

= 2(–94.1) + 3 (–68.3) – (–21.1)

= –188.2–204.9 + 21.1

= – 372 kcal.

523. Consider the following processes
ΔH (kJ/mol)

$$\frac{1}{2}A \longrightarrow B + 150$$
$$3B \longrightarrow 2C + D - 125$$
$$E + A \longrightarrow 2D + 350$$

For $B + D \longrightarrow E + 2C, \Delta H$ will be

(a) 525 kJ/mol (b) –175 kJ/mol
(c) –325 kJ/mol (d) 325 kJ/mol

VITEEE-2012

Ans. (b): For B+D → E + 2C

We have to multiply in eq^n (i) by (2) we get:–

$\frac{1}{2}A \rightarrow B,\ \Delta H = 150\ \ kJmol^{-1}$

$2\times\frac{1}{2}A \rightarrow 2B,\ \ \Delta H = +300\ \ kJmol^{-1}$

$A \rightarrow 2B$ …….(i), $\Delta H = +300\ \ kJmol^{-1}$

$3B + \rightarrow 2C + D$ …….(ii), $\Delta H = -\ 125\ kJmol^{-1}$

$E + A \rightarrow 2D$ …….(iii), $\Delta H = +\ 350\ kJmol^{-1}$

Adding eq^n. (i) and (ii) and the subtracting by (iii)

(i) + (ii) - (iii), we have

$\therefore \Delta H = [+300 - 125 - 350)]$

$= -175\ kJ/mol^{-1}$

524. Heat of formation, ΔH_f° of an explosive compound like NCl$_3$ is

(a) Positive (b) Negative
(c) Zero (d) Positive or negative

VITEEE- 2011

Ans. (a) : Formation of NCl$_3$ is endothermic process. In endothermic reaction, heat is absorbed. Hence the sign of the ΔH will be positive.

525. Enthalpy of a compound is equal to its

(a) Heat of combustion (b) Heat of formation
(c) Heat of reaction (d) Heat of solution

VITEEE- 2010

Ans. (b) : Heat of formation is equal to enthalpy of a compound.

526. Given: 2C(s) + 2O$_2$ (g) → 2CO$_2$ (g); ΔH = –787 kJ

$$H_2(g) + \frac{1}{2}O_2(g) \rightarrow H_2O(l);\ \Delta H = -286\ kJ$$

$$C_2H_2(g) + 2\frac{1}{2}O_2(g) \rightarrow 2CO_2(g) + H_2O(l)\ ;\Delta H = -1310\ kJ$$

The heat of formation of acetylene is

(a) –1802 kJ (b) +1802 kJ
(c) +237 kJ (d) –800 kJ

VITEEE- 2007

Ans. (c) : We have to find

$$2C(s) + 2H_2(g) \longrightarrow C_2H_2(g),\ \ \Delta H = ?$$

This is the equation for formation of acelytene

$2C(s) + 2O_2(g) \longrightarrow 2CO_2(g);\ \ \Delta H = -787\,kJ$ …..(1)

$H_2(g) + \frac{1}{2}O_2(g) \longrightarrow H_2O(l); \Delta H = -286\,kJ$ …..(2)

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$$C_2H_2(g)+2\frac{1}{2}O_2(g)\longrightarrow 2CO_2(g)+H_2O(l);$$

$\Delta H=-1310\,kJ$ ….(3)

Add eq. (1) and (2), we get –

$$2C(s)+H_2(g)+2\frac{1}{2}O_2(g)\longrightarrow 2CO_2(g)+H_2O(l);$$

$\Delta H=-1073\,kJ$ ….(4)

Subtract eq. (3) form eq. (4), we get –

$$2C(s)+H_2(g)\longrightarrow C_2H_2(g);$$

$\Delta H=+237$ kJ

527. Calculate ΔH (in joules) for
$C_{(graphite)} \rightarrow C_{(diamond)}$ from the following data,
$C_{(graphite)} + O_2(g) \rightarrow CO_2(g)$; $\Delta H = -393.5$ kJ
$C_{(diamond)} + O_2(g) \rightarrow CO_2(g)$; $\Delta H = -395.4$ kJ

(a) 1900 J (b) -788.9×10^3 J
(c) 190000 J (d) $+788.9 \times 10^3$ J

SRMJEEE – 2014

Ans. (a) :
$C_{(graphite)} + O_2(g) \rightarrow CO_2(g)$ $\Delta H° = -393.5$ kJ …..(i)
$C_{(diamond)} + O_2(g) \rightarrow CO_2(g)$ $\Delta H° = -395.4$ kJ ….. (ii)
We find –
$C_{graphite} \rightarrow C_{diamond}$
Subtracting the equation (i) by (ii), we get –
$\Delta H° = -393.5 - (-395.4)$
$\Delta H° = 1.9$ kJ
or $\Delta H° = 1900$ J

528. Enthalpy of formation of $C_2H_4(g)$, $CO_2(g)$ and $H_2O(l)$ at 25°C and 1 atm pressure are 52, –394 and –286 kJ/mol respectively. Enthalpy of combustion of $C_2H_4(g)$ is

(a) +1412 kJ/mol (b) –1412 kJ/mol
(c) +141.25 kJ/mol (d) –141.2 kJ/mol

SRMJEEE – 2012

Ans. (b) : Given that, $\Delta H°_{(C_2H_4)} = 52$ kJ/mol
$\Delta H°_{(CO_2)} = -394$ kJ/mol, $\Delta H°_{(H_2O)} = -286$ kJ/mol
Now, following reaction occur:-
$C_2H_4(g) + 3O_2(g) \longrightarrow 2CO_2(g) + 2H_2O(g)$

$$\Delta_r H° = \Delta H°_{Product} - \Delta H°_{reactant}$$

$$\Delta_r H° = \left(2\Delta H^o_{CO_2} + 2\Delta H^o_{H_2O}\right) - \left(\Delta H^o_{C_2H_4} - 3\Delta H^o_{O_2}\right)$$

$$\Delta_r H° = \left[2\times(-394)+2\times(-286)\right]-\left[52-3\times 0\right]$$

$$\Delta_r H° = -788-572-52$$

$$\Delta_r H° = -1412\,kJ/mol$$

529. Which of the following equations correctly represents the standard heat of formation $\left(\Delta H^o_f\right)$ of methane?

(a) $C_{(diamond)} + 2H_2(g) = CH_4(g)$
(b) $C_{(diamond)} + 2H_2(g) = CH_4(g)$
(c) $C_{(graphite)} + 2H_2(g) = CH_4(g)$
(d) $C_{(graphite)} + 4H_2(g) = CH_4(g)$

SRMJEEE – 2007

Ans. (c) : The heat of a formation of a substance is the enthalpy associated with one mole of a substance from its elements in their standard states under standard conditions. $C_{graphite} + 2H_2(g) \longrightarrow CH_4(g)$

530. Given that,
$C(s) + O_2(g) \rightarrow CO_2(g)$; $\Delta H° = -x$ kJ mol^{-1}
$2CO(g) + O_2(g) \rightarrow 2CO_2(g)$; $\Delta H° = -y$ kJ mol^{-1}
The enthalpy of formation of CO will be

(a) $\frac{y-2x}{3}$ (b) $\frac{y-2x}{2}$
(c) $\frac{2x-y}{2}$ (d) $\frac{x-y}{2}$

AP-EAMCET – 2016

Ans. (b) : Given that,

$$C(s)+O_2(g)\rightarrow CO_2(g), \Delta H° = -x\,kJ/mole \quad ...(i)$$

$$2CO(s)+O_2(g)\rightarrow 2CO_2(g), \Delta H° = -y\,kJ/mole$$

or

$$CO(s)+\frac{1}{2}O_2(g)\rightarrow CO_2(g), \Delta H° = -\frac{y}{2}kJ/mole \quad ...(ii)$$

Subtracting equation (ii) from (i), we get–

$$C(s)+\frac{1}{2}O_2(g)\rightarrow CO(g)$$

and $\Delta H = -x-\left(-\frac{y}{2}\right)$

$$\Delta H = \frac{y}{2}-x$$

$$\Delta H = \frac{y-2x}{2}$$

531. Which of the following mixture of solutions follow the condition $\Delta_{mix}H < 0$ and $\Delta_{mix}V < 0$?
(i) Nitric acid + Water
(ii) Acetic acid + Pyridine
(iii) Ethanol + Water
(iv) Carbon tetra chloride + Chloroform

(a) (iii) & (iv) only (b) (ii) & (iii) only
(c) (i) & (iii) only (d) (i) & (ii) only

AP- EAPCET- 07-09-2021, Shift-I

Ans. (d) : Mixture of solution follow the conditions
$\Delta_{mix}H < 0$ and $\Delta_{mix}V < 0$ is
(i) Nitric acid + water
(ii) Acetic acid + Pyridine

532. Heat of formation of CO and CO_2 are –26.4 and –94.0 kcal/mol respectively. What is the heat of combustion of CO in k-cal?

(a) +26.4 (b) 120.6
(c) – 67.6 (d) 135.2

AP- EAMCET(Medical) -2010

Ans. (c): Given that, $\Delta_f H_{CO} = -26.4$ Kcal/mol
$\Delta_f H_{CO_2} = -94.0$ Kcal/mol

Now, $CO+\frac{1}{2}O_2 \longrightarrow CO_2$

Heat of combustion $(\Delta_C H) = \Delta_f H_{CO_2} - \left(\Delta_f H_{CO} + \frac{1}{2}\times\Delta_f H_{O_2}\right)$

@apna_pdf

or $\Delta_C H = -94.0 - \left(-26.4 + \frac{1}{2} \times 0\right)$

or $\Delta_C H = -94.0 + 26.4$

$\Delta_C H = -67.6$ kcal/mol

533. Calculate the difference between ΔE and ΔH for the following reaction at 27°C (in kcal)

$$\textbf{C(graphite)} + \textbf{H}_2\textbf{(g)} \longrightarrow \textbf{CH}_4\textbf{(g)}$$

(a) – 0.6 (b) – 1.2
(c) + 0.6 (d) + 1.2

AP - EAMCET (Medical) - 2007

Ans. (c) : For the reaction–

$C_{(graphite)} + 2H_2(g) \rightarrow CH_4(g)$

Now, $\Delta H = \Delta E + P\Delta V$

or $\Delta H = \Delta E + \Delta n_g RT$

or $\Delta E - \Delta H = -\Delta n_g RT$

Given, $\Delta n_g = 1 - 2 = -1$

$R = 1.987$ cal/mol-K

or $R \approx 2$ cal/mol-K

∴ $\Delta E - \Delta H = -(-1) \times 2 \times 300$ cal

$\Delta E - \Delta H = 600$ cal

$\Delta E - \Delta H = +0.6$ kcal

534. The heat of formation of CO (g) and CO_2 (g) are ΔH = –110 and ΔH = –393 kJmol^{-1} respectively. What is the heat of reaction (ΔH) (in kJ mol^{-1}) for the following reaction?

$$\textbf{CO(g)} + \frac{1}{2}\textbf{O}_2\textbf{(g)} \rightarrow \textbf{CO}_2\textbf{(g)}$$

(a) –504 (b) –142.5
(c) –283 (d) 504

AP-EAMCET (Engg.)-2005

Ans. (c) : Given that,

$\Delta H_{CO} = 110$ KJmol^{-1}

$\Delta H_{CO_2} = -393\,\text{KJmol}^{-1}$

For the reaction-

$$CO\ (g) + \frac{1}{2}O_2(g) \longrightarrow CO_2(g)$$

Heat of reaction (ΔH) = $(\Delta H_{product}) - (\Delta H_{reactant})$

$$\Delta H = \Delta H_{CO_2} - (\Delta H_{CO} + \frac{1}{2}\Delta H_{O_2})$$

or $\Delta H = -393 - (-110 + \frac{1}{2} \times 0)$

or $\Delta H = -393 + 110$

or $\Delta H = -283$ kJmol^{-1}

535. The enthalpy of formation of water is [Given that the bond energies of H–H, O=O and O–H bonds are 433 kJ/mol, 492 kJ/mol and 464 kJ/mol, respectively]

(a) 430 kJ/mol (b) –249 kJ/mol
(c) –461 kJ/mol (d) 215 kJ/mol

AMU-2019

Ans. (b) : $H_2(g) + \frac{1}{2}O_2(g) \rightarrow H_2O(g)$

ΔH = (BE of reactant) – (BE of product)

= (BE of H_2 + $\frac{1}{2}$ × BE of O_2) – (2×BE of OH)

$= 433 + \left(\frac{1}{2} \times 492\right) - (2 \times 464)$

= 433 + 246 – 928

= – 249 kJ/mol

536. For the reaction: $S_{(rhombic)} + O_2 \rightarrow SO_2$, ΔH = – 298 kJ mol^{-1} at 25 °C and 1 atm. Therefore, ΔH for the reaction should be

(a) – 298 kJ mol^{-1}
(b) – 298 + 8.314 × 298 kJ mol^{-1}
(c) – 298 – 8.314 × 298 kJ mol^{-1}
(d) – 298 – 2 × 8.314 × 298 kJ mol^{-1}

AMU-2017

Ans. (a) : $S_{(rhombic)} + O_2 \rightarrow SO_2$; ΔH= –298 kJ mol^{-1}
This is an exothermic process, heat released are 298 kJ mol^{-1}.Therefore, ΔH for this reaction should be= –298 kJ mol^{-}

537. For the reaction,
$H_2F_2(g) \rightarrow H_2(g) + F_2(g)$; ΔE= –14.2 kcal/mole at 25° C. The change in enthalpy of the reaction is

(a) –1.36 kJ/mole (b) –13.6 kJ/mole
(c) 1.36 kJ/mole (d) 13.6 kJ/mole

AMU-2015

Ans. (b) : $H_2F_2(g) \rightarrow H_2(g) + F_2(g)$

∵ $\Delta H = \Delta E + \Delta n_g RT$

Δn_g = No. of mole of product – No. of mole of reactant

$\Delta n_g = (1+1) - 1 = 1$

∴ ΔH= – 14.2 Kcal mol^{-1}+1×2×10^{-3}×298

= –14.2 + .6

= – 13.6 Kcal mol^{-1}

538. The heat produced on combustion of methane is approximately

(a) 890 kJ per g (b) 74.2 kJ per g
(c) 55.6 kJ per g (d) 49.5 kJ per g

AMU-2015

Ans. (c) : $CH_4(g) + 2O_2(g) \rightarrow CO_2(g) + 2H_2O(l)$
Enthalpy change for a given reaction is equal to the (sum of standard enthalpies of formation of products)– (Sum of standard enthalpies of formation of reactants)

$\Delta H = \Delta H_{products} - \Delta H_{reactants}$

∵ Enthalpy of CO_2 = –393.5kJ/mol.

Enthalpy of H_2O = –285.8 kJ/mol.

Enthalpy of CH_4= –74.9 kJ/mol.

∴ Enthalpy combustion of methane

=[–393.5+2×(–285.8)]–[–74.9+2×0]

= –965.1+74.9

= –890.2 kJ/mol.

$= \frac{890.2}{16}$ kJ/g

= –55.6kJ/g

Here, negative sign indicate that the combustion reaction of CH_4 is exothermic reaction.

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539. A boy after swimming comes out from a pool covered with a film of water weighing 80g. How much heat must be supplied to evaporate this water? ($\Delta H_v^o = 40.79$ kJ mol^{-1})

(a) 1.61×10^2 kJ (b) 1.71×10^2 kJ
(c) 1.81×10^2 kJ (d) 1.91×10^2 kJ

AMU-2015

Ans. (c) : Given that,

$\Delta H_v^o = 40.79$ kJ mol^{-1}

No. of moles (n) = $\frac{80}{18}$

Heat (q) = n ΔH_v^o

$= \frac{80}{18} \times 40.79$

= 181. 28 KJ = 1.81×10^2 kJ

540. On complete combustion, 0.246 g of an organic compound gave 0.198 g of CO_2 and 0.1014 g of H_2O. The ratio of carbon and hydrogen atoms in the compound is

(a) 1 : 3 (b) 1 : 2
(c) 2 : 5 (d) 2 : 7

AMU-2014

Ans. (c) : % of C = $\frac{12}{14} \times \frac{0 \cdot 198 \times 100}{0 \cdot 246}$

= 21.95%

% of H = $\frac{2}{18} \times \frac{0 \cdot 1014 \times 100}{0 \cdot 246} = 4.57$

% of O= (100–21.95–4.57)

= 73.47

Mole of C= $\frac{21.95}{12} = 1.83$

Mole of H= $\frac{4.57}{1} = 4.57$

Mole of O= $\frac{73.47}{16} = 4.59$

Ratio= C:H = 1.83 : 4.57=2 : 5

541. The change of energy on vaporizing 1.00 kg of liquid water at 0^oC and 1 atm is

(a) 2367 kJ kg^{-1} (b) 333.4 kJ kg^{-1}
(c) -333.4 kJ mol^{-1} (d) -2367 kJ g^{-1}

AMU-2012

Ans. (c) : Enthalpy of fusion

= 6.03 kJ mol^{-1} at 0^oC

For 18g of water enthalpy of fusion = –6.03 kJ / mole

1g of water enthalpy of fusion = $\frac{6.03}{18}$

for 1kg of water enthalpy of fusion

$= \frac{-6.03 \times 1000}{18} = -333.4$ kJ/kg

542. The difference between heats of formation at constant pressure and constant volume for the reaction ,

$2C_6H_6(l) + 15O_2(g) \rightarrow 12CO_2(g) + 6H_2O(l)$ at 25°C in kJ is

(a) –7.43 (b) +3.72
(c) –3.72 (d) +7.43.

AMU – 2008

Ans. (a) : We know that, $\Delta H = \Delta E + \Delta n_g RT$.

$\therefore \Delta H - \Delta E = \Delta n_g RT$

For the reaction –

$2C_6H_6(l) + 15O_2(g) \rightarrow 12CO_2(g) + 6H_2O(l)$

$\therefore \Delta n_g$ = no. of gaseous moles of product – no. of gaseous moles of reactant .

= 12 – 15 = – 3.

$\therefore \Delta H - \Delta E = \Delta n_g RT$

$= -3 \times 8.314 \times (273 + 25)$

= – 7432.12 J = –7.432 kJ

543. The enthalpy change when 2.63 g of phosphours reacts with an excess of bromine according to the equation :

$2P(s) + 3Br_2(l) \rightarrow 2PBr_3(g)$; $\Delta_r H^o = -243$ kJ mol^{-1} will be

(Molar mass of phosphorus = 30.97 mol^{-1})

(a) 103 kJ (b) 10.3 kJ
(c) 20.6 kJ (d) 24.3 kJ

AMU – 2007

Ans. (c) **:**

$2P(s)+3Br_2(l) \rightarrow 2PBr_3(g)$, $\Delta_r H^o = -243$ kJ mol^{-1}

Therefore, 30.97 g (1 mol) of P when reacted liberates 243 kJ of energy.

1 g of P when reacted will librates = 7.846 kJ

2.6 g of P when reacted will librates = 7.846×2.63

=20.64 kJ

Since, the enthalpy change will be20.64 kJ.

544. The free energy change at 300 K for

$2CuO(s) \rightarrow Cu_2O(s) + \frac{1}{2}O_2(g)$ will be [Given that $\Delta H = 145.6$ kJ mol^{-1}, $\Delta S = 0.116$ kJ K^{-1} mol^{-1}]

(a) 11.08 kJ mol^{-1} (b) 11.88 kJ mol^{-1}
(c) 110.8 kJ mol^{-1} (d) 118.8 kJ mol^{-1}

AMU–2006

Ans. (c) : Given that, ΔH=145.6 kJ mol^{-1}

$\Delta S = 0.116$ kJ K^{-1} mol^{-1}

$\because \Delta G = \Delta H - T\Delta S$

$= (145.6 - 300 \times 0.116)$ kJ mol^{-1}

= 110.8 kJ mol^{-1}

545. Enthalpy of neutralization of all strong acids and bases has same value, because

(a) Neutralization leads to the formation of a salt and water
(b) Strong acids and bases are ionic substances
(c) Acids always give H^+ ions and bases give OH^- ions
(d) The net chemical change involves the combination of H^+ and OH^- ions to form water

Assam CEE-2014

Ans. (a) : $HCl + NaOH \rightarrow NaCl + H_2O$

ΔH neutralization = –13.7 k cal = – 57.2 kJ

Because when strong acids reacts with a strong base , then there is a formation of salt and H_2O and hence, enthalpy of neutralization is same.

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546. **In which of the following neutralization reactions, the heat of neutralization is highest?**

(a) NH_4OH and H_2SO_4
(b) CH_3COOH and KOH
(c) HCl and NaOH
(d) CH_3COOH and NH_4OH

Assam CEE-2014
SRMJEEE-2008

Ans. (c) : Heat of neutralizations maximum (i.e. approximately 13.7 kcal/mole) for the neutralization of a strong acid and strong base if one of them is weak, then heat of neutralization also decreases (due to being consumed in ionization of weak electrolyte. Hence, Heat of neutralization of HCl and NaOH will be the highest.

547. **The heat of neutralisation of any strong acid and a strong base is nearly equal to :**

(a) – 75.3 kJ (b) + 57.3 kJ
(c) –57.3 kJ (d) + 75.3 kJ

BCECE-2005

Ans. (c) : Enthalpy of neutralization is defined as the enthalpy change when 1 mole of acid/base is completely neutralized by base/ acid in dilute solution.

For strong acid and strong base neutralization net chemical change is

$H^+(aq) + OH^-(aq) \rightarrow H_2O(l)$

$\Delta_r H^o = -57.3 kJ / mol$

548. **Given,**

$$C(diamond) + O_2 \longrightarrow CO_2 ; \Delta H = -395 kJ$$

$$C(graphite) + O_2 \longrightarrow CO_2 ; \Delta H = -393 kJ$$

The heat of formation of diamond from graphite is–

(a) + 2.0 kJ (b) –1.5 kJ
(c) – 788 kJ (d) 788 kJ

BCECE-2011

Ans. (a) : $C_{(Diamond)} + O_2 \rightarrow CO_2$, $\Delta H = -395$ kJ (i)

$C_{(Graphite)} + O_2 \rightarrow CO_2$, $\Delta H = -393$ kJ (ii)

Heat of formation of Diamond from graphite

$C_{(graphite)} \rightarrow C_{(Diamond)}$

equation (ii) – equation (i)

$\Delta H = -393 - (-395)$ kJ = + 2kJ

549. **The enthalpies of combustion of carbon and carbon monoxide are –393.5 and –283 kJ mol^{-1} respectively. The enthalpy of formation of carbon monoxide per mole is**

(a) 110.5 kJ (b) 676.5 kJ
(c) –675.5 kJ (d) –110.5 kJ

BCECE-2010

Ans. (d) : $C + O_2 \rightarrow CO_2$, ……(i)

$\Delta H = -393.5$ kJ mol^{-1}

$CO + \frac{1}{2}O_2 \rightarrow CO_2$……(ii)

$\Delta H = -283.0$ kJ mol^{-1}

Subtract equation (ii) from equation (i)

$$C + \frac{1}{2}O_2 \rightarrow CO$$

$\Delta H = -395.5 - (-283) = -110.5$ kJ

550. **Change in enthalpy for the reaction,**

$$2H_2O_2(l) \longrightarrow 2H_2O(l) + O_2(g)$$

if heat of formation of H_2O_2 (*l*) and H_2O(*l*) are –188 and –286 kJ/mol respectively is

(a) –196 kJ/mol (b) + 196 kJ/mol
(c) + 948 kJ/mol (d) – 948 kJ/mol

BCECE-2012

Ans. (a) : $2H_2O(1) \rightarrow 2H_2O(l) + O_2(g)$

$\Delta H = 2\,\Delta H_{H_2O} - 2\,\Delta H_{H_2O_2} + \Delta H_{O_2}$

$\Delta H = (2\times-286) - (2\times-188) + 0$

$\Delta H = -196$ kJ/mol.

551. **ΔU° of combustion of methane is –X k J mol^{-1}. The value of ΔH° is**

(a) $= \Delta U^\circ$ (b) $> \Delta U^\circ$
(c) $< \Delta U^\circ$ (d) $= 0$

BCECE-2012

Ans. (c) : $CH_4(g) + 2O_2(g) \rightarrow CO_2(g) + 2H_2O(l)$

$\Delta n_g = (n_p - n_r) = 1 - 3 = -2$ $\because \Delta n_g < 0$

$\Delta H^o = \Delta U^o + \Delta n_g RT$

$= -X - 2RT$ $\Delta H < \Delta E$

$\boxed{\Delta H^o < \Delta U^o}$

552. **From the following reactions at 298K,**

$$(A)\ CaC_2(s) + 2H_2O(l) \rightarrow Ca(OH)_2(s) + C_2H_2(g) DH^0 (kJmol^{-1}) - 127.9$$

$$(B)\ Ca(s) + \frac{1}{2}O_2(g) \rightarrow CaO(s) - 635.1$$

$$(C)\ CaO(s) + H_2O(l) \rightarrow Ca(OH)_2 - 65.2$$

$$(D)\ C(s) + O_2(s) \rightarrow CO_2(s) - 393.5$$

$$(E)\ C_2H_2(g) + \frac{5}{2}O_2(g) \rightarrow 2CO_2(g) + H_2O(e) - 1299.58$$

Calculate the heat of formation of CaC_2(s) at 298 K.

(a) –59.82 KJ mol^{-1} (b) +59.82 KJ mol^{-1}
(c) –190.22 KJ mol^{-1} (d) +22 KJ mol^{-1}

BCECE-2013

Ans. (a): (A) $CaC_2 + 2H_2O(l) \rightarrow Ca(OH)_2(s) + C_2H_2(g) = -127.9$

(B) $Ca(s) + \frac{1}{2}O_2(g) \rightarrow CaO(s) = -635.1$

(C) $CaO(s) + H_2O(l) \rightarrow Ca(OH)_2 = -65.2$

(D) $C(s) + O_2(s) \rightarrow CO_2(s) = -393.5$

(E) $C_2H_2(g) + O_2(g) \rightarrow 2CO_2(g) + H_2O = -1299.5$

Multiplying in statement (D) by 2,

Adding the equation (B) (C) (D) and Substracting from A and E

$= -635.1 + (-65.2) + (2\times-393.5) - (-1299.58 - 127.9)$

$= -635.1 - 65.2 - 787 + (1299.58 + 127)$

$= -1487.3 + 1427.48$

$= -59.82$ kJ/mole.

553. **ΔG° and ΔH° for a reaction at 300 K is –66.9 kJ mol^{-1} and –41.8 kJ mol^{-1} respectively. ΔG° for the same reaction at 330 K is–**

@apna_pdf

(a) -25.1 kJ mol^{-1} (b) $+25$ kJ mol^{-1}
(c) 18.7 kJ mol^{-1} (d) -69.4 kJ mol^{-1}

BCECE-2013

Ans. (d) : ΔH^o and ΔS^o remain constant in the given temperature range,

$$\therefore \Delta S^o = -\frac{\Delta G^o - \Delta H^o}{T}$$

$$= -\left(\frac{-66.9+41.8}{300}\right)$$

$= 0.08367$ kJK^{-1} mol^{-1}

$\therefore \Delta G^o = \Delta H^o - T\Delta S^o$

$= -41.8 - 330 \times 0.08367$

$= -69.4$ kJ mol^{-1}

554. At 1000K, from the data

$$\mathbf{N_2(g) + 3H_2(g) \longrightarrow 2NH_3(g).}$$

$$\mathbf{\Delta H = -123.77 kJmol^{-1}}$$

Substance	N_2	H_2	NH_3
P/R	3.5	3.5	4

Calculate the heat of formation of NH_3 at 300 K.

(a) -44.42 kJ mol^{-1} (b) -88.85 kJ mol^{-1}
(c) $+44.42$ kJ mol^{-1} (d) $+88.85$ kJ mol^{-1}

BCECE-2013

Ans. (a) : From Kirchhoff's equation

$\Delta H_{2\,(1000K)} = \Delta H_{1\,(300K)} + \Delta C_p\,(1000-300)$

Here, $\Delta H_{2\,(1000K)} = -123.77$ kJ Mol^{-1}

$\Delta Cp = 2Cp_{(NH_3)} - [Cp_{(N_2)} + 3Cp_{(H_2)}]$

$\Delta Cp = 2\times4R - [3.5R + 3\times3.5R]$

$\Delta Cp = 8R - 14R$

$\Delta Cp = -6R$

$\Delta Cp = -6 \times 8.314 \times 10^{-3}$kJ

$\therefore -123.77 = \Delta H_{1\,(300K)} - 6 \times 8.314 \times 10^{-3} \times 700$

or $\Delta H_{1\,(300K)} = -88.85$KJ

For two moles of NH_3

$$\therefore H_{f(NH_3)} = \frac{\Delta H_{1(300K)}}{2}$$

$$= -\frac{88.85}{2}$$

$= -44.42$ kJ mol^{-1}

555. The enthalpy changes for the following processes are listed below–

$$\mathbf{Cl_2(g) \longrightarrow 2Cl(g), 242.3 kJmol^{-1}}$$

$$\mathbf{I_2(g) \longrightarrow 2I(g), 151.0 kJmol^{-1}}$$

$$\mathbf{ICl \longrightarrow I(g) + Cl(g), 211.3 kJmol^{-1}}$$

$$\mathbf{I_2(s) \longrightarrow I_2(g), 62.76 kJmol^{-1}}$$

Given that the standard states for iodine and chlorine are $I_2(s)$ and $Cl_2(g)$, the standard enthalpy for the formation of ICl(g) is–

(a) -14.6 kJ mol^{-1} (b) -16.8 kJ mol^{-1}
(c) $+16.8$ kJ mol^{-1} (d) $+244.8$ kJ mol^{-1}

BCECE-2014

Ans. (c) : $\frac{1}{2}I_2 + \frac{1}{2}Cl_2(g) \rightarrow ICl(g)$

$$\Delta H_{ICl} = \left[\frac{1}{2}\Delta H_{I_2(S)\rightarrow I_2(g)} + \frac{1}{2}\Delta H_{I-I} + \frac{1}{2}\Delta H_{Cl-Cl}\right] - [\Delta H_{I-Cl}]$$

$$= \left[\frac{1}{2}\times62.76 + \frac{1}{2}\times151.0 + \frac{1}{2}\times242.3\right] - [211.3]$$

$= 16.83$ kJ/mol.

556. Given the following bond dissociation enthalpies (kJ mol^{-1}).

$$\mathbf{P \equiv P - 490, P - P - 209, N \equiv N - 946, N - N - 160}$$

Compare the enthalpy changes for the process

i. $2P_2(g) \longrightarrow P_4(g)$

ii. $2N_2(g) \longrightarrow N_4(g)$

(a) P_4 is feasible but N_4 is not feasible
(b) P_4 is not feasible but N_4 is feasible
(c) Both P_4 and N_4 are feasible
(d) Both P_4 and N_4 are not feasible

BCECE-2015

Ans. (a) : The process involves replacement of 2(x≡x) units by 6(x–x) bonds in the X_4 tetrahedron. Energy is released when bonds are formed and thus species formed is stable.

(i) $2P_2\,(g) \rightarrow P_4(g)$

$\Delta H = -6\times BE_{(P-P)} + 2\times BE_{(P\equiv P)}$

$= -6\times209 + 2\times490 = -274$ kJ/mol feasible,

(ii) $2N_2(g) \rightarrow N_4(g)$

$\Delta H_t = 6BE_{(N-N)} + 2BE_{(N\equiv N)}$

$= -6\times160 + 2\times946$

$= +932$ kJ mol^{-1}

Formation of N_4 is endothermic, thus is not feasible.

557. What is the enthalpy of the disproportionation of MgCl is –125 kJ/mol and the $MgCl_2$ is –642kJ/mol?

(a) -767 kJ/mol (b) 767 kJ/mol
(c) -392 kJ/mol (d) 392 kJ/mol

BCECE-2015

Ans. (c) : $Mg(s) + Cl_2(g) \rightarrow MgCl_2(s)$

$\Delta H_1 = -642$ kJ mol^{-1}

$Mg(s) + \frac{1}{2}Cl_2(g) \rightarrow MgCl(s)$

$\Delta H_2 = -125$ kJ mol^{-1}

$2MgCl \rightarrow MgCl_2 + Mg$

$\Rightarrow \Delta H = \Delta H_1 - 2\Delta H_2$

$= -642 + 2\times125$

$= -392$ kJ mol^{-1}

558. Consider the following reactions,

$$\mathbf{C(s) + O_2(g) \longrightarrow CO_2(g), \Delta H = -94kcal}$$

$$\mathbf{2CO(g) + O_2 \longrightarrow 2CO_2(g), \Delta H = -135.2kcal}$$

Then, the heat of formation of CO(g) is–

(a) 26.4 kcal (b) –26.4 kcal
(c) 41.2 kcal (d) –41.2 kcal

BCECE-2015

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Ans. (b) :
$C(s) + O_2(g) \longrightarrow CO_2(g). \Delta H = -94\,kcal$ .....(1)

$CO_2(g)+O_2(g) \rightarrow CO+\frac{1}{2}O_2(g)$

$\Delta H_3 = \frac{135.2}{2} = 67.6$ kcal .....(3)

∵ The required equation,

$C(s)+\frac{1}{2}O_2=CO(g),\ \Delta H_4=?$

Adding equation (1) and (3) use get–

$C(s) + \frac{1}{2}O_2 \rightarrow CO(g)$

$\Delta H = -94 + 67.6 = -26.4$ kcal.

559. In the reaction
$CO_2(g) + H_2(g) \rightarrow CO(g) + H_2O(g)$
ΔH = 40 kJ; ΔH represents :
(a) Heat of formation
(b) Heat of combustion
(c) Heat of neutralisation
(d) Heat of reaction

BITSAT 2005

Ans. (d) : Heat of reaction, the amount of heat that must be added or removed during a chemical reaction in order to keep all of the substances present at the same temperature. The difference between enthalpy of substances present at the end of the reaction and the enthalpy of the substances present at the start of reaction. Thus, the heat of reaction determined at constant pressure is also designated the enthalpy of reaction, represented by the symbol ΔH.

560. At 25^0C and 1 bar which of the following has a non-zero ΔH_f^0 ?
(a) $Br_2(\ell)$
(b) C (graphite)
(c) $O_3(g)$
(d) $I_2(s)$

BITSAT 2009

Ans. (c) : Ozone is allotropic form of oxygen and is of higher energy (by 68 K Cal mol^{-1}) than O_2.
Hence it can not be taken as the reference in standard state.

561. If the enthalpy of vaporization of water is 186.5 kJmol^{-1}, the entropy if its vaporization will be :
(a) 0.5 kJ K^{-1} mol^{-1}
(b) 1.0 kJ K^{-1} mol^{-1}
(c) 1.5 kJ K^{-1} mol^{-1}
(d) 2.0 kJ K^{-1} mol^{-1}

BITSAT 2014

Ans. (a) : Given enthalpy of vaporization,
$\Delta H = 186.5\,kJ\,mol^{-1}$
Boiling point of water
$= 100^0C = 100 + 273 = 373\,K$
Entropy change,
$$\Delta S = \frac{\Delta H}{T} = \frac{186.5\,kJ\,mol^{-1}}{373\,K}$$
$\Delta S = 0.5$ kJ mol^{-1} K^{-1}

562. The heats of neutralisation of CH_3COOH, HCOOH, HCN and H_2S are – 13.2, –13.4, –2.9 and –3.8 k cal per equivalent respectively. Arrange the acids in increasing order of acidic strength.
(a) $HCOOH > CH_3COOH > H_2S > HCN$
(b) $CH_3COOH > HCOOH > H_2S > HCN$
(c) $H_2S > HCOOH > CH_3COOH > HCN$
(d) $HCOOH > H_2S > CH_3COOH > HCN$

BITSAT 2014

Ans. (a) : The greater the (negative value) of heat of neutralization, the more is the strength of the acid. Hence,
$HCOOH > CH_3COOH > H_2S > HCN$

563. For the dissociation reaction,
$H_2(g) \rightarrow 2H(g)$, ΔH = 162 Kcal,
heat of atomization of H is
(a) 81 Kcal
(b) 162 Kcal
(c) 208 Kcal
(d) 218 Kcal

BITSAT 2013

Ans. (a) : $\Delta H = \Delta H_{(product)} - \Delta H_{(reactant)}$
$162 = 2 \times \Delta H_H - \Delta H_{H_2}$
$\Delta H_H = \frac{162}{2} \qquad (\because \Delta H_{H_2} = 0)$
$\Delta H_H = 81\,Kcal$

564. The enthalpy of combustion of 2 moles of benzene at 27^0C differs from the value determined in bomb calorimeter by
(a) –2.494 kJ
(b) 2.494 kJ
(c) –7.483 kJ
(d) 7.483 kJ

BITSAT 2013

Ans. (c) : By bomb calorimeter, we get ΔE–
$2C_6H_6(1) + 15O_2(g) \rightarrow 12CO_2(g) + 6H_2O(l)$
$\Delta H - \Delta E = \Delta n_g RT$
Δn_g = 12+6–(15+2)=1
= (12 – 15) × 8.314 × 300 = –7.483 kJ

565. In which of the following reactions, standard entropy change (ΔS^0) is positive and standard Gibb's energy change (ΔG^0) decreases sharply with increasing temperature?
(a) $C(graphite) + \frac{1}{2}O_2(g) \rightarrow CO(g)$
(b) $CO(g) + \frac{1}{2}O_2(g) \rightarrow CO_2(g)$
(c) $Mg(s) + \frac{1}{2}O_2(g) \rightarrow MgO(s)$
(d) $\frac{1}{2}C(graphite) + \frac{1}{2}O_2(g) \rightarrow \frac{1}{2}CO_2(g)$

BITSAT 2012

Ans. (a) : Since, in the first reaction gaseous products are forming from solid carbon hence entropy will increase i.e. ΔS^0 = +ve.

@apna_pdf

$C(gr.) + \frac{1}{2}O_2(g) \rightarrow CO(g); \Delta S^0 = +ve$

Since, $\Delta G^0 = \Delta H^0 - T\Delta S^0$

Hence, the value of ΔG^0 decrease on increasing temperature.

566. Bond enthalpies of H_2, X_2 and HX are in the ratio 2 : 1 : 2. If enthalpy of formation of HX is – 50 kJ mol^{-1}, the bond enthalpy of X_2 is

(a) 100 kJ mol^{-1} (b) 300 kJ mol^{-1}

(c) 200 kJ mol^{-1} (d) 400 kJ mol^{-1}

BITSAT 2012

Ans. (a) : $\frac{1}{2}H_2 + \frac{1}{2}X_2 \rightarrow HX$

Let the bond enthalpy of X – X bond be x.

$\Delta H_{f(HX)} = -50$

$-50 = \frac{1}{2}\Delta H_{H-H} + \frac{1}{2}\Delta H_{X-X} - \Delta H_{H-X}$

$-50 = \frac{1}{2} \times 2x + \frac{1}{2} \times x - 2x = \frac{-x}{2}$

$\therefore x = 50 \times 2 = 100\,kJ\,mol^{-1}$

So, Bond enthalpy of X_2 is 100 kJ mol^{-1}

567. Given

Reaction	**Energy Change (in kJ)**
$Li(s) \rightarrow Li(g)$	**161**
$Li(g) \rightarrow Li^+(g)$	**520**
$\frac{1}{2}F_2(g) \rightarrow F(g)$	**77**
$F(g) + e^- \rightarrow F^-(g)$	**(Electron gain enthalpy)**
$Li^+(g) + F^-(g) \rightarrow LiF(s)$	**–1047**
$Li(s) + \frac{1}{2}F_2(g) \rightarrow LiF(s)$	**–617**

Based on data provided, the value of electron gain enthalpy of fluorine would be :

(a) –300 kJ mol^{-1} (b) –350 kJ mol^{-1}

(c) –328 kJ mol^{-1} (d) –228 kJ mol^{-1}

BITSAT 2016

Ans. (c) : Applying Hess's Law

$\Delta_f H^0 = \Delta_{sub}H + \frac{1}{2}\Delta_{diss}H + I.E. + E.A + \Delta_{lattice}H$

–617 = 161 + 520 + 77 + E.A. + (–1047)

E.A. = –617 + 289 = –328 kJ mol^{-1}

$\therefore$ Electron affinity of fluorine = – 328 kJ mol^{-1}

568. For vaporization of water at 1 atmospheric pressure, the values of ΔH and ΔS are 40.63 $kJmol^{-1}$ and 108.8 JK^{-1} mol^{-1}, respectively. The temperature when Gibbs energy change (ΔG) for this transformation will be zero, is :

(a) 293.4K (b) 273.4K

(c) 393.4K (d) 373.4K

BITSAT 2018

Ans. (d) : Given that,

$\Delta H = 40630\,J\,mol^{-1}$

$\Delta S = 108.8\,JK^{-1}mol^{-1}$

$\Delta G = \Delta H - T\Delta S$

When $\Delta G = 0$,

$0 = \Delta H - T\Delta S$

$T = \frac{\Delta H}{\Delta S} = \frac{40630\,J\,mol^{-1}}{108.8\,J\,k^{-1}\,mol^{-1}} = 373.4K$

569. To which of the following determination of heat, Hess's law is used?

(a) Heat of chemical reaction

(b) Heat of formation

(c) Heat of bond formation

(d) All of the above

CG PET -2008

Ans. (d) : Hess's Law - Hess's law of heat summation states that for a chemical equation that can be written as the sum of two or more steps, the enthalpy change for the overall equation is the sum of enthalpy changes for the individual steps.

570. Energy of activation of an endothermic reaction is

(a) negative (b) positive

(c) Zero (d) Cannot be predicted

CG PET- 2011

Ans. (b) : In endothermic reactions, the reactants are present at comparatively lower energy than the products, which means the products formed in the reaction are less stable than the reactants. Since, the reaction moves towards a more stable molecule, towards a less stable molecule, the overall enthalpy change of the reaction is positive.

571. Which of the following relationships is correct?

(a) $k = \frac{T\Delta S^o - \Delta H^o}{RT}$ (b) $k = \frac{\Delta H^o - T\Delta S^o}{RT}$

(c) $\ln k = \frac{T\Delta S^o - \Delta H^o}{RT}$ (d) $\ln k = \frac{\Delta H^o - T\Delta H^o}{RT}$

CG PET- 2011

Ans. (c) : $\Delta G° = -nRT\,lnk$

$\Delta H° - T\Delta S° = -nRT\,lnk$

$lnk = \frac{-(\Delta H° - T\Delta S°)}{RT}$

$lnk = \frac{T\Delta S° - \Delta H°}{RT}$

572. $C_2H_2 + \frac{5}{2}O_2 \rightarrow 2CO_2 + H_2O;\ \Delta H = -310kcal$

$C + O_2 \rightarrow O_2;\ \Delta H = -94kcal$

$H_2 + \frac{1}{2}O_2 \rightarrow H_2O;\ \Delta H = -68kcal$

On the basis of the above equations, ΔH_f (enthalpy of formation) of C_2H_2 will be

(a) –148 kcal (b) +54 kcal

(c) –54 kcal (d) –80 kcal

CG PET -2009

Ans. (b) : Given,

$C_2H_2 + \frac{5}{2}O_2 \rightarrow 2CO_2 + H_2O,\ \Delta H = -310\ kcal$.....(i)

$C + O_2 \rightarrow CO_2,\ \Delta H = -94\ kcal$............(ii)

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$H_2 + \frac{1}{2}O_2 \rightarrow H_2O, \ \ \Delta H = -68$ kcal....(iii)

Enthalpy of formation of C_2H_2 will be....

$2C + H_2 \rightarrow C_2H_2$

Reverse equation (i) + equation (ii) × 2 + equation (iii)

$= -(-310) + (-94\times2)+(-68)$

$= 310 - 188 - 68$

$= +54$ kcal

573. Heat of neutralization of HCl and NaOH is

(a) −13.7 kcal (b) −13.7 J

(c) −13.7 kJ (d) None of these

CG PET- 2012

Ans. (a) : $NaOH + HCl \text{——} NaCl + H_2O$

$\Delta H = -57.1$ kJ/ mol.

As we know that heat of neutralization of a strong acid by a strong base is heat of formation of water.

Therefore, $H^+ + OH^- \rightarrow H_2O$

We know that, 1 calorie = 4.184 joule

$$= \frac{-57.1}{4.184} = -13.7\,\text{kcal}.$$

574. For the equilibrium reaction,

$$2SO_2(g) + O_2(g) \rightleftharpoons 2SO_3(g) + \Delta H$$

the increase in temperature

(a) favours the formation of SO_3

(b) favours the decomposition of SO_3

(c) does not affect the equilibrium

(d) stops the reaction

CG PET- 2012

Ans. (b) :

$2SO_2(g)+O_2(g)\rightarrow 2SO_3(g)+\Delta H$

If we increase the temperature the equilibrium reaction will shift in backword direction which mean's decomposition of SO_3 favours.

575. When 1 M H_2SO_4 is completely neutralized by NaOH, the heat liberated is 114.64 kJ. What is the enthalpy of neutralization?

(a) +114.64kJ (b) −114.64kJ

(c) −57.32kJ (d) +57.32

CG PET- 2013

Ans. (c) : Enthalpy of neutralisation: It is the change in enthalpy that occurs, when one equivalent of an acid and a base undergo a neutralisation to form H_2O and salt.

$$\underset{\text{(Sulphuric acid)}}{H_2SO_4} + \underset{\text{(Sodium hydroxide)}}{2NaOH} \longrightarrow Na_2SO_4 + 2H_2O$$

ΔH= −114.64 kJ (ΔH is (–ve) because heat is liberated)

$$\underset{\text{(2 mole)}}{2H_2O} \longrightarrow -114.64\text{ kJ}$$

$$\underset{\text{(1 mole)}}{1\,H_2O} \longrightarrow \frac{-114.64}{2}\text{ kJ}$$

= −57.32 kJ

So, enthalpy of neutralization is −57.32 kJ.

576. What is the role of a catalyst in a catalysed reaction?

(a) Lowers the activation energy

(b) Increases the activation energy

(c) Affects the free energy change

(d) Affects the enthalpy change

CG PET -2005

Ans. (a) : It is a substance which increases the rate of reaction without it self undergo any change is called catalyst.

Basically the role of catalyst in a reaction is to "lower the activation energy."

577. Consider the following reaction :

$CaO(s) + CO_2(g) \rightarrow CaCO_3(s)$

The reaction is spontaneous at low temperature because

(a) ΔH is negative ΔS is positive
ΔG is negative

(b) ΔH is negative ΔS is negative
ΔG is negative

(c) ΔH is positive ΔS is negative
ΔG is positive

(d) ΔH is positive ΔS is positive
ΔG is negative

CG PET -2018

Ans. (d) : $\Delta G = \Delta H - T\Delta S$

For spontaneous $\Delta G < 0$

and this is possible when

$\Delta H = +ve$

$\Delta S = +ve$

$\Delta G = -ve$

At low temperature

578. The heat of neutralisation of hydrogen cyanide (HCN) is −2.9 kcal mol^{-1}. This shows that heat of dissociation of HCN is

(a) + 13.7 kcal mol^{-1} (b) + 10.8 kcal mol^{-1}

(c) − 13.7 kcal mol^{-1} (d) − 13.7 kcal mol^{-1}

CG PET -2018

Ans. (b) : When a strong acid will react with a strong base, nearly 13.7 kcal mol^{-1} heat comes out from the reaction.

But when a weak acid (like HCN) go for neutralization, some heat is used up to dissociate the HCN molecules.

∵ Given, only 2.9 kcal/mol heat is coming out, means.

13.7–2.9 = + 10.8 kcal / mole heat is used up to dissociates the HCN molecules.

579. The standard enthalpy of vapourisation $\Delta_{vap}H^o$, for water at 100ºC is 40.66 kJ mol^{-1} The internal energy of vapourisation of water at 100ºC (in kJ mol^{-1}) is (assume water vapour to behave like an ideal gas)

(a) +43.76 (b) +40.66

(c) +37.56 (d) None of these

CG PET -2017

Ans. (c) : Given $H_2O(l) \rightarrow H_2O(g)$, $\Delta H = 40.6$ kJ/mol

$= 40660$ J/ mol

$R = 8.314$ J/ mol.K

∵ $\Delta H(g) = \Delta E + \Delta n_g RT$

Where Δn = number of moles of gaseous species

@apna_pdf

Here $\Delta n = 1$

$\therefore \quad \Delta E = \Delta H(g) - \Delta n_g RT$

$= 40660 - 1 \times 8.314 \times 373$

$= 40660 - 3101.22$

$= 37558.75 \, J/mol = 37.56 \, kJ/mol$

580. In which of the following $\Delta E = \Delta H$?

(a) $N_2O_4(g) \rightleftharpoons 2NO_2(g)$

(b) $2SO_2(g) + O_2(g) \rightleftharpoons 2SO_3(g)$

(c) $H_2(g) + I_2(g) \rightleftharpoons 2HI(g)$

(d) $H_2(g) + \frac{1}{2}O_2(g) \rightleftharpoons H_2O(I)$

CG PET- 2015

Ans. (c) : $\Delta H = \Delta E + \Delta n_g RT$

$2HI(g) \rightarrow H_2(g) + I_2(g)$

$\Delta n_g = 2 - 2 = 0$

$\Delta H = \Delta E + 0 \times RT$

$\Delta H = \Delta E$

581. What is the free energy change ΔG when 10 moles of water at 100ºC and 1 atm pressure is converted into steam at 100ºC and 1 atm pressure?

(a) 540 cal
(b) –9800 cal
(c) 9800 cal
(d) 0 cal

CG PET- 2015

Ans. (d) : $H_2O(l) \rightarrow H_2O(g)$

1atm, 100°C 1atm, 100°C

$\Delta G = VdP - SdT \quad (\because SdT = 0)$

$\Delta G = VdP = \frac{nRT}{P}dP = nRT \ln\frac{P_2}{P_1} \quad (\because PV = nRT)$

$\Delta G = nRT \ln\left(\frac{1}{1}\right) = nRT \times 0 = 0$

$\boxed{\Delta G = Zero}$

582. Based on the following thermochemical equation

$\mathbf{H_2O(g) + C(s) \rightarrow CO(g) + H_2(g); \Delta H = 131kJ}$

$\mathbf{CO(g) + \frac{1}{2}O_2(g) \rightarrow CO_2(g); \Delta H = -282kJ}$

$\mathbf{H_2(g) + \frac{1}{2}O_2(g) \rightarrow H_2O(g); \Delta H = -242kJ}$

$\mathbf{C(s) + O_2(g) \rightarrow CO_2(g); \Delta H = XkJ}$

the value of X will be

(a) –393kJ
(b) –655kJ
(c) +393kJ
(d) +655kJ

CG PET- 2010

Ans. (a) :

$C(s) + O_2(g) \rightarrow CO_2(g)$

$\Delta H = xkJ$

$H_2O(g) + C(s) \rightarrow CO(g) + H_2(g)$

$\Delta H = 131 \; kJ$ .....(i)

$CO(g) + \frac{1}{2}O_2(g) \rightarrow CO_2(g)$

$\Delta H = -282 \; kJ$ ....(ii)

$H_2(g) + \frac{1}{2}O_2(g) \rightarrow H_2O(g)$

$\Delta H = -242 \; kJ$ . ...(iii)

$C(s) + O_2(g) \rightarrow CO_2(g)$

By adding equation (i), (ii), (iii), we get–

$\Delta H = 131 + (-282) + (-242)$

$= -393$ kJ

583. The standard enthalpy of formation (ΔH_f°) at 298 K for methane, CH_4 (g) is –74.8 kJ mol^{-1}. The addition information required to determine the average energy for C–H bond formation would be

(a) The dissociation energy of H_2 and enthalpy of sublimation of carbon
(b) Latent heat of vaporisation of methane
(c) The first four ionisation energies of carbon and electron gain enthalpy of hydrogen
(d) The dissociation energy of hydrogen molecule, H_2

AIEEE-2006

Ans. (a) : The standard enthalpy of formation (ΔH_f^0) of a compound is defined as the enthalpy change for the reaction that forms 1 mole of compound from its elements, with all substances in their standard states.

Carbon is found in solid state. The state of any substance affects the enthalpy change.

$C(s) \rightarrow C(g)$ sublimation

$H_2(g) \rightarrow 2H(g)$ dissociation are required for C–H bond.

584. Consider the reaction,

$N_2 + 3H_2 \longrightarrow 2NH_3$ carried out at constant temperature and pressure. If ΔH and ΔE are the enthalpy and internal energy changes for the reaction, which of the following expressions is true?

(a) $\Delta H > \Delta E$
(b) $\Delta H < \Delta E$
(c) $\Delta H = \Delta E$
(d) $\Delta H = 0$

AIEEE-2005

Ans. (b) : $N_2(g) + 3H_2(g) \rightarrow 2NH_3$

It is exothermic reaction

$\Delta n_g = 2 - 3 - 1 = -2$

$\therefore \Delta H = \Delta E + \Delta n_g RT$

$\Delta H = \Delta E + (-2) RT$

$\Delta H = \Delta E - 2 RT$

$\Delta H < \Delta E$

585. If the bond dissociation energies of XY, X_2 and Y_2 (all diatomic molecules) are in the ratio of 1:1:0.5 and ΔH_f for the formation of XY is –200 kJ mol^{-1}. The bond dissociation energy of X_2 will be

(a) 400 kJ mol^{-1}
(b) 300 kJ mol^{-1}
(c) 200 kJ mol^{-1}
(d) None of these

AIEEE-2005

Ans. (d) : Formation of XY is shown as

$X_2 + Y_2 \rightarrow 2XY$

$\Delta H = [(BE)_{X-X} + (BE)_{Y-Y}] - [\, 2\,(BE)_{X-Y}]$

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If (BE) Of X–Y = a kJ/mol

Then, (BE) of (X–X) = a

Since, (BE) of (Y –Y) = $\frac{a}{2}$ $\left[\because \frac{1}{2}X_2 + \frac{1}{2}Y_2 \rightarrow XY\right]$

ΔH_f (X–Y) = – 200 kJ

–400 (for 2 mol XY) = $\left(a + \frac{a}{2} - 2a\right) = \frac{-a}{2}$

a = 800 kJ

The bond dissociation energy of X_2 = 800 kJ

586. The enthalpies of combustion of carbon and carbon monoxide are –393.5 and –283 kJ mol^{-1} respectively. The enthalpy of formation of carbon monoxide per mole is

(a) 110.5 kJ (b) 676.5 kJ
(c) –676.5 kJ (d) –110.5 kJ

AIEEE-2004

Ans. (d) : Enthalpy of formation (ΔH_f^0) -

Enthalpy changes also occur when a compound is formed from elements.

$C + O_2 \rightarrow CO_2,\ \Delta H = -393.5$ kJ ....(i)

$CO + \frac{1}{2}O_2 \rightarrow CO_2,\quad \Delta H = -283$ kJ ....(ii)

equation (ii) subtract from equation (i)

$C + \frac{1}{2}O_2 \rightarrow CO,\quad \Delta H = -393.5 - (-283) = -110.5$ kJ

587. On the basis of the following thermochemical data $\left[\Delta_f G^o H^+(aq) = 0\right]$

$$H_2O(l) \rightarrow H^+(aq) + OH^-(aq);$$

ΔH = 57.32 kJ

$$H_2(g) + \frac{1}{2}O_2(g) \rightarrow H_2O(l);$$

ΔH = –286.02 kJ

The value of enthalpy of formation of OH$^-$ ion at 25°C is

(a) –22.88 kJ (b) –228.88 kJ
(c) +228.88 kJ (d) –342.52 kJ

AIEEE-2009

Ans. (b) : Consider the heat of formation of H_2O

$$H_2(g) + \frac{1}{2}O_2(g) \rightarrow H_2O(1);\ \Delta H = -286.02 \text{ kJ}$$

$$\Delta H_r = \Delta H_{f\,(H_2O,l)} - \Delta H_{f\,(H_2,g)} - \frac{1}{2}\Delta H_{f(O_2,g)}$$

$$-286.20 = \Delta H_{f\,(H_2O,l)} - 0 - 0$$

$$\Delta H_{f\,(H_2O,l)} = -286.20$$

Now, $H_2O(l) \rightarrow H^+(aq) + OH^-(aq);\ \Delta H = 57.32$ kJ

$$\Delta H_r = \Delta H_{f\,H^+(aq)} + \Delta H_{f\,OH^-(aq)} - \frac{1}{2}\Delta H_{f(H_2O,l)}$$

$$57.32 = 0 + \Delta H_{f\,OH^-(aq)} - (-286.20)$$

$$\Delta H_{f\,OH^-(aq)} = 57.32 - 286.20 = -228.88 \text{ kJ}$$

588. Oxidising power of chlorine in aqueous solution can be determined by the parameters indicated below

$$\frac{1}{2}Cl_2(g) \xrightarrow{\frac{1}{2}\Delta_{diss}H^\ominus} Cl(g) \xrightarrow{\Delta_{EA}H^\ominus}$$

$$Cl^-(g) \xrightarrow{\Delta_{hyd}H^\ominus} Cl^-(aq)$$

The energy involved in the conversion of $\frac{1}{2}Cl_2(g)$ to $Cl^-(aq)$

(using the data, $\Delta_{diss}H^o_{Cl_2}$ = 240 kJ mol^{-1}

$\Delta_{eg}H^\ominus_{Cl}$ = –349 kJ mol^{-1},

$\Delta_{hyd}H^\ominus_{Cl}$ = –381 kJ mol^{-1}) will be

(a) +152 kJ mol^{-1} (b) –610 kJ mol^{-1}
(c) –850 kJ mol^{-1} (d) +120 kJ mol^{-1}

AIEEE-2008

Ans. (b) : Oxidising power of chlorine in aqueous solution can be estimated by calculating the over all enthalpy change of reaction.

$$\frac{1}{2}Cl_2(g) \rightarrow Cl^{-1}(aq)$$

$$\Delta H = \frac{1}{2}\Delta_{diss}H^-_{Cl_2} + \Delta_{eg}H^-_{Cl} + \Delta_{hyd}H^-_{Cl}$$

= 240/2 + (–349) + (–381) = –610 kJ/mol

589. The heats of combustion of carbon and carbon monoxide are –393.5 and –283.5 kJ mol^{-1}, respectively. The heat of formation (in kJ) of carbon monoxide per mole is

(a) 676.5 (b) −676.5
(c) –110.5 (d) 110.5

JEE Main-2016

Ans. (c) : Enthalpy change's also occur when a compound is formed from element.

$C + O_2 \rightarrow CO_2,\ \Delta H = -393.5.$ ....(i)

$CO + \frac{1}{2}O_2 \rightarrow CO_2,\ \Delta H = -283.5$ ....(ii)

equation (ii) subtract from equation (i) -

$C + \frac{1}{2}O_2 \rightarrow CO \quad \Delta H = -393.5 - (-283.5) = -110$ kJ

590. For the complete combustion of ethanol,

$$C_2H_5OH(l) + 3O_2(g) \rightarrow 2CO_2(g) + 3H_2O(l)$$

the amount of heat produced as measured in bomb calorimeter is 1364.47 kJmol^{-1} at 25°C. Assuming ideality, the enthalpy of combustion, $\Delta_C H$ for the reaction will be

[R = 8.314 JK^{-1}mol^{-1}]

(a) –1366.95 kJmol^{-1} (b) –1361.95 kJmol^{-1}
(c) –1460.50 kJmol^{-1} (d) –1350.50 kJmol^{-1}

[JEE Main 2014]

Ans. (a) : Given, ΔE = 1364.47 kJmol^{-1}

T = 25°C, R = 8.314 JK^{-1} mol^{-1}

$C_2H_5OH(l) + 3O_2(g) \rightarrow 2CO_2 + 3H_2O\ (l)$

$\Delta n_g = -1 \ \because$ complete combustion

$\because\ \Delta H = \Delta E + P\Delta V = \Delta E + \Delta n_g RT$

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$$(\because P\Delta V = \Delta n_g RT)$$

$$\Delta H = -1364.47 + \left((-1)\times\frac{8.314}{1000}\times 298\right)$$

$$\Delta H = -1366.95 \text{ kJ mol}^{-1}$$

591. The combustion of benzene (l) gives CO_2(g) and H_2O(l). Given that heat of combustion of benzene at constant volume is –3263.9 kJ mol^{-1} at 25°C; heat of combustion (in kJ mol^{-1}) of benzene at constant pressure will be (R = 8.314 JK^{-1} mol^{-1})

(a) 4152.6 (b) –452.46

(c) 3260 (d) –3267.6

[JEE Main 2018]

Ans. (d) : Given, Heat of constant volume

(ΔU) = –3263.9 kJ mol^{-1}, T = 25 °C = 273 + 25 = 298 K

R = 8.314 JK^{-1} mol^{-1}

$C_6H_6(g) + O_2(g) \rightarrow CO_2(g) + H_2O(l)$

After balancing the equation,

$$C_6H_6(l) + \frac{15}{2}O_2(g) \rightarrow 6CO_2(g) + 3H_2O(l)$$

$$\because \Delta n_g = 6 - 15/2 = -3/2$$

$$\Delta U = -3263.9 \text{kJ/mol}^{-1}$$

We know that,

$$\Delta H = \Delta U + \Delta n_g RT = -3263.9 + (-1.5)\times\frac{8.314}{1000}\times 298$$

$$\Delta H = -3267.6 \text{ kJ/mol}^{-1}$$

592. Enthalpy of sublimation of iodine is 24 cal g^{-1} at 200°C. If specific heat of I_2 (s) and I_2 (vap.) are 0.055 and 0.031 cal g^{-1} K^{-1} respectively, then enthalpy of sublimation of iodine at 250°C in cal g^{-1} is

(a) 2.85 (b) 5.7

(c) 22.8 (d) 11.4

[JEE Main 2019 April Shift-1]

Ans. (c) : $\Delta H_{r,200°C}$ = 24cal/g at 200°C

$$I_2(s) \rightleftharpoons I_2(g)$$

$$\Delta H_{r,T_2} - \Delta H_{r,T_1} = \Delta C_P (T_2 - T_1)$$

$$\Delta H_{r,250} - \Delta H_{r,200} = \Delta C_P (T_2 - T_1)$$

$$\Delta H_{r,250} - 24 = (0.031 - 0.055)\times(250 - 200)$$

$$\Delta H_{r,250} = 24 - 1.2$$

$$\boxed{\Delta H_2 = 22.8 \text{ cal/g}}$$

593. The standard enthalpies of formation of Al_2O_3 and CaO are – 1675 kJ mol^{-1} and –635 kJ mol^{-1} respectively. For the reaction, $3CaO + 2Al \rightarrow 3Ca + Al_2O_3$ the standard reaction enthalpy Δ_rH^o.................kJ. (Round off to the nearest integer).

[JEE Main 2021, 17 March Shift-I]

Ans. 3 CaO + 2Al → 3Ca+Al_2O_3

$$\Delta H_f^0 = \Delta H_{fP}^0 - \Delta H_{fR}^0$$

$$= \Delta H^0_{f(Al_2O_3)} - 3\times\Delta H^0_{f(CaO)}$$

$$= -1675 - 3\times(-635)$$

= 230 kJ

594. Lattice enthalpy and enthalpy of solution of NaCl are 788 kJ mol^{-1} and 4kJ mol^{-1}, respectively. The hydration enthalpy of NaCl is

(a) –780 kJ mol^{-1} (b) 780 kJ mol^{-1}

(c) –784 kJ mol^{-1} (d) 784 kJ mol^{-1}

[JEE Main 2020, 5 Sep Shift-II]

Ans. (c) : NaCl(s) → NaCl(aq)

$\Delta H_{Sol.} = L.E + \Delta H_{hyd}$

$4 = 788 + \Delta H_{hyd}$

$\Delta H_{hyd} = -788 + 4$

$\Delta H_{hyd} = -784$ kJ/mol

595. The standard heat of formation $\left(\Delta_f H^o_{298}\right)$ of ethane (in kJ/mol), if the heat of combustion of ethane, hydrogen and graphite are –1560, –393.5 and –286 kJ/mol, respectively is ....

[JEE Main 2020, 7 Jan Shift-II]

Ans. $C_2H_6(g) + \frac{7}{2}O_2(g) \rightarrow 2CO_2 + 3H_2O$

ΔH = – 1560 kJ/mol....................(i)

$H_2(g) + \frac{1}{2}O_2(g) \rightarrow H_2O(g)$ ....(ii)

ΔH = – 393.5 kJ/mole

$C(s) + O_2(g) \rightarrow CO_2(g)$...................(iii)

ΔH = – 286 kJ/mole

$2C(s) + 3H_2(g) \rightarrow C_2H_6(g)$

ΔH = equation (iii)×2+ equation (ii) × 3 + reverse equation (i)

= –286 × 2 + (–393.5×3) – (–1560)

= –572 –1180.5 + 1560

ΔHC = –192.5 kJ/mole

596. The heat of combustion of ethanol into carbon dioxides and water is –327 kcal at constant pressure. The heat evolved (in cal) at constant volume and 27° C (if all gases behave ideally) is (R = 2 cal mol^{-1} K^{-1}) ....

[JEE Main 2020, 2 Sep Shift-II]

Ans. Given that, $\Delta H(C_2H_5OH) = -327$ kcal.

ΔT = 27°C = 273+27= 300 K, R = 2 cal mol^{-1} K^{-1}

$C_2H_5OH(l) + 3O_2(g) \rightarrow 2CO_2(g) + 3H_2O(l)$

$\Delta n_g = 2 - 3 = -1$

$\because \Delta H = \Delta E + \Delta n_g RT$

ΔH = ΔE – RT

ΔE = ΔH + RT

$$\Delta E = -327 + \frac{2}{1000}\times 300$$

ΔE = – 326.4 Kcal = –326400 cal

597. If enthalpy of atomisation for Br_2(l) is x kJ/mol and bond enthalpy for Br_2 is y kJ/mol, the relation between them

(a) is x <y (b) does not exist

(c) is x > y (d) is x = y

[JEE Main 2020, 9 Jan Shift-II]

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Ans. (c) :

$$\begin{tikzcd}
\mathrm{Br_2(l)} \arrow[r, "\Delta H_{\text{atmoziation}} = x\,\text{kJ/mol}"] \arrow[d, "\Delta H_{\text{vap.}}"] & \mathrm{2Br(g)} \\
\mathrm{Br_2(g)} \arrow[ur, "\text{Bond enthalpy} = y\,\text{kJ/mol}"'] &
\end{tikzcd}$$

$Br_2(l) \rightarrow 2Br(g) \Rightarrow Br_2(l) \rightarrow 2Br(g)$

$\Delta H = x$ kJ/mol $\quad \Delta H = 2x$ kJ/mol

$Br_2(g) \rightarrow 2Br(g)$

$\Delta H = y$ kJ/mol

$Br_2(l) \rightarrow Br_2(g)$

$\Delta H = (x-y) > 0 \Rightarrow \boxed{x>y}$

598. If the standard molar enthalpy change for combustion of graphite powder is -2.48×10^2kJmol^{-1}, the amount of heat generated on combustion of 1 g of graphite powder is........kJ. (Nearest integer)

[JEE Main 2021, 22 July Shift-II]

Ans. (21):-

ΔH_c of 12 gram (1 mole) graphite $= -2.48 \times 10^2$ kJ

$= -248$

$$\Delta H_c \text{ of 1 gram graphite } = \frac{-248}{12}$$

$\Delta H_c = -20.67$ kJ/g

$\Delta H_c \approx -21$ kJ/g

599. 200 mL of 0.2 M HCl is mixed with 300 mL of 0.1 M NaOH. The molar heat of neutralisation of this reaction is –57.1 kJ. The increase in temperature in °C of the system on mixing is $x \times 10^{-2}$.

The value of x is .... (Nearest integer)

[Given, specific heat of water = 4.18 J g^{-1} K^{-1}

Density of water = 1.00 gcm^{-3}]

(Assume no volume change on mixing)

[JEE Main 2021, 27 Aug Shift-I]

Ans. Millimoles of HCl = 200 × 0.2 = 40

Millimoles of NaOH = 300 × 0.1 = 30

$$\text{Heat released } = \frac{30}{1000} \times 57.1 \times 1000 = 1713\,\text{J}$$

Mass of solution = 500ml × 1g/mL = 500 g

$$\Delta T = \frac{q}{m \times c} = \frac{1713\,\text{J}}{500 \times 4.18} = 0.8196\,\text{K}$$

$$\Delta T = 81.96 \times 10^{-2}\,\text{K} \simeq 82 \times 10^{-2}\,\text{K}$$

600. An ideal gas undergoes isothermal compression from 5m^3 to 1m^3 against a constant external pressure of 4 Nm^{-2}. Heat released in this process is used to increase the temperature of 1 mole of Al. If molar heat capacity of Al is 24J mol^{-1} K^{-1}, the temperature of Al increases by

(a) $\frac{3}{2}$K (b) 1K

(c) 2K (d) $\frac{2}{3}$K

[JEE Main 2019, 10 Jan Shift-II]

Ans. (d) : Work done by Isothermal Irreversible process for ideal gas.

$W = -P_{ext}dV = -P_{ext}(V_2-V_1) = -4(1-5) = 16$ J

For isothermal Process $\Delta U = 0$

q = 16J

$q = nC\Delta T \quad$ [n = 1, C = 24J/mole-K]

$16 = 1 \times 24 \times \Delta T$

$$\Delta T = \frac{16}{24} = \frac{2}{3}\text{ K}$$

601. The internal energy change (in J) when 90 g of water undergoes complete evaporation at 100°C is ....(Given : ΔH_{vap} for water at 373

K = 41kJ/mol, R = 8.314 JK^{-1}mol^{-1})

[JEE Main 2020, 5 Sep Shift-I]

Ans. $H_2O(l) \xrightarrow{\quad} H_2O(g)$

$$90 \text{ gm of } H_2O = \frac{90}{18} \text{ mol of } H_2O = 5 \text{ mol of } H_2O$$

$$\Delta H = \Delta U + \Delta n_g RT$$

$$5 \times 41000 = \Delta U + 1 \times 8.314 \times 373 \times 5$$

$$\Delta U = 189494.39\,\text{J}$$

602. The ionisation enthalpy of Na$^+$ formation from Na(g) is 495.8 kJ mol^{-1}, while the electron gain enthalpy of Br is –325.0 kJmol^{-1}. Given, the lattice enthalpy of NaBr is –728.4 kJmol^{-1}. The energy for the formation of NaBr ionic solid is (–)................$\times 10^{-1}$kJmol^{-1}.

[JEE Main 2021, 25 Feb., Shift-I]

Ans: $Na(s) \rightarrow Na^+(g) + \Delta H = 495.8$

$$\frac{1}{2}Br_2 + e^- \rightarrow Br^- + \Delta H = -325$$

$Na^+(g) + Br(g) \rightarrow NaBr(s) + \Delta H = -728.4$

$$Na(s) + \frac{1}{2}Br_2(l) \rightarrow NaBr(s) = \Delta H = ?$$

$\Delta H = 495.8 - 325 - 728.4$

$= -557.6$ kJ $= -5576 \times 10^{-1}$ kJ

603. Enthalpy of combustion of carbon to CO$_2$ is -393.52 kJ/mol. The heat released upon formation of 11 g of CO$_2$ from carbon and dioxygen is

(a) 35.77 kJ (b) 98.38 kJ

(c) 1574.08 kJ (d) 393.52 kJ

J & K CET-(2012)

Ans. (b) : 1 mol CO_2 = 44 g of CO_2

So, for 44 gm of CO_2

formation energy released is +393.52 kJ

∴ for 11g of CO_2

formation energy released

$$= \frac{393.52}{44} \times 11$$

$$= \frac{196.75}{22} \times 11$$

= 98.38 kJ

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604. Which one of the following hydrogen halides has the least bond dissociation enthalpy?

(a) HF (b) HBr

(c) HI (d) HC*l*

J & K CET-(2016)

Ans. (c) : The amount of energy required to break a given bond to produce two radical fragments is bond dissociation.

∵ size of Halogen (F, Cl, Br, I)

As the size of halogen increases from F to I, the bond dissociation energy decreases.

605. The standard enthalpies of formation in kJ mol^{-1} for $CO_{2(g)}$' $H_2O_{(l)}$ and $C_2H_5OH_{(l)}$ are –393.5, –286.0 and –278.0 respectively. The standard enthalpy of combustion of $C_2H_5OH_{(l)}$ in kJ mol^{-1} is

(a) –923 (b) +1367

(c) +1923 (d) –1367

J & K CET-(2016)

Ans. (d) :

$C(s)+O_2(g)\rightarrow CO_2(g)$, $\Delta H = -393.5$ kJ mol^{-1}.............(i)

$$H_2(g)+\frac{1}{2}O_2(g)\rightarrow H_2O(l), \Delta H = -286\,\text{kJ mol}^{-1} \text{....(ii)}$$

$$2C(s)+3H_2(g)+\frac{1}{2}O_2(g)\rightarrow C_2H_5OH(l)$$

$\Delta H = -278.0$ kJ mol^{-1}........................(iii)

$C_2H_5OH(l)+3O_2(g)\rightarrow 2CO_2(g)+3H_2O$

$\Delta H = ?$

ΔH combustion = (i) × 2 + 3× (ii) – (iii)

ΔH combustion = 2 × (–393.5) + 3×(–286) – (–298)

= –1367 kJ mol^{-1}

606. The equilibrium constant K_c value for equilibrium at 227°C is 1×10^{10}. If the standard enthalpy change for this is –97.95 KJ mol^{-1}, the standard entropy change in JK^{-1} mol^{-1} for this equilibrium at the same temperature is (R = 8.3 J K^{-1} mol^{-1} and 2.303 ≅ 2.3)

(a) –5 (b) +5

(c) +10 (d) –10

J & K CET-(2016)

Ans. (a) : $\Delta G = -2.303\,RT\log K_c$

$= -2.3 \times 8.3 \times 500 \log(1\times10^{10}) = -95450$ J

Now, $\Delta G = \Delta H - T\Delta S$

$-95450 = -97950 - 500\,\Delta S \Rightarrow \Delta S = -5$ JK^{-1} mol^{-1}

607. What should be the correct order of lattice energy values of the following alkali halides? LiCl, KI, KCl and NaCl

(a) KI > KCl > NaCl < LiCl

(b) NaCl > KCl > LiCl > KI

(c) LiCl > KCl > KI > NaCl

(d) LiCl > NaCl > KCl > KI

J & K CET-(2017)

Ans. (d) : Lattice energy can be defined as the energy required to convert one mole of an ionic solid into gaseous ionic constituents.

Order of Lattice energy,

$\boxed{\text{LiCl > NaCl > KCl > KI}}$

608. What will be the enthalpy of formation of toluene considering the data given?

Bond energies of C – C = 79 kcal, C = C = 135 kcal, C – H = 102 kcal, heat of atomisation Of C = 156.8 kcal and heat of atomisation of H = 49.5 kcal

(a) – 43.4 kcal (b) 43.4 kcal

(c) 114.6 kcal (d) –114.6 kcal

J & K CET-(2017)

Ans. (a) : $7C(g) + 4H_2(g) \rightarrow C_7H_8(g)$

ΔH = Enthalpy of atomisation – Bond energies

= (7 × 156.8 + 8 × 49.5) – (8 × 102 + 4 × 79+3×135)

= – 43.4 kcal

609. What will be the molar entropy change when silver is heated from 227° C to 727°C? Consider the molar specific heat of Ag, $C_p = 5.3 + 0.0028\,T$

(a) 7.873 eu (b) 12.341 eu

(c) 3.214 eu (d) 5.074 eu

J & K CET-(2017)

Ans. (d) : Given,

$T_1 = 227 + 273 = 500$K

$T_2 = 727 + 273 = 1000$ K

n = 1

$C_P = 5.3 + 0.0028$ T

$$\Delta S = \frac{\Delta H}{T} = \frac{nC_P dT}{T} = \frac{(5.3+0.0028T)}{T}dT$$

Integrating both the sides,

$$\int \Delta S = \int_{T_1}^{T_2} \frac{5.3+0.0028T}{T}dT$$

$$= 5.3\int_{T_1}^{T_2}\frac{dT}{T} + 0.0028\int_{T_1}^{T_2} dT$$

$$= 5.3[\ln T]_{T_1}^{T_2} + 0.0028[T]_{T_1}^{T_2}$$

$$= 5.3\times[2.303\log T]_{T_1}^{T_2} + 0.0028[T]_{T_1}^{T_2}$$

Substituting value of T_1 = 1000 and T_2 = 500,

$$\Delta S = 5.3\times2.303[\log1000-\log500]+0.0028[1000-500]$$

$$\Delta S = 5.3\times2.303[3-2.6989]+500\times0.0028$$

$$\Delta S = 3.6752+1.4 = 5.0752\,\text{eu}$$

610. What will be the ΔH° and ΔS° values for the given cell having E° at 20° C and 30° C to be 0.18 V and 0.28 V respectively?

The cell: (Pt) H_2 / H+ || KCl /Hg_2Cl_2 / Hg

(Given: 1 F = 96500 coulombs)

(a) ΔS° = 2017 JK^{-1} and ΔH° = 630.54 kJ

(b) ΔS° = – 4532 JK^{-1} and ΔH° = 768.73 kJ

(c) ΔS° = 3425 JK^{-1} and ΔH° = –530.75 kJ

(d) ΔS° = 1930 JK^{-1} and ΔH° = 530.75 kJ

J & K CET-(2017)

Ans. (d) :

Cathode – $Hg_2Cl_2(s) + 2e^- \rightarrow 2Hg(l) + 2Cl(g)$

Anode – $2H^+ + 2e^- \rightarrow H_2$, n = 2

$\Delta G° = -nFE°$

= –2 × 96500 × 0.18

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$= -209000 \times 0.18$
$= -39740J$

$$\Delta S^\circ = nF\left(\frac{dE}{dT}\right)$$

$$\frac{dE}{dt} = \frac{\Delta E}{\Delta T}$$

$$= \frac{0.28 - 0.18}{10}$$

$= 0.01 V/K$

Now,

$\Delta S^\circ = 2\times96500\times0.01 = 1930 JK^{-1}$

$\Delta H^\circ = \Delta G^\circ + T\Delta S^\circ$

$\Delta H^\circ = -34740 + 293 \times 1930$

$\Delta H^\circ = 530.75$ kJ

611. What will be the heat change at constant volume for the reaction whose heat change at constant pressure is –560kcal at 27ºC? The reaction is

$C_8H_{16} + 12O_2 \rightarrow 8CO_2 + 8H_2O$

(Given R = 2 cal mol^{-1} K^{-1})

(a) –558200 calories
(b) 442800 calories
(c) –561800 calories
(d) 368240 calories

J & K CET-(2018)

Ans. (a) : Given,

$\Delta H = -560$ kcal, T = 27 + 273 = 300 K

R = 2 cal mol^{-1} K^{-1}

$C_8H_{16}(l) + 12O_2(g) \rightarrow 8CO_2(g) + 8H_2O(l)$

$\Delta n_g = 8 - 12 = -4$

$\Delta H = \Delta E + \Delta n_g RT$

$\Delta E = \Delta H - \Delta n_g RT = -560\times10^3 - (-4\times2\times300)$

$= -560\times10^3 + 2400$

$= -557600$ cal $\simeq -558200$ cal

612. The heat of neutralisation will be highest in

(a) HCl + NaOH
(b) $NH_4OH + H_2SO_4$
(c) $CH_3COOH + NaOH$
(d) $CH_3COOH + NH_4OH$

J & K CET-(2019)

Ans. (a) : Strong acid and strong base has greater heat of neutralization than weak acid or weak base.

613. The standard enthalpy of formation of all elements in their standard state is

(a) zero
(b) unity
(c) Less than zero
(d) more than zero

J & K CET-(2019)

Ans. (a) : The standard enthalpy of formation of a substance is the enthalpy change that occurs when 1 mole of the substance is formed from its constituent elements in their standard states.

Enthalpies of all elements in their standard state are zero.

614. Calculate the enthalpy change for the reaction $C_2H_4(s) + H_2(g) \rightarrow C_2H_6(g)$ using the data given below :

$C_2H_4(g) + 3O_2(g) \rightarrow CO_2(g) + 2H_2O(l)$; $\Delta H = -1415$ kJ

$C_2H_6(g) + \frac{7}{2}O_2(g) \rightarrow 2CO_2(g) + 3H_2O(l)$; $\Delta H = -1566$ kJ

$H_2(g) + \frac{1}{2}O_2(g) \rightarrow H_2O(l)$; $\Delta H = -286$ KJ

(a) –437 kJ
(b) 135 kJ
(c) –135 kJ
(d) none of these

J & K CET-(2013)

Ans. (c) :

equation (i), $\Delta H = -1415$ KJ

equation (ii), $\Delta H = -1566$ KJ

equation (iii), $\Delta H = -286$ KJ

We know, $C_2H_4(g) + H_2(g) \rightarrow C_2H_6(g)$

$\Delta H = ?$

ΔH = Eq. (i) + Eq. (iii) – Eq. (ii)

ΔH Value is = (–1415) + (–286) – (–1566)

= –135 KJ

615. The standard enthalpy of formation of $H_2(g)$ and $Cl_2(g)$ and HCl(g) are 218 kJ/mol, 121.88 kJ/mol and –93.31 kJ/mol respectively. Calculate standard enthalpy change in kJ for

$\frac{1}{2}H_2(g) + \frac{1}{2}Cl_2(g) \rightarrow HCl(g)$

(a) +431.99
(b) –262.14
(c) –431.99
(d) +247.37

J & K CET-(2010)

Ans. (b) :

$$\Delta H = \sum \Delta H_P - \sum \Delta H_R = -93.31 - \left(\frac{218}{2} + \frac{121.88}{2}\right)$$

$$= -93.31 - 169.94 = -263.25 \simeq -262.14 \text{ kJ}$$

616. Changes in a system from an initial state to the final state were made by a different manner that remains ΔH remains same but q changes because

(a) ΔH is a path function and q is a state function
(b) ΔH is a state function and q is a path function
(c) both ΔH and q are state functions
(d) both ΔH and q are path functions.

J & K CET-(2010)

Ans. (b) : Enthalpy change- ΔH is a State function, depends only upon the initial and final states not upon the path followed.

617. The standard enthalpies of formation of A (NH_3), B (CO_2), C (HI) and D (SO_2) are respectively –46.19, –393.4, + 24.94 and –296.9 kJ mol^{-1}.

The increasing order of their stability is

(a) B < D < A < C
(b) C < A < D < B
(c) D < B < C < A
(d) A < C < D < B

J & K CET-(2009)

Ans. (b) : Lower the value of standard enthalpy of formation, higher the stability. The increasing order of standard enthalpies formation of given molecule is

$$\boxed{C < A < D < B}$$

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618. In which of the following pairs the enthalpy of neutralization is less than or more than the standard value?

(a) HNO_3 and NaOH (b) HCl and NaOH

(c) HCN and NaOH (d) H_2SO_4 and NaOH

J & K CET-(2010)

Ans. (c) : The enthalpy of neutralization of strong base and strong acid always highest. However, if either the weak acid (like HCN) or the weak base some of the energy is utilised to ionise the acid/base.

So, enthalpy of neutralization is less or more then standard value.

619. When 400 mL of 0.2 n solution of a weak acid is neutralized by a dilute aqueous solution of sodium hydroxide under standard conditions, 4.4kJ amount of heat is liberated. Therefore, the standard enthalpy of neutralization of this weak acid in kJ equiv^{-1} is

(a) –11 (b) –44

(c) –55 (d) –22

J & K CET-(2009)

Ans. (c) $\therefore$ Milliequivalents of weak acid = 400 × 0.2

= 80 milliequivalents

Equivalents of the acid = 0.08 equivalent

$\therefore$ Since, heat evolved when 0.08 equivalent of acid is neutralized = 4.4 kJ

$\therefore$ The heat evolved, when 1 equivalent is neutralized, when 1 equivalent is neutralized

$$= \frac{4.4\times 1}{0.08} = 55 \text{ kJ equiv}^{-1}$$

620. Which one of the following is always not negative?

(a) Enthalpy of combustion

(b) Enthalpy of formation

(c) Enthalpy of neutralisation

(d) Lattice enthalpy

J & K CET-(2009)

Ans. (b) :

(a) Enthalpy of Combustion

Combustion is an Energy librating Process So, $\Delta H_C = -Ve$

(b) Enthalpy of formation are

Not Always Negative

$\Delta H_f^0 = +Ve$

(c) Enthalpy of Neutralization this is an Exothermic Process

$\Delta H_n = -Ve$

(d) Lattice Energy

Energy librating Process

$\Delta H = -Ve$

621. Heat of combustion of carbon monoxide at constant volume and at 17^{0}C is – 67,710 calories. The heat of combustion at constant pressure is

(a) –68,000 calories (b) –67,800 calories

(c) 67,050 calories (d) + 68,500 calories

J & K CET-(2007)

Ans. (a) : $CO(g) + \frac{1}{2}O_2(g) \rightarrow CO_2(g)$

$$\Delta n_g = (1) - \left(1 + \frac{1}{2}\right) = -\frac{1}{2}$$

$\Delta H = \Delta E + \Delta n_g RT$

$$\Delta H = -67710 - \frac{1}{2} \times 2 \times 290$$

$= -68000$ cal.

622. In which of the following reactions, the heat liberated is known as "heat of combustion"?

(a) $H^+_{(aq)} + OH^-_{(aq)} \rightarrow H_2O_{(l)} + \text{heat}$

(b) $C(\text{graphite}) + \frac{1}{2}O_{2(g)} \longrightarrow CO(g) + \text{heat}$

(c) $CH_{4(g)} + 2O_{2(g)} \rightarrow CO_{2(g)} + 2H_2O_{(l)} + \text{heat}$

(d) $H_2SO_{4(aq)} + H_2O(l) \rightarrow H_2SO_4(aq) + \text{heat}$

J & K CET-(2006)

Ans. (c) : Amount of Heat Absorbed or evolved when 1 mole substance is completely oxidised are called Heat combustion

$\Delta H_C \rightarrow$ Exothermic Process

$CH_4(g) + 2O_2(g) \rightarrow CO_2(g) + 2H_2O(l) + H$

623. Calculate ΔH (in joules) for C (graphite) → C (diamond), from the following data

$C(\text{graphite}) + O_{2(g)} \rightarrow CO_{2(g)}$; $\Delta H = -393.5$ kJ.

$C(\text{diamond}) + O_{2(g)} \rightarrow CO_{2(g)}$; $\Delta H = -395.5$ kJ.

(a) 1900 (b) -788.9×10^3

(c) 190000 (d) $+788.9\times 10^3$

J & K CET-(2006)

Ans. (a) : According to Hess' law,

$$C_{graphite} + O_2(g) \longrightarrow CO_2, \Delta H = -393.5 \text{ kJ/mol}$$

$$CO_2(g) \longrightarrow C_{diamond} + O_2(g), \Delta H = +395.4 \text{ kJ/mol}$$

$$C_{graphite} \longrightarrow C_{diamond}, \Delta H = -393.5 + 395.4 = 1.9 \text{ kJ/mol}$$

$$= 1900 \text{ J/mol}$$

624. 1 mole of H_2SO_4 is mixed with 2 moles of NaOH. The heat evolved will be

(a) 57.3 kJ (b) 2 × 57.3 kJ

(c) 57.3/2 kJ (d) cannot be predicted

J & K CET-(2004)

Ans. (b) 1 mole of H_2SO_4 completely neutralised by 2 mole of NaOH

As we know,

Gram equivalent = No. of moles x Valency factor

Valency factor of H_2SO_4 = 2

Heat evolved in the neutralization of 1gm eg. of strong acid =57.3 kJ

Heat evolved in neutralization of 2 gm eg. of strong acid = (57.3 × 2) kJ

625. The enthalpy of vapourisation of liquid water using the data

$$H_2(g) + \frac{1}{2}O_{2(g)} \rightarrow H_2O_{(l)}; \Delta H = -285.77 \text{kJ/mole}$$

$$H_2(g) + \frac{1}{2}O_{2(g)} \rightarrow H_2O_{(g)}; \Delta H = -241.84 \text{kJ/mole}$$

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(a) +43.93 kJ/mol (b) –43.93 kJ/mol
(c) 527.61 kJ/mol (d) –527.61 kJ/mol

J & K CET-(2003)

Ans. (a) :

$$H_2O(l) \rightarrow H_2(g)+\frac{1}{2}O_2(g); \quad \Delta H = 285.77 \text{ kJ}$$

$$H_2(g)+\frac{1}{2}O_2(g) \rightarrow H_2O(g); \quad \Delta H = -241.84 \text{ kJ}$$

H_2O (l) → $H_2O(g)$;

$\Delta H = (285.77–241.84)$ kJ = + 43.93 kJ mol^{-1}

626. Enthalpy of NH_3 is –46 kJ mol^{-1}, ΔH for the reaction: $2NH_{3(g)} \rightarrow N_{2(g)} + 3H_{2(g)}$ is

(a) 46 kJ (b) 92 kJ
(c) –92 kJ (d) –23 kJ

J & K CET-(2002)

Ans. (b) :

$$\frac{1}{2}N_2(g)+\frac{3}{2}H_2(g) \rightarrow NH_3(g)$$

$\Delta H = –46.0$ KJ/mol

Multiply above equation with 2,

$N_2(g) + 3H_2(g) \rightarrow 2NH_3(g)$

$\Delta H = –46.0×2$

$= –92.0$ KJ/mol

Reverse above equation

$2\ NH_3(g) \rightarrow N_2\ (g) + 3H_2\ (g)$

$\Delta H = +92.0$ KJ/mol

The enthalpy change for the reaction,

$2\ NH_3(g) \rightarrow N_2(g) + 3H_2(g)$ is 92.0 KJ mol^{-1}

627. The factor which does not affect the heat of reaction is

(a) physical state of the reactants and products
(b) temperature of the reaction
(c) whether the reaction is carried out in an open vessel or a closed vessel
(d) whether the reaction is carried out directly or indirectly

J & K CET-(2002)

Ans. (d) : Heat of reaction does not depend upon whether the reaction is carried out directly or indirectly, Heat of reaction, the amount of heat that must be added or removed during a chemical reaction in order to keep all of the substances present at the same temperature.

628. The change in heat energy of a chemical reaction at constant temperature and pressure is called

(a) enthalpy (b) free energy
(c) internal energy (d) bond energy

J & K CET-(2000)

Ans. (a) : Enthalpy is the heat change in a chemical reaction at constant temperature and pressure.
Enthalpy is the sum of the internal energy and pressure times volume.
H = E + PV

629. Hess's law is used for the determination of

(a) heat of formation (b) heat of reaction
(c) heat of transition (d) all of these

J & K CET-(2000)

Ans. (d) : Hess's Law for constant Heat summation. The standard enthalpy of a reaction, which takes place in several steps, is the sum of the standard enthalpies of intermediate reactions into which the overall reactions may be divided at the same temperature.

$$\boxed{\Delta H = \Delta H_1 + \Delta H_2 + \Delta H_3}$$

630. If the enthalpy change for the reaction is $2NH_{3(g)} \rightarrow N_{2(g)} + 3H_{2(g)}$ is 92 kJ mol^{-1} the enthalpy of formation of ammonia is

(a) –23.0 kJ mol^{-1} (b) –46 kJ mol^{-1}
(c) –92.0 kJ mol^{-1} (d) 46 kJ mol^{-1}

J & K CET-(2001)

Ans. (b) : Enthalpy of reaction ($\Delta_rH°$) = –92 kJ mol^{-1}

$N_2(g) + H_2(g) \rightarrow 2NH_3(g)$

Hence, Standard enthalpy of NH_3 is equal to the $\frac{1}{2}\Delta_rH°$

$\Delta_rH°$ = 92 kJ mol^{-1}

∵ Standard enthalpy of $NH_3 = \frac{-92}{2} = -46$ kJ mol^{-1}

631. The heat of solution depends upon

(a) nature of solute
(b) nature of solvent
(c) concentration of the solution
(d) all of these

J & K CET-(2001)

Ans. (d) : Heat of solution depend on the following factor.
(a) Nature of solute particle
(b) Nature of solvent
(c) Concentration of the solution

632. The enthalpy of neutralization of NaOH with acetic acid is 55 kJ and with HCl is 57.1 kJ. This happens because

(a) some heat is required for complete ionization of acetic acid
(b) acetic acid is an organic acid
(c) acetic acid is less soluble in water
(d) acetic acid is a weak acid and required lesser alkali

J & K CET-(2001)

Ans. (a): The enthalpy of neutralization of NaOH with CH_3COOH is 55 kJ and with HCL is 57.1 kJ. This is due to that weak acid is not completely dissociated Hence, some of heat is utilized for complete ionization of weak acid. i.e. CH_3COOH

633. Lattice and hydration energies of NaCl are +777.8 kJ mol^{-1} and -774.1 kJ mol^{-1} respectively. Heat of solution of NaCl will be

(a) 1551.9 kJ mol^{-1} (b) –1519 kJ mol^{-1}
(c) –37 kJ mol^{-1} (d) +3.7 kJ mol^{-1}

J & K CET-(1999)

Ans. (d) Heat of solution = Hydration energy + lattice energy

= +777.8 – 774.1 = +3.7 kJ mol^{-1}

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634. The equation for the complete combustion of propane, C_3H_8 is
$C_3H_{8(g)} + 5O_{2(g)} \rightarrow 3CO_{2(g)} + 4H_2O_{(g)}$
What is the maximum mass of carbon dioxide formed when a mixture of 0.50 mole of propane and 3.0 mole oxygen are ignited?

(a) 22.0 g (b) 29.3 g
(c) 44.0 g (d) 66.0 g

J & K CET-(1997)

Ans. (d) : Solution : -

$$C_3H_8(g) + 5O_2(g) \longrightarrow 3CO_2(g) + 4H_2O(g)$$

1 mole 5 mole 3 mole
44g 160g 132g

$\because$ 1 mole propane gives 132g CO_2
$\therefore$ 0.50 mole propane gives 132 × 0.50 = 66.0g CO_2

635. Equal volumes of molar hydrochloric acid and sulphuric acid are neutralized by dilute NaOH Solution and *x* kcal and y kcal of heat are liberated respectively. Which of the following is true?

(a) $x = y$ (b) $x = \frac{1}{2}y$
(c) $x = 2y$ (d) none of these

J & K CET-(2000, 1997)

Ans. (b) : $HCl + NaOH \rightarrow NaCl + H_2O$
or $H^+ + OH^- \rightarrow H_2O$ $\Delta H_1 = x$
$H_2SO_4 + 2NaOH \rightarrow Na_2SO_4 + 2H_2O$
or
$2H^+ + 2OH^- \rightarrow 2H_2O$ $\Delta H_2 = y$
$H^+ + OH^- \rightarrow H_2O$

$$\Delta H_1 = \frac{1}{2}\ \Delta H_2$$

$$\therefore x = \frac{y}{2}$$

636. The heat of combustion of hydrogen gas at constant pressure and at 23°C is 280 kJ mol^{-1}. The heat of combustion at constant volume and at 23°C will be (R=8.3143 J mol^{-1} K^{-1})

(a) –280 kJ mol^{-1} (b) –283.74 kJ mol^{-1}
(c) –267.69 kJ mol^{-1} (d) –278.76 kJ mol^{-1}

J & K CET-(1998)

Ans. (d) : Solution :-

$$H_2(g) + \frac{1}{2}O_2(g) \longrightarrow H_2O(g)$$

$$\Delta n_{(g)} = 1 - \left(1 + \frac{1}{2}\right)$$

$$\Delta n_{(g)} = -\frac{1}{2}$$

$$\because \Delta H = \Delta E + \Delta n_g RT$$

$$\Delta E = \Delta H - \Delta n_g RT$$

$$\Delta E = -280 - \left(\frac{-1}{2} \times \frac{8.314}{1000} \times 296\right)$$

$$\Delta E = -280 + 1.23$$

$$\Delta E = -278.77\ kJ\,mol^{-1}$$

637. The heat of combustion of cyclohexane at 25°C and constant pressure is 3919.9 kJ mol^{-1}. The reaction is
$C_6H_{12}(l) + 9O_2(g) \rightarrow 6H_2O.\ (l) + 6CO_2\ (g)$, What is the best value of ΔE for this reaction at 25°C and at constant volume?

(a) 3912.45 kJ (b) 3927.33 kJ
(c) 3924.88 kJ (d) –3424.76 kJ

J & K CET-(1997)

Ans. (b) : Given:- $\Delta H = 3919.9$ kJ mol^{-1}

$$\Delta H = \Delta E + \Delta n_g RT \quad ....(i)$$

$$\because \quad \Delta n_g = 6 - 9$$

$$\Delta n_g = -3$$

Form equation (i)

$$3919.9 = \Delta E + \left(-3 \times 8.134 \times 10^{-3} \times 298\right)$$

$$\Delta E = 3919.9 + 3 \times 8.134 \times 10^{-3} \times 298$$

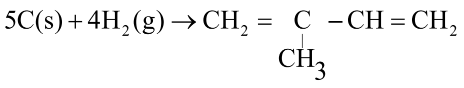
$$\Delta E = 3927.33\,kJ$$

638. Using bond energy data, calculate the heat of formation of isoprene. Given that bond energy of C – H = 98.8 kcal, H – H = 104 kcal, C – C = 83 kcal, C=C = 147 kcal and $C_{(s)} \rightarrow C_{(g)}$ = 171 kcal.

(a) 28.3 kcal (b) 20.6 kcal
(c) 283 kcal (d) 220.6 kcal

J & K CET-(1997)

Ans. (b) :



$$5C(s) + 4H_2(g) \rightarrow CH_2 = \underset{\underset{CH_3}{|}}{C} - CH = CH_2$$

$$5C(s) \longrightarrow 5C(g)$$

Bond energy of 2(C – C) ,Bond energy of 2(C = C)
Bond energy of 8(C – H)Bond energy of 4(H – H)
ΔH = Sum of B.E. of reactants – Sum of B.E. of products

B.E.=5B.E. $_{C(s) \longrightarrow C(g)}$
+4B.E.$_{(H–H)}$ – (2B.E.$_{(C–C)}$+2B.E.$_{(C=C)}$+8B.E.$_{(C–H)}$)
= (5×171+4×104) – (2×83+2×147+8×98.8)
= 1271–1250.4
B.E. = 20.6 kcal

639. The latent heat of vaporization of water is 540 cal g^{-1} at 100ºC. What will be the entropy increase when one mole of water is evaporated at 100ºC?

(a) 28 cal K^{-1} mol^{-1} (b) 26 cal K^{-1} mol^{-1}
(c) 540 cal K^{-1} mol^{-1} (d) 1.82 cal K^{-1} mol^{-1}

JCECE - 2003

Ans. (b): $\Delta G = \Delta H - T\Delta S$
At phase change $\Delta G = 0$
$0 = \Delta H - T\Delta S$
$\Delta H = T\Delta S$

$$\Delta S = \frac{\Delta H}{T} = \frac{540 \times 18}{373}$$

= 26.059 cal/mol K

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640. $\mathbf{S+\frac{3}{2}O_2 \longrightarrow SO_3\ \Delta H = 2x,}$

$\mathbf{SO_2+\frac{1}{2}O_2 \longrightarrow SO_3\ \Delta H = y,}$

Then heat of formation of SO_2 is :

(a) $2x - y$ (b) $2x + y$

(c) $x + y$ (d) $\frac{2x-y}{2}$

JCECE - 2006

Ans. (a) :

$S + {}^3/_2\, O_2 \rightarrow SO_3 + 2\,x$ kcal..............(i)

$SO_2 + {}^1/_2\, O_2 \rightarrow SO_3 + y$ kcal............(ii)

Subtract eq. (ii) from (i)

$S + O_2 \rightarrow SO_2 + (2x - y)$ kcal

∵ Heat of formation of SO_2 is equal to $(2x–y)$ kcal.

641. The enthalpy of vaporization of substance is 840 J-mol^{-1} and its boiling point is-173°C. Its entropy of vaporization is:

(a) 42 J mol^{-1}K^{-1} (b) 21 J mol^{-1}K^{-1}

(c) 84 J mol^{-1}K^{-1} (d) 8.4 J mol^{-1}K^{-1}

JCECE - 2005

Ans. (d) : $\Delta G = \Delta H - T\Delta S$, at phase change $\Delta G = 0$

$$0 = \Delta H - T\Delta S$$

$$\Delta S = \frac{\Delta H}{T} \quad \because (T = -173 + 273 = 100K)$$

$$\Delta S = \frac{840}{100K} = 8.4\text{mol}^{-1}\ K^{-1}$$

642. Given the following thermochemical equations:

$\mathbf{Zn + \frac{1}{2}\ O_2 \longrightarrow ZnO + 84{,}000\ cal}$

$\mathbf{Hg + \frac{1}{2}\ O_2 \longrightarrow HgO + 21{,}700\ cal}$

Accordingly the heat of reaction for the following reaction Zn + HgO ⟶ Hg + heat is:

(a) 105,700 cal (b) 61,000 cal

(c) 105,000 cal (d) 62,300 cal

JCECE - 2005

Ans. (d) : $Zn + \frac{1}{2}O_2 \rightarrow ZnO + 84000$ cal ....(i)

$Hg + \frac{1}{2}O_2 \rightarrow HgO + 21700$ cal ....(ii)

The reaction 2 is reversed and added to the reaction 1 to obtain the reaction $Zn + HgO \rightarrow ZnO + Hg$

The heat of this reaction is 84000 – 21700 = 62300 cal.

643. The enthalpies of combustion of carbon and carbon monoxide are -393.5 and – 283 kJmol^{-1} respectively. The enthalpy of formation of carbon monoxide per mol is

(a) 110.5 kJ (b) 676.5 kJ

(c) –676.5 kJ (d) –110.5 kJ

JCECE - 2008

Ans. (d) : Combustion of C and CO are given,

C + O_2 → CO2 ; Δ H = – 393.5 kJ (i)

$CO + \frac{1}{2}O_2 \rightarrow CO_2$; Δ H = – 283 kJ (ii)

Subtract equation (ii) from equation (i)

$C + \frac{1}{2}O_2 \rightarrow CO,$

Δ H = –393.5 – (–283) = –110.5 kJ

644. An aqueous solution of 6.3 g of oxalic acid dihydrate is made upto 250 mL. The volume of 0.1 N NaOH required to completely neutralize 10 mL. of this solution is

(a) 40 mL (b) 20 mL

(c) 10 mL (d) 4 mL

JCECE - 2008

Ans. (a) : Given:- $N_2 = 0.1$, $V_1 = 10$

n – factor for H2 C2 O4. 2H2O = 2

$$\text{Normality} = \frac{\text{weight} \times 2 \times 1000}{\text{Molecular weight} \times 250}$$

$$N_1 = \frac{6.3 \times 2000}{126 \times 250} = 0.4$$

$$N_1V_1 = N_2V_2$$

$$V_2 = \frac{N_1V_1}{N_2}$$

$$V_2 = \frac{10 \times 0.4}{0.1}$$

$$V_2 = 40\,\text{mL}$$

645. If at 298 K the bond energies of C—H, C—C, C=C and H—H bonds are respectively 414, 347, 615 and 435 kJ mol^{-1}, the value of enthalpy change for the reaction $\mathbf{H_2C{=}CH_2(g)+H_2(g)\rightarrow H_3C{-}CH_3(g)}$ at 298 K will be

(a) +250 kJ (b) –250 kJ

(c) +125 kJ (d) –125 kJ

JCECE - 2008

Ans. (d) : $H_2C = CH_2 + H_2 \rightarrow H_3C - CH_3$

The value of enthalpy change for the reaction = ΔH

So, ΔH = Sum of B.E. of reactants – Sum of B.E. of products

ΔH = B.E. of (C = C) + 4B.E. of (C – H) + B.E. of (H – H) – B.E. of (C – C) – 6B.E. of (C – H)

ΔH = 615 + 4 × 414 + 435 – 347 – 6 × 414

ΔH = 1050 – 347 – 828

ΔH = 703 – 828

ΔH = −125 kJ

646. The heat of neutralisation is highest for the reaction between

(a) NH_4OH — CH_3COOH

(b) HNO_3 — NH_4OH

(c) NaOH — CH_3COOH

(d) HCl — NaOH

JCECE - 2010

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Ans. (d) : Heat of neutralisation of strong acid by strong base is always greater than the heat of neutralisation of weak acid or weak base because some energy is used to ionise weak acid or weak base.

(a) $NH_4OH — CH_3COOH$
weak base — weak acid

(b) $HNO_3 — NH_4OH$
strong acid — weak base

(c) $NaOH — CH_3COOH$
strong base — weak acid

(d) $HCl — NaOH$
strong acid — strong base

$\because$ HCl is a strong acid and NaOH is a strong base.

$\therefore$ Their heat of neutralisation will be highest among the given.

647. In the combustion of 2.0 g of methane, 25 kcal heat is liberated. Heat of combustion of methane would be

(a) 150 kcal (b) 200 kcal
(c) 250 kcal (d) 350 kcal

JCECE - 2011

Ans. (b) : When 2.0 g $\left(\text{or}\frac{2}{16}\text{mol}\right)$ methane is burnt, heat evolved = 25 kcal.

$\therefore$ When 1 mol methane is burnt, heat evolved will be

$$=\frac{25}{(2/16)}=\frac{25\times16}{2}=200\,\text{kcal}$$

648. Heat of neutralisation of HF (a weak acid) with strong base is –16.4 kcal. Calculate heat of ionisation of HF in water.

(a) – 13.7 kcal (b) – 2.7 kcal
(c) + 30.1 kcal (d) + 3.01 kcal

JCECE - 2013

Ans. (b) :

$HF + OH^- \longrightarrow H_2O + F^-$; $\Delta H = -16.4$ kcal ——— (i)

$H^+ + OH^- \longrightarrow H_2O$; $\Delta H = -13.7$ kcal ——— (ii)

Subtracting the equation (i) & (ii)

the required equation (ionization of HF in water)

$HF \longrightarrow H^+ + F^-$; $\Delta H = -2.7$ kcal

649. For the reaction,
$C_3H_8(g) + 5O_2(g) \rightarrow 3CO_2(g) + 4H_2O(l)$ at constant temperature, $\Delta H - \Delta E$ is

(a) + 3RT (b) – RT
(c) + RT (d) – 3RT

JCECE - 2013

Ans. (d) : For the given reaction, $\Delta n_g = n_p - n_r = 3 - 6 = -3$

$\Delta H = \Delta E + \Delta n_g RT$

$\Delta H - \Delta E = \Delta n_g RT$

$\Delta H - \Delta E = -3RT$

650. Which of the reactions defines ΔH_f^o ?

(a) $C_{diamond} + O_2(g) \rightarrow CO_2(g)$

(b) $\frac{1}{2}H_2(g) + \frac{1}{2}F_2(g) \rightarrow HF(g)$

(c) $N_2(g) + 3H_2(g) \rightarrow 2NH_3(g)$

(d) $CO(g) + \frac{1}{2}O_2(g) \rightarrow CO_2(g)$

JCECE - 2014

Ans. (b) : ΔH_f^o, standard heat of formation, is the amount of heat evolved or absorbed when one gram mole of a substance is formed from its constituent elements.

For standard state, temperature is 25ºC or 298 K and the pressure of gaseous substance is 1 atm. Therefore, in given thermochemical equation, formation of HF represents the standard heat of formation of HF.

651. The bond dissociation energies of gaseous H_2, Cl_2 and HCl are 104, 58 and 103 kcal respectively. The enthalpy of formation of HCl gas would be

(a) –44 kcal (b) 44 kcal
(c) – 22 kcal (d) 22 kcal

JCECE - 2014

Ans. (c) : $\frac{1}{2}H_2 + \frac{1}{2}Cl_2 \longrightarrow HCl$

$\Delta H = \sum$BE of reactants – $\sum$BE of products

$$=\left[\frac{1}{2}\text{BE of}(H_2)+\frac{1}{2}\text{BE of}(Cl_2)\right]-\text{BE of}(HCl)$$

$$=\left[\left(\frac{1}{2}\times104\right)+\left(\frac{1}{2}\times58\right)\right]-103$$

$= (52 + 29) - 103$

$= -22$ kcal

652. Standard enthalpy and standard entropy change for the oxidation of NH_3 at 298 K are -382.64kJmol^{-1} and -145.6 J mol^{-1} respectively. Standard Gibbs energy change for the same reaction at 298 K is

(a) + 339.3 kJ mol^{-1} (b) – 439.3 kJ mol^{-1}
(c) – 339.3 kJ mol^{-1} (d) – 393.3 kJ mol^{-1}

JCECE - 2014

Ans. (d) : $\Delta G^o = \Delta H^o - T\Delta S^o$

$= -382.64 - 298 \times (-145.6 \times 10^{-3})$

$= -339.3\text{ kJ mol}^{-1}$

653. The heat of neutralisation of a strong acid and a strong alkali is 57.0 kJ mol^{-1}. The heat released when 0.5 mole of HNO_3 solution is mixed with 0.2 mole of KOH is

(a) 57.0 kJ (b) 11.4 kJ
(c) 28.5 kJ (d) 34.9 kJ

JCECE - 2015

Ans. (b) : 0.2 mole of KOH will neutralise 0.2 mole of HNO_3. Thus, heat evolved = 57 × 0.2 = 11.4 kJ

654. For the gaseous reaction involving complete combustion of isobutane (assuming all products and reactants are in gaseous state). The relation between ΔH and ΔE will be

(a) $\Delta H > \Delta E$ (b) $\Delta H = \Delta E$
(c) $\Delta H < \Delta E$ (d) $\Delta H = 0$ and $\Delta E = \infty$

JCECE - 2016

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Ans. (a) : Combustion of isobutane will be as follows:

$$C_4H_{10}(g)+\frac{13}{2}O_2(g)\longrightarrow 4CO_2(g)+5H_2O(g)$$

$\because$ $\Delta H = \Delta E + \Delta nRT$

Where, Δn = no. of gaseous moles (products) – no. of gaseous mole (reactant)

$$\Delta n=(4+5)-\left(1+\frac{13}{2}\right)$$

$$\Delta n=+\frac{3}{2}(+ve)$$

Since, Δn is +ve

ΔH must be greater than ΔE.

$\therefore$ $\Delta H > \Delta E$

655. Given, $S+\frac{3}{2}O_2 \rightarrow SO_3 + 2x$ kcal

$$SO_2+\frac{1}{2}O_2 \rightarrow SO_3 + y \text{ kcal}$$

with the help of above reactions, find out the heat of formation of SO_2.

(a) (2x – y)
(b) (x + y)
(c) (2x + y)
(d) (2x / y)

JCECE - 2016

Ans. (a) : Our required equation will be

$S + O_2 \rightarrow SO_2$

Given, $S+\frac{3}{2}SO_2 \rightarrow SO_3 + 2x$ kcal ...(i)

$SO_2 + \frac{1}{2}O_2 \rightarrow SO_3 + y$ kcal ...(ii)

So, to get the required equation, we will subtract Eq. (ii) from Eq. (i), thus we get,

$S + O_2 \rightarrow SO_2 + (2x – y)$ kcal.

$\therefore$ (2x – y) is heat of formation of SO_2.

656. The energy released when 6 moles of octane is burnt in air will be [Given, ΔHf for $CO_2(g)$, $H_2O(g)$ and $C_8H_{18}(l)$, respectively are –490, –240 and + 160 J/mol]

(a) –37.4 kJ
(b) –20 kJ
(c) – 6.2 kJ
(d) – 35.5 kJ

JIPMER-2017

Ans. (a) : $\because$ According to Hess's Law,

$C + O_2 = CO_2,\ \Delta H = -490$ (i)

$H_2 + \frac{1}{2}O_2 = H_2O, \Delta H = -240$ (ii)

$8C + 9H_2 = C_8H_{18}, \Delta H = +160$ (iii)

By applying 8 × eqn. (i) + 9 × eqn. (ii) – eqn. (iii)

$$2\,C_8H_{18} + \frac{25}{2}O_2 = 8CO_2 + 9\,H_2O$$

So, $\Delta H = 8 \times (-490) + 9 \times (-240) - 160$

$\Delta H = -3920 - 2160 - 160$

$\Delta H = -6240\ Jmol^{-1}$

Hence, energy released when 6 moles of octane is burnt in air = 6 × – 6240 = – 37440 J

$\Delta H_R = -37.4$ kJ

657. Combustion of glucose takes place according to the equation,

$C_6H_{12}O_6 + 6O_2 \longrightarrow 6CO_2 + 6H_2O$, $\Delta H = -72$ k – cal

The energy required for combustion of 1.6 g of glucose is

(a) 0.064 k-cal
(b) 0.64 k-cal
(c) 6.4 k-cal
(d) 64 k-cal

JIPMER-2017

Ans. (b) : $6CO_2 + 6H_2O + 72\ Cal \rightarrow C_6H_{12}O_6 + 6O_2$

For production of 180 gm of glucose, heat energy is 72 kcal.

Number of moles of glucose

$$=\frac{1.6}{180}$$

So, required heat for 1.6 gm of glucose

$$=\frac{72}{180}\times 1.6 = 0.64\ \text{kcal}$$

658. When the heat of reaction at constant pressure is -2.5×10^3 cal and entropy change is 7.4 cal deg^{-1} at 25° C, the reaction is predicted as

(a) reversible
(b) spontaneous
(c) non-spontaneous
(d) irreversible

JIPMER-2017

Ans. (b) : $\Delta H = -2.5 \times 10^3$ cal

$\Delta S = 7.4$ cal deg^{-1}

$\therefore \Delta G = \Delta H - T\Delta S = -2.5\times 10^3 - 298 \times 7.4$

$\Delta G = -2.5\times 10^3 - 2205.2$

$\Delta G = -4705.2$ cal.

$\because \Delta G$ is negative so the reaction is spontaneous.

659. 0.001 mole of $[Co(NH_3)_5\ (NO_3)(SO_4)]$ was passed through a cation exchanger and the acid coming out of it required 20mL of 0.1 M NaOH for neutralization. Thus, the complex is

(a) $[Co(NH_3)_5(NO_3)]SO_4$
(b) $[Co(NH_3)_5(SO_4)]NO_3$
(c) $[Co(NH_3)_5]\ NO_3.SO_4$
(d) None of the above

JIPMER-2015

Ans. (a) : n_{eq} of complex = n_{eq} of acid released from cation exchanger = n_{eq} of NaOH.

$\therefore 0.001 \times n = 20 \times 10^{-3} \times 0.1$

$n = 2$

$\therefore$ the complex is $[Co\,(NH_3)_5\,(NO_3)]\,SO_4$

660. What would be the heat released when an aqueous solution containing 0.5 mole of HNO_3 is mixed with 0.3 mole of OH^-?

(enthalpy of neutralization is –57.1kJ)

(a) 28.5 kJ
(b) 17.1 kJ
(c) 45.7 kJ
(d) 1.7 kJ

JIPMER-2015

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Ans. (b) : The enthalpy of neutralization is
–57.1 KJ/mol
0.3 mole of HNO_3 will react with 0.3 mol of OH^-
The heat released would be
0.3 mol × –57.1 kJ/mol = 17.1 kJ

661. The standard enthalpies of formation of A (NH_3),B(CO_2),C(HI) and D $(SO)_2$ are –46.19, –393.4, + 24.94 and –296.9 kJ mol^{-1} respectively. The increasing order of their stability is.

(a) B< D< A< C (b) C<A<D<B
(c) D<B<C<A (d) A<C<D<B

JIPMER-2014

Ans. (a) : Lower the value of standard enthalpy of formation, higher the stability. The increasing order of stability is given as,

$$\boxed{B< D< A< C}$$

662. The heat of formation of CO(g) and CO_2 (g) are ΔH = – 110 and ΔH = – 393 kJ mol^{-1} respectively. What is the heat of reaction (ΔH) $\left(\text{in kJ mol}^{-1}\right)$ for the following reaction?

$$CO(g)+\frac{1}{2}O_2(g)\longrightarrow CO_2(g)$$

(a) – 504 (b) – 142.5
(c) – 283 (d) 504

JIPMER-2009

Ans. (c) : According to Hess's law,

$$C+\frac{1}{2}O_2 \rightarrow CO, \Delta H = -110\,kJmol^{-1} \quad (i)$$

$$C + O_2 \rightarrow CO_2,\ \Delta H = -393\ kJmol^{-1} \quad (ii)$$

On subtracting Eq. (i) from Eq. (ii), we get

$$CO+\frac{1}{2}O_2 \rightarrow CO_2$$

$$\Delta H = -393-(-110)$$

$$\Delta H = -393+110$$

$$\boxed{\Delta H = -283\ \mathbf{k}J\ mol^{-1}}$$

663. The absolute enthalpy of neutralization of the reaction

$MgO(s)$ + $2HCl(aq)$ $\longrightarrow$ $MgCl_2(aq)$ + $H_2O(l)$ will be

(a) less than – 57.33kJ mol^{-1}
(b) – 57.33kJ mol^{-1}
(c) greater than – 57.33kJ mol^{-1}
(d) 57.33 kJ mol^{-1}

JIPMER-2007
NEET -2005

Ans. (a) : Heat of neutralization of strong acid and strong base is -57. 33 kJ. MgO is weak base while HCl is strong acid. So, the heat of neutralization of MgO and HCl is lower to – 57.33kJ because MgO requires some heat in ionisation, then net released amount of heat is decreased.

664. The enthalpy of combustion at 25°C of H_2, cyclohexane (C_6H_{12}) and cyclohexene (C_6H_{10}) are –241, –3920 and –3800 kJ/mol respectively. The heat of hydrogenation of cyclohexene is:

(a) –121kJ/mol (b) +121KJ/mol
(c) –242kJ/mol (d) +242kJ/mol

JIPMER-2006

Ans. (a) :

$$(1)\ H_2+\frac{1}{2}O_2 \rightarrow 2H_2O \quad \Delta H = -241\,kJ$$

$$(2)\ C_6H_{10}+\frac{17}{2}O_2 \rightarrow 6CO_2+5H_2O \quad \Delta H = -3800kJ$$

$$(3) C_6H_{12}+9O_2 \rightarrow 6CO_2+6H_2O \quad \Delta H = -3920kJ$$

By adding (1) , (2) and subtracting (3) we get,

$$C_6H_{10}+H_2 \rightarrow C_6H_{12}$$

So,

$$C_6H_{10}+H_2 \rightarrow C_6H_{12}$$

$$\Delta H = -241-3800+3920$$

$$\Delta H = -121\,kJ$$

665. $C_{(dia)} + O_2 \rightarrow CO_2$; ΔH = – 395.4 kJ/mole
$C_{(gr)} + O_2 \rightarrow CO_2$; ΔH = – 393.5 kJ/mole
$C_{(gr)} \rightarrow C_{(dia)}$; ΔH = ?

(a) –3.8 (b) –1.9
(c) +3.8 (d) +1.9

JIPMER-2005

Ans. (d) :
C (diamond) + O_2(g) → CO_2, Δ H = –395.4kJ/mol
C (graphites) + O_2(g) → CO_2, Δ H = –393.5 kJ/mol
On subtracting e.q. (i) by e.q. (ii) we get,
C (diamond) → C (graphite)
Δ H = −395.4 –(–393.5) = +1.9 kJ

666. For the formation of Cr_2O_3 and Al_2O_3, values of Δ_fG^o are –540 kJ mol^{-1} and –827 kJ mol^{-1} respectively. What will be the possibility for reaction of Cr_2O_3 by Al?

(a) Reduction of Cr_2O_3 by Al will take place
(b) Oxidation of Cr_2O_3 by Al will take place
(c) Neither oxidation nor reduction will take place
(d) Reaction is not feasible

JIPMER-2016

Ans. (a) :

$$2\,Cr+\frac{3}{2}O_2 \rightarrow Cr_2\,O_3\ ;\ \boldsymbol{\Delta}_f\ G^o = -540\ \mathbf{k}J\ mol^{-1} \quad (i)$$

$$2\,Al+\frac{3}{2}O_2 \rightarrow Al_2\,O_3\ ;\ \boldsymbol{\Delta}_f\ G^o = -827\ \mathbf{k}J\ mol^{-1} \quad (ii)$$

Subtracting equation (i) from (ii)

$$2Al + Cr_2O_3 \rightarrow Al_2O_3 + 2Cr$$

$$\boldsymbol{\Delta}_fG = [-827]-(-540)\ kJ\ mol^{-1}$$

$$\boldsymbol{\Delta}_fG = -287\ kJ\ mol^{-1}$$

667 In the reaction, $S+\frac{3}{2}O_2 \longrightarrow SO_3+2x\,kJ$ **and**

$$SO_2+\frac{1}{2}O_2 \longrightarrow SO_3+y\,kJ\ .$$

Heat of formation of SO_2 is

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(a) x + y (b) x – y
(c) 2x – y (d) 2x + y

Karnataka-CET-2015
Kerala-CEE-2008

Ans. (c) : $S+\frac{3}{2}O_2 \rightarrow SO_3, \Delta H = -2x$ kcal (i)

$SO_2+\frac{1}{2}O_2 \rightarrow SO_3, \Delta H = -y$ kcal (ii)

Now Subtract eq. (i) from (ii), we get
Heat of formation of SO_2= (2x –y) kcal.

668. The ratio of heats liberated at 298 K from the combustion of one kg of coke and by burning water gas obtained from kg of coke is (Assume code to be 100% carbon). (Given : enthalpies of combustion of CO_2, CO and H_2 as 393.5 kJ, 285 kJ, 285 kJ respectively all at 298 K)

(a) 0.79 : 1 (b) 0.69 : 1
(c) 0.86 : 1 (d) 0.96 : 1

Karnataka-CET-2014

Ans. (b) : Given, $\Delta H_{CO_2} = 393.5$ kJ,

$\Delta H_{CO} = 285$ kJ

$\Delta H_{H_2} = 285$ kJ

The ratio of heats liberated $= \frac{\Delta H_{CO_2}}{\Delta Hco + \Delta H_{H_2}}$

$= \frac{393.5\,kJ}{285\,kJ + 285\,kJ} = \frac{0.69}{1}$

669. Given thermochemical equation,
$2H_2(g) + O_2(g) \rightarrow 2H_2O(l); \Delta H = -571.6$ kJ. Heat of decomposition of water is

(a) –571.6 kJ (b) + 571.6 kJ
(c) – 1143.2 kJ (d) + 285.8 kJ

Karnataka-CET-2013

Ans. (d) : $2H_2(g) + O_2(g) \rightarrow 2H_2O, \Delta H = -571.6$kJ

at $H_2O(l) \rightarrow H_2(g) + \frac{1}{2}O_2(g)$

$\therefore \Delta H = ?$

If reaction (i) is reversed and divided by 2, the sign ΔH change i.e.

$= +\frac{571.6}{2} = 285.8$ kJ

670. The amount of heat evolved when 500 cm^3 of 0.1 M HCl is mixed with 200 cm^3 of 0.2 M NaOH is

(a) 2.292 kJ (b) 1.292 kJ
(c) 0.292 kJ (d) 3.392 kJ

KARNATAKA-CET, 2010, 2011

Ans. (a) : $HCl + NaOH \rightarrow NaCl + H_2O$

Initial moles $\frac{500\times0.1}{1000}$ $\frac{200\times0.2}{1000}$ 0 0
= 0.05 = 0.04
Final moles
0.05 – 0.04 0 0.04 0.04
= 0.01

$\because$ For neutralisation of 1 mole of NaOH by 1 mole HCl, heat evolved = 57.3 kJ
$\therefore$ To neutralise 0.04 mole of NaOH by 0.04 mole of HCl,
heat evolved will be = 57.3 × 0.04 kJ
= 2.292 kJ

671. Enthalpy of vaporization of benzene is +35.3 kJ mol^{-1} at its boiling point, 80°C. The entropy change in the transition of the benzene in [JK^{-1} mol^{-1}] is

(a) – 441 (b) – 100
(c) + 441 (d) + 100

KARNATAKA-CET, 2010

Ans. (d) : Entropy change in the transition of the vapour to liquid

$$\Delta S_{cond} = \frac{\Delta H_{cond}}{T_b}$$

$$= \frac{35.3\times10^3\,J\,mol^{-1}}{(80+273)K}$$

$= 100\ JK^{-1}\ mol^{-1}$

672. The enthalpy of formation of NH_3 is – 46 kJ mol^{-1}. The enthalpy change for the reaction
$2NH_3(g) \rightarrow N_2(g) + 3H_2(g)$ is

(a) +184 kJ (b) + 23 kJ
(c) +92 kJ (d) + 46 kJ

KARNATAKA-CET, 2009

Ans. (c) : $2NH_3(g) \longrightarrow N_2(g) + 3H_2(g)$

$\Delta H_r = -(2 \times$ enthalpy of formation of $NH_3)$
$= -(2 \times -46) = 92$ kJ

673. When 0.2 g of 1-butanol was burnt in a suitable apparatus, the heat evolved was sufficient to raise the temperature of 200 g water by 5°C. The enthalpy of combustion of 1 butanol in kcal mol^{-1} will be

(a) +37 (b) +370
(c) -370 (d) -740
(e) -14.8

Kerala-CEE-2009

Ans. (b) : Molar mass of $C_4H_{10}O = 74\ gmol^{-1}$
Heat required to raise the temperature of 200 gm of water by 5°C.

$= m \times s \times \Delta t$
$= 200 \times 1 \times 5$
$= 1$ kcal

$\because$ 0.2 gm of 1-butanol liberates 1 kcal of heat.

So, enthalpy of combustion $= 1\times\frac{74}{0.2}$

$= 370$ kcal mol^{-1}

$\Delta H = +370$ kcal mol^{-1}

Since, the heat is liberated , $\Delta H = -370$ KCal

674. What would be the heat released when an aqueous solution containing 0.5 mole of HNO_3 is mixed with 0.3 mole of OH^- (enthalpy of neutralization is –57.1 kJ)?

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(a) 28.5 kJ (b) 17.1 kJ
(c) 45.7 kJ (d) 1.7 kJ
(e) 2.85 kJ

Kerala-CEE-2005

Ans. (b) : $H^+(aq) + OH^-(aq) \rightarrow H_2O(l)$

$\Delta H = -57.1$ kJ

0.5 mol of $HNO_3 \longrightarrow [H^+] = 0.5$ mol

$[OH^-] = 0.3$ mol

1 mol of H^+ & $OH^- \longrightarrow$ energy release = 57.1 kJ

0.3 mol of H^+ & $OH^- \longrightarrow$ energy released

$= 57.1 \times 0.3$ kJ

$= 17.13$ kJ

675. The enthalpy change for the transition of liquid water to steam is 40.8 kJ mol^{-1} at 373 K. What is the entropy of vaporization of water?

(a) 209.4 (b) 109.4
(c) –109.4 (d) –209.4
(e) 250.4

Kerala-CEE-2004

Ans. (b) $H_2O\ (l) \rightarrow H_2O\ (g)$

$\Delta G = \Delta H - T\Delta S$

We know that, $\Delta S_{vapour} = \dfrac{\Delta H_{vapour}}{T}$

$\Delta H_{vapour} = 40.8$ kJ mol^{-1}

$= 40.8 \times 1000$ J mol^{-1}

T = 373 K

Thus, $\Delta S_{vapour} = \dfrac{40.8 \times 1000}{373} = 109.38 JK^{-1}mol^{-1}$

676. Molar heat capacity of aluminium is 25 JK^{-1} mol^{-1}. The heat necessary to raise the temperature of 54 g of aluminium (atomic mass 27 g mol^{-1}) from 30°C to 50°C is

(a) 1.5 kJ (b) 0.5 kJ
(c) 1.0 kJ (d) 2.5 kJ
(e) 2.0 kJ

Kerala-CEE-2011

Ans. (c) : ∵ Molar heat capacity is.

$$nC = \frac{Q}{T_2 - T_1}$$

$$Q = nC\ (T_2 - T_1)$$

$$Q = \frac{54}{27} \times 25 \times (50 - 30)$$

$$Q = 2 \times 25 \times 20$$

$$Q = 1000g \Rightarrow 1.0\ kJ$$

677. The standard enthalpies of combustion of $C_6H_6(l)$, $C_{(graphite)}$ and $H_2(g)$ are respectively –3270 kJ mol^{-1}, –394 kJ mol^{-1} and –286 kJ mol^{-1}. What is the standard enthalpy of formation of $C_6H_6(l)$ in kJ mol^{-1}?

(a) – 48 (b) + 48
(c) – 480 (d) + 480
(e) – 72

Kerala-CEE-2012

Ans. (b) :

(a) $C_6H_6 + \frac{15}{2}O_2 \rightarrow 6CO_2 + 3H_2O;\ \Delta H = -3270\,kJ\,mol^{-1}$

(b) $C_{(graphite)} + O_2 \rightarrow CO_2;\ \ \Delta H = -394\,kJ\,mol^{-1}$

(c) $H_2 + \frac{1}{2}O_2 \rightarrow H_2O;\ \ \Delta H = -286\,kJ\,mol^{-1}$

Now, Multiplication of (b) by 6 and (c) by 3, gives

(d) $6C(s) + 6O_2 \rightarrow 6CO_2;\ \ \Delta H = -394 \times 6 = -2364 kJ\,mol^{-1}$

(e) $3H_2 + \frac{3}{2}O_2 \rightarrow 3H_2O;\ \ \Delta H = -286 \times 3 = -858 kJ\,mol^{-1}$

On inverting (a) we get

(f) $6CO_2 + 3H_2O \rightarrow C_6H_6 + \frac{15}{2}O_2;\ \ \Delta H = +3270\,kJ\,mol^{-1}$

by adding (f), (e) and (d) we get :-

$6C + 3H_2 \rightarrow C_6H_6;\ \Delta H = 3270 + (-2364 - 858)$

$\Delta H = +48$ kJ mol^{-1}

678. The entropy of vaporization of a liquid is 58 JK^{-1} mol^{-1}. If 100 g of its vapour condenses at its boiling point of 123° C, the value of entropy change for the process is

(a) – 100 JK^{-1} (b) 100 JK^{-1}
(c) – 123 JK^{-1} (d) 123 JK^{-1}
(e) 1230 JK^{-1}

Kerala-CEE-2014

Ans. (a) : ∵ Entropy change when 1 mole of the liquid vapourises = 58 JK^{-1}

∴ Entropy change when 1 mole of the liquid condense = – 58JK^{-1}

Moles of the liquid used in the change = 1.724 mol.

∴ Entropy change when 1.724 moles (for 100 g) of the liquid condenses, $\Delta S = \dfrac{-58 \times 1.724}{1} = -100 JK^{-1}$

679. The lattice energy of NaCl is 788 kJ mol^{-1} This means that 788 kJ of energy is required

(a) To separate one mole of solid NaCl into one mole of Na (g) and one mole of Cl (g) to infinite distance
(b) To separate one mole of solid NaCl into one mole of Na^+ (g) and one mole of Cl^- (g) to infinite distance
(c) To convert one mole of solid NaCl into one mole of gaseous NaCl
(d) To convert one mole of gaseous NaCl into one mole of solid NaCl
(e) To separate one mole of gaseous NaCl into one mole of Na^+ (g) and one mole of Cl^- (g) to infinite distance

Kerala-CEE-2014

Ans. (b) : Lattice energy– Lattice energy is that amount of energy which is required to separate one mole of a solid into its constituents gaseous ions at infinite distances.

Since the lattice energy of NaCl is 788 kJ /mol. It means that 788 kJ of energy is required to separate one mole of solid NaCl into one mole of Na^+ (g) and one mole of Cl^- (g) to infinite distance.

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680. The enthalpy of combustion of glucose (mol. wt. : 180 g mol^{-1}) is - 2840 kJ mol^{-1}. Then the amount of heat evolved when 0.9 g of glucose is burnt, will be

(a) 14.2 kJ (b) 142 kJ
(c) 28.4 kJ (d) 1420 kJ
(e) 142 kJ

Kerala-CEE-2015

Ans. (a) : Solution:-

The enthalpy of combustion of glucose = -2840 kJ/mole

180g glucose gives enthalpy of combustion = 2840 kJ/mol

1g glucose gives enthalpy of combustion = $\frac{2840}{180}$

So, 0.9g glucose gives enthalpy of combustion

$$= \frac{2840}{180} \times 0.9 = \frac{2840 \times 9}{1800}$$

$$= \frac{2840}{200} = 14.2 \text{kJ}$$

681. The standard enthalpy of formation of H_2O (l) and $Fe_2O_3(s)$ are respectively -286kJ mol^{-1} and – 824 kJ mol^{-1}. What is the standard enthalpy change for the following reaction?

$Fe_2O_3(s) + 3H_2(g) \longrightarrow 3H_2O(l) + 2Fe(s)$

(a) -538 kJ mol^{-1} (b) +538 kJ mol^{-1}
(c) -102 kJ mol^{-1} (d) +34 kJ mol^{-1}
(e) -34 kJ mol^{-1}

Kerala-CEE-2016

Ans. (e) : H_R (Heat of reaction) = ΣH_f^0 (Product)– ΣH_f^0 (reactant)

$H_R = -(3 \times 286) - (-824)$
$H_R = -858 + 824$

$\because$ H_f^0 for H_2 and Fe = 0

$\therefore$ $H_R = -34$ kJ/mol

682. The standard heat of formation of CH_4, CO_2 and H_2O (l) are –76.2, –394.8 and –285.82 kJ mol^{-1}, respectively. Heat of vaporization of water is 44 kJ mol^{-1}. Calculate the amount of heat evolved when 22.4 L of CH_4, kept under normal conditions, is oxidized into its gaseous products.

(a) 802 kJ (b) 878.4 kJ
(c) 702 kJ (d) 788.4 kJ
(e) 500 kJ

Kerala-CEE-2019

Ans. (a) : $C + 2H_2 \rightarrow CH_4$,

$\Delta_f H^o = -76.2$ kJ/mol — (1)

$C + O_2 \rightarrow CO_2$,

$\Delta_f H^o = -394.8$ kJ/mol —— (2)

$H_2 + 1/2O_2 \rightarrow H_2O$,

$\Delta_f H^o = -285.82$ kJ/mol —— (3)

H_2O (l) $\rightarrow H_2O$(g) ,

$\Delta_v H^o = 44$ kJ/mol —— (4)

Given that,

$CH_4(g) + 2O_2(g) \rightarrow CO_2 + 2H_2O(g)$
$\Delta H^o = 76.2 - 2 \times 285.82 - 394.8 + 2 \times 44$
$\Delta H^o = -802.24$ kJ/mol.

Thus, heat evolved when 22.4 lit (1 mole of CH_4) is oxidized into its gaseous product is 802.24kJ.

683. The standard enthalpies of formation of $H_2O(l)$ and $CO_2(g)$ are respectively –286 kJ mol^{-1} and –394 kJ mol^{-1}. If the standard heat of combustion of $CH_4(g)$ is –891 kJ mol^{-1}, then the standard enthalpy of formation of $CH_4(g)$ is

(a) –75 kJ mol^{-1} (b) +75 kJ mol^{-1}
(c) –211 kJ mol^{-1} (d) + 211 kJ mol^{-1}
(e) –1571 kJ mol^{-1}

Kerala-CEE-2020

Ans. (a) : $CH_4(g) + 2O_2(g) \longrightarrow CO_2(g) + 2H_2O(l)$

$\therefore$ $\Delta H = [\{\Delta_f H(CO_2) + 2\Delta_f H(H_2)\} - \{\Delta_f H(CH_4) - 2\Delta_f H(O_2)\}]$

$\Delta H = [\{-394 + (2 \times 286)\} - \{\Delta_f H(CH_4) - 2 \times 0\}]$

or $-891 = -394 - 572 - \Delta_f H(CH_4)$

or $\Delta_f H(CH_4) = -(966 - 891)$
$= -(+75 \text{ kJ mol}^{-1})$
$= -75 \text{ kJ mol}^{-1}$

$\because$ Combustion is an exothermic process So, it will taken as $\Delta H = -$ ve sign

So, option (a) is correct.

684. Bond enthalpies of A_2, B_2 and AB are in the ratio 2 : 1 : 2. If bond enthalpy of formation of AB is -100kJ mol^{-1}. The bond enthalpy of B_2 is

(a) 100 kJ mol^{-1} (b) 50 kJ mol^{-1}
(c) 200 kJ mol^{-1} (d) 150 kJ mol^{-1}

Kerala-CEE-29.08.2021
Karnataka-CET-2021

Ans. (c) : Given that,

$A_2 : B_2 : AB = 2 : 1 : 2$

$\Delta H_{AB} = -100 \text{ kJmol}^{-1}$

The following reaction take place -

$A_2 + B_2 \rightarrow 2AB$

or $\frac{1}{2}A_2 + \frac{1}{2}B_2 \rightarrow AB$

We can calculate the bond enthalpy of B_2 by the given equation -

$$\frac{1}{2}\Delta H_{A_2} + \frac{1}{2}\Delta H_{B_2} - \frac{1}{2}\Delta H_{AB} = -100$$

or $\frac{1}{2} \times 2x + \frac{x}{2} - 2x = -100$

or $x = 200 \text{ kJmol}^{-1}$

685. For the reaction

$CH_3COOH_{(l)} + 2O_{2(g)} \rightleftharpoons 2CO_{2(g)} + 2H_2O_{(l)}$

at 25ºC and 1 atm pressure, ΔH = –874kJ. Then the change in internal energy (ΔE) is :

(a) – 874 kJ (b) – 871.53 kJ
(c) – 876.47 kJ (d) + 874 kJ

Manipal-2019

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Ans. (a) : Given reaction,

$$CH_3COOH(l)+2O_2(g) \rightleftharpoons 2CO_2(g)+2H_2O(l), \Delta H=-874kJ$$

We know that,

$$\Delta H = \Delta E + P\Delta V$$

from Ideal gas equation $P\Delta V = \Delta nRT$

$\Rightarrow \Delta H = \Delta E + \Delta nRT$

No. of mole of reactant = No. of mole of product

$$\Delta n = 0$$

Then, $\Delta H = \Delta E$

$$\Delta E = -874kJ$$

686. The enthalpy change for the transition of liquid water to steam is 40.8 kJ mol^{-1} at 373 K. Calculate the entropy of vaporisation of water :

(a) 109.4 JK^{-1} mol^{-1}
(b) 10.94 JK^{-1} mol^{-1}
(c) 1.094 JK^{-1} mol^{-1}
(d) 1009.4 JK^{-1} mol^{-1}

Manipal-2018

Ans. (a) : Given, $\Delta H_{vapour} = 40.8$ kJmol^{-1}, T = 373K

$$H_2O\ (l) \rightarrow H_2O\ (g)$$

$$\Delta S_{vapour} = \frac{\Delta H_{vapour}}{T}$$

$$\Delta H_{vapour} = 40.8 \text{ KJ mol}^{-1}$$
$$= 40.8 \times 1000 \text{ J mol}^{-1}$$

$$\Delta S_{vapour} = \frac{40.8 \times 1000}{373}$$
$$= 109.38 \text{ JK}^{-1} \text{ mol}^{-1}$$

687. The entropy change for the fusion of 1 mol of a solid which melts at 27ºC is (latent heat of fusion = 600 cal mol^{-1})

(a) 2 cal K^{-1}
(b) 22.2 cal K^{-1}
(c) 180 k cal K
(d) 0.5 cal^{-1} K

Manipal-2018

Ans. (a) : Given, T = 27 + 273 = 300 K

We know that,

$$\Delta S \text{ of fusion } = \frac{\Delta H_{fus.}}{T} = \frac{600}{300} = \frac{6}{3} = 2\text{cal K}^{-1}$$

688. The formation of oxide ion O^{2-} (g) require first an exothermic and then an endothermic step a shown below :

$$\mathbf{O(g) + e^- \longrightarrow O^-(g);\ \Delta H^o = -142\ kJ\ mol^{-1}}$$

$$\mathbf{O^-(g) + e^- \longrightarrow O^{2-}(g);\ \Delta H^o = 844\ kJ\ mol^{-1}}$$

This is because :

(a) Oxygen is more electronegative
(b) O$^-$ ion has comparatively larger size than oxygen atom
(c) O$^-$ ion will tend to resist the addition of another electron
(d) Oxygen has high electron affinity

Manipal-2018

Ans. (c) : Formation of the oxide ion O^{2-} (g) require first an exothermic and then an endothermic step.

$$O^{-1}(g) + e^- \rightarrow O^{-2}(g)$$

When an electron is added to negatively charged ion, it will experiences more repulsion rather than attraction.

689. Enthalpy of formation of HF and HCl are –161 kJ and –92 kJ, respectively. Select the incorrect statement on the basis of the above fact.

(a) HF is more stable than HCl
(b) HCl is more stable than HF
(c) Affinity of fluorine to hydrogen is greater than affinity of chlorine to hydrogen
(d) HF and HCl are exothermic compound

Manipal-2016

Ans. (b) : Compound for which ΔH_f is negative is more stable than the compound for which ΔH_f is positive. i.e exothermic compounds are more stable than endothermic compounds as HF with ΔH_f = 161kJ is more stable than HCl with ΔH_f = –92kJ.

690. Calculate the difference between heat of combustion of carbon monoxide gas at constant pressure and at constant volume at 27°C? (R = 2 cal K^{-1} mol^{-1})

(a) 54 cal
(b) + 600 cal
(c) – 300 cal
(d) 27 cal

MHT CET-02.05.2019, SHIFT-III

Ans. (b) : $2C(s) + O_2(g) \rightarrow 2CO(g)$

Heat of combustion of monoxide at constant pressure is ΔH and volume is ΔU.

$$\Delta H - \Delta U = n_gRT$$
$$n_g = 1$$
$$T = 27 + 273 = 300 \text{ K}$$
$$\Delta H - \Delta U = 1 \times 2 \times 300 = 600 \text{ cal.}$$

691. If C(s) +O$_2$(g) → CO$_2$(g), ΔH = –X,

$$\mathbf{CO(g) + \frac{1}{2}O_2(g) \rightarrow CO_2(g),\ \Delta H = -Y,}$$ **Calculate Δ_fH for CO$_{(g)}$ formation**

(a) – Y – X
(b) Y – X
(c) X + Y
(d) X – Y

MHT CET-02.05.2019, SHIFT-II

Ans. (b) : Given

$$C(s) + O_2(g) \rightarrow CO_2(g);\ \Delta H = -X \quad ....(i)$$

$$CO(g) + \frac{1}{2}O_2 \rightarrow CO_2;\quad \Delta H = -Y \quad ....(ii)$$

On reversing equation (ii) we get,

$$CO_2(g) \longrightarrow CO(g) + \frac{1}{2}O_2(g); \Delta H = +y \quad ....(iii)$$

Adding equation (i) & (iii),

$$C(s) + \frac{1}{2}O_2(g) \longrightarrow CO(g);\ \Delta H = -x + y = y - x$$

692. Calculate the work done during compression of 2 mol of an ideal gas from a volume of 1m^3 to 10 dm^3 300K against a pressure of 100 KPa.

(a) – 99 kJ
(b) +99 kJ
(c) + 22.98 kJ
(d) – 22.98 kJ

MHT CET-2017

Ans. (b) : We know that,

$$W = -PdV = -P(V_2 - V_1) = P(V_1 - V_2)$$
$$W = 100\,(1 - 10 \times 10^{-3}) \qquad (\because 1dm^3 = 10^{-3}m^3)$$
$$W = 100\,(1 - 0.01)$$
$$W = 100 \times 0.99 = +99kJ$$

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693. Assuming enthalpy of combustion of hydrogen at 273 K is –286 kJ and enthalpy of fusion of ice at the same temperature to be +6.0 kJ, calculate enthalpy change during formation of 100 g of ice.

(a) + 1622 kJ (b) – 1622 kJ
(c) + 292 k j (d) – 292 kJ

MHT CET-2014

Ans. (b) :

$H_2(g) + \frac{1}{2}O_2(g) \rightarrow H_2O(l)\ ;\ \Delta H_{comb.} = -286KJ$ ... (i)

$H_2O(s) \rightarrow H_2O(l)\ ;\quad \Delta H_{fus.} = +6kJ$ .... (ii)

On subtracting (II) from (I)

$H_2(g) + \frac{1}{2}O_2(g) \rightarrow H_2O(s)\ ;\ \Delta H = -286 - 6$

$= -292$ KJ

$\because$ On formation of 100g ice, change in enthalpy

$= \frac{-292 \times 100}{18} = \frac{-292 \times 50}{9} = -1622$ kJ

694. Which of the following on combustion gives maximum energy?

(a) Ethane (b) Propane
(c) Methane (d) Butane

MHT CET-2012

Ans. (d) : Equation for combustion of alkanes is as follows

$$C_nH_{2n+2} + \left(\frac{3n+1}{2}\right)O_2 \rightarrow n\,CO_2 + (n+1)\,H_2O + \text{Heat}$$

Greater the value of n greater will be the heat produced. Therefore, on combustion of butane gives maximum energy.

695. The heat of neutralization of a strong acid and a strong alkali is 57.0 kJ mol^{-1}. The heat released when 0.5 mole of HNO_3 solution is mixed with 0.2 mole of KOH is

(a) 57.0 kJ (b) 11.4 kJ
(c) 28.5 kJ (d) 34.9 kJ

MHT CET-2011

Ans. (b) :

$NHO_3 + KOH \rightarrow KNO_3 + H_2O$

0.2 mole HNO_3 + 0.2 mole KOH $\rightarrow$ 0.3 mole HNO_3 unneutralized

$(\Delta H_{neut.})_{\text{strong acid + strong alkali}} = 57.0$ kJ/mol

but 0.2 mol neutralized ,

0.2 mole × 57.0 = 11.4 kJ

696. The heat of formation of water is 260 kJ. How much H_2O is decomposed by 130 kJ of heat?

(a) 0.25 mol (b) 1 mol
(c) 0.5 mol (d) 2 mol

MHT CET-2010

Ans. (c) : Given, Heat of formation = 260 kJ

$H_2 + \frac{1}{2}O_2 \rightarrow H_2O\ ;\ \Delta H = 260\,kJ$ ...... (i)

On reversing Eq. (i) we get,

$H_2O \rightarrow H_2 + \frac{1}{2}O_2\ ;\ \Delta H = -260$ kJ ……..(ii)

$\because$ By 260 kJ heat water decomposed = 1 mol

$\therefore$ 130 kJ heat will decompos water $= \frac{1 \times 130}{260} = 0.5$ mol

697. Heat of combustion of methane is –800 kJ. What is the heat of combustion for 4×10^{-4} kg of methane?

(a) – 800 kJ (b) – 3.2 × 10^4 kJ
(c) – 20 kJ (d) – 1600 kJ

MHT CET-2009

Ans. (c) : On combustion of methane,

$CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O\ ;\ \Delta H_C = -800kJ$

$\because$ Heat of combustion of 16×10^{-3} kg of CH_4 = –800 kJ

$\therefore$ Heat of combustion of 4×10^{-4} kg of CH_4

$= \frac{-800 \times 4 \times 10^{-4}}{16 \times 10 - 3} = -20kJ$

698. If ΔE is the heat of reaction for
$C_2H_5OH(l) + 3O_2(g) \rightarrow 2CO_2(g) + 3H_2O(l)$
at constant volume, the ΔH (heat of reaction at constant pressure), at constant temperature is

(a) ΔH = ΔE + RT (b) ΔH = ΔE – RT
(c) ΔH = ΔE – 2RT (d) ΔH = ΔE + 2RT

MHT CET-2008

Ans. (b) : Given reaction,

$C_2H_5OH(l) + 3O_2(g) \rightarrow 2\,CO_2(g) + 3H_2O(l)$

We know that,

$\Delta H = \Delta E + \Delta nRT$

$\Delta n = 2 - 3 = -1$

$\boxed{\Delta H = \Delta E - RT}$

699. For the reaction,

$$2H_2(g) + O_2(g) \longrightarrow 2H_2O(g)\ ;\Delta H = -573.2\,kJ$$

The heat of decomposition of water per mole is

(a) 286.6 kJ (b) 573.2 kJ
(c) – 28.66 kJ (d) zero

MHT CET-2007

Ans. (a) :

$2H_2(g) + O_2(g) \longrightarrow 2H_2O(g)\ ;\Delta H = -573.2\,kJ$

On reversing and dividing by 2 we get,

$H_2O(g) \rightarrow H_2(g) + \frac{1}{2}O_2(g)\ ;\ \Delta H = +\frac{573.2}{2} = +286.6$ kJ

700. The values of ΔH and ΔS for the reaction,
$C_{(graphic)} + CO_2(g) \rightarrow 2CO(g)$
are 170 kJ and 170 J K^{-1}, respectively. This reaction will be spontaneous at

(a) 910 K (b) 1110 K
(c) 510 K (d) 710 K

NEET-2009

Ans. (b) : Given, ΔH = 170 kJ = 170 × 10^3 J

ΔS = 170 JK^{-1} mol^{-1}

For the reaction to be spontaneous, ΔG = –ve

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Applying, $\Delta G = \Delta H - T\Delta S$, the value of $\Delta G = -ve$ only when $T\Delta S > \Delta H$, which is possible only when T = 1110K.

$\therefore \Delta G = 170 \times 10^3 - (1110 \times 170) = -18700J$

Thus, reaction is spontaneous at T = 1110K

701. The following two reactions are known
$Fe_2O_3(s)+3CO(g) \to 2Fe(s)+3CO_2(g);$
$\Delta H = -26.8kJ$
$FeO(s)+CO(g) \to Fe(s)+CO_2(g);\ \Delta H = -16.5kJ$
The value of ΔH for the following reaction.
$Fe_2O_3(s) + CO(g) \to 2Fe(s)+CO_2(g)$ is

(a) + 10.3 kJ (b) – 43.3 kJ
(c) – 10.3 kJ (d) + 6.2 kJ

NEET-2010

Ans. (d) : Given, equation –

$Fe_2O_3(s)+3CO(g) \to 2Fe(s)+3CO_2(g)$;
$\Delta H = -26.8$ kJ ....(i)

$FeO(s)+CO(g) \to Fe(s)+CO_2(g)$; $\Delta H = -16.5$ kJ ….(ii)

on multiplying E.q (ii) with 2, we get

$2FeO(s) + 2CO(g) \to 2Fe(s) + 2CO_2(g)$;
$\Delta H = -33kJ$ ….(iii)

On substracting Eq (iii) from (i),

$Fe_2O_3(s) + CO(g) \to 2FeO(s) + CO_2(g)$;
$\Delta H = -26.8 - (-33) = +6.2$ kJ

702. For which one of the following equation is $\Delta H^0_{reaction}$ equal to ΔH^0_f for the product?

(a) $N_{2(g)} + O_{3(g)} \to N_2O_{3(g)}$

(b) $CH_{4(g)} + 2Cl_{2(g)} \to CH_2Cl_{2(\ell)} + 2HCl_{(g)}$

(c) $Xe_{(g)} + 2F_{2(g)} \to XeF_{4(g)}$

(d) $2CO_{(g)} + O_{2(g)} \to 2CO_{2(g)}$

NEET-2003

Ans. (c) :

$$\Delta H^o_r = (\Delta H^o_f\ XeF_4) - \left[\Delta H^o_f\ Xe + \Delta H^o_f\ F_2 \times 2\right]$$

$$\searrow\ \swarrow$$

$$\text{elementary}\ \boxed{\Delta H = 0}$$

The heat of formation is defined as the heat generated or absorbed when the compound is formed from its component elements in their standard state.

703. Heat of combustion ΔH for C(s), $H_2(g)$ and $CH_4(g)$ are –94, –68 and –213 kcal/mol, Then ΔH for $C(s) + 2H_2(g) \to CH_4(g)$ is

(a) –17 kcal (b) –111 kcal
(c) –170 kcal (d) –85 kcal

NEET-2002

Ans. (a) :

$C + O_2 \to CO_2$; $\Delta H = -94$ kcal

$2H_2 + O_2 \to 2H_2O$; $\Delta H = -68 \times 2$ kcal

$CH_4 + 2O_2 \to CO_2 + 2H_2O$; $\Delta H = -213$ kcal

$C(s) + 2H_2(g) \to CH_4(g)$;

$\Delta H = -[\Delta H_{Comb.}$ of $C + 2 \times \Delta H_{Comb.}$ of $H_2]$

$= -[-213 - (-94 + 2 \times -68)] = 213 - 230 = -17$ kcal

704. Change in enthalpy for reaction,
$2H_2O_2(l) \to 2H_2O(l) + O_2(g)$
If heat of formation of $H_2O_2(l)$ and $H_2O(l)$ are –188 and –286 kJ/mol respectively, is

(a) –196 kJ/mol (b) + 196 kJ/mol
(c) + 948 kJ/mol (d) – 948 kJ/mol

NEET-2001

Ans. (a) : $2H_2O_2(l) \to 2H_2O(l) + O_2(g)$

$\Delta H = [2 \times \Delta H_f$ of $H_2O(l) + (\Delta H_f$ of $O_2) - (2 \times \Delta H_f$ of $H_2O_2(l))]$

$= (2 \times -286) + (0) - (2 \times -188)$

$= -572 + 376 = -196$ kJ/mol

705. Enthalpy of CH_4 + 1/2 $O_2 \to CH_3OH$ is negative. If enthalpy of combustion of CH_4 and CH_3OH are x and y respectively, then which relation is correct?

(a) x > y (b) x < y
(c) x = y (d) x ≥ y

NEET-2001

Ans. (b) : $CH_2 + 2O_2 \to CO_2 + 2H_2O$; $\Delta H = x$ ….(i)

$2CH_3OH + 3O_2 \to 2CO_2 + 4H_2O$; $\Delta H = y$

On equation divided by 2 we get,

$CH_3OH + 1.5O_2 \to CO_2 + 2H_2O$; $\Delta H = y$ ….(ii)

Subtract equation (i) and (ii),

$$CH_4 + \frac{1}{2}O_2 \longrightarrow CH_3OH\ ;\quad \Delta H = -ve$$

$$x - y = -ve = \boxed{y > x}$$

706. In the reaction : S + 3/2$O_2 \to SO_3$ + 2x kcal and SO_2 + 1/2 $O_2 \to SO_3$ + y kcal, the heat of formation of SO_2 is

(a) (2x + y) (b) (x – y)
(c) (x + y) (d) (2x – y)

NEET-1999

Ans. (d) :

$$S + \frac{3}{2}O_2 \to SO_3 + 2x\,kcal \quad ....(i)$$

$$SO_2 + \frac{1}{2}O_2 \to SO_3 + y\,kcal \quad ....(ii)$$

Now subtract equation (ii) & (i) we get,

$$S - SO_2 + O_2 \to 2x - y\,kcal$$

$\therefore$ Heat of formation of SO_2 is equal to 2x – y kcal.

707. Given that $C + O_2 \to CO_2$; $\Delta H^o = -x$ kJ
$2CO + O_2 \to 2CO_2$; $\Delta H^o = -y$ kJ
The enthalpy of formation of carbon monoxide will be

(a) $\frac{y-2x}{2}$ (b) 2x – y

(c) y – 2x (d) $\frac{2x-y}{2}$

WB-JEE-2014, NEET-1997

Ans. (a) :

$C + O_2 \to CO_2$; $\Delta H^o = -x$ kJ …..(i)

$2CO + O_2 \to 2CO_2$; $\Delta H^o = -y$ kJ ….(ii)

Substration equation (i) and divided by 2 equation (ii),

$$C + \frac{1}{2}O_2 \to CO\ ;\Delta H = -x - (-y/2) = \frac{y-2x}{2}$$

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708. If enthalpies of formation for $C_2H_{4(g)}$, $CO_{2(g)}$ and $H_2O(l)$ at 25^0C and 1 atm pressure are 52, –394 and –286 kJ/mol respectively, then enthalpy of combustion of $C_2H_{4(g)}$ will be

(a) + 141.2 kJ/mol (b) + 1412 kJ/mol
(c) – 141.2 kJ/mol (d) – 1412 kJ/mol

NEET-1995

Ans. (d) : $C_2H_4(g) + 3O_2 \to 2CO_2 + 2H_2O$;

$\Delta H = \Delta H_{(products)} - \Delta H_{(reactant)}$

$= 2\times\Delta H_{CO_2} + 2\times\Delta H_{H_2O} - \Delta H_{C_2H_4} - 3\times\Delta H_{O_2}$

$= 2 \times (-394) + 2\times(-286) - 52 - 3 \times 0$

$= -1412$ kJ/mol

709. The bond dissociation energies of X_2, Y_2 and XY are in the ratio of 1:0.5:1. ΔH for the formation of XY is –200 kJ mol^{-1}. The bond dissociation energy of X_2 will be

(a) 200 kJ mol^{-1} (b) 100 kJ mol^{-1}
(c) 800 kJ mol^{-1} (d) 400 kJ mol^{-1}

NEET-2018

Ans. (c) :

$$\frac{1}{2}X_2 + \frac{1}{2}Y_2 \to XY \quad \Delta H = -200\,kJ/mol$$

$$1 \quad 0.5 \quad 1$$

$$X \quad X/2 \quad X$$

$$\Delta H = \sum H_R - \sum H_P \Rightarrow -200 = \left(\frac{1}{2}\times x + \frac{1}{2}\times 0.5x\right) - x$$

$200 = 0.25x \Rightarrow x = 200 \times 4 = 800$ kJ/mol

710. The heat of combustion of carbon to CO_2 is –393.5 kJ/mol. The heat released upon formation of 35.2 g of CO_2 from carbon and oxygen gas is

(a) + 315 kJ (b) – 630 kJ
(c) – 31.5 kJ (d) – 315 kJ

MHT CET-2011
NEET-2015

Ans. (d) :

$C(s) + O_2(g) \to CO_2(g)$; $\Delta H = -393.5$ kJ/mol

Heat released on formation of 44g $CO_2 = -393.5$ kJ/mol

∴ Heat released on formation of 35.2g CO_2 =

$$\frac{-393.5}{44}\times 35.2 = -314.5\,kJ/mol \simeq -315\,kJ/mol$$

711. When 5 litres of a gas mixture of methane and propane is perfectly combusted at 0^0C and 1 atmosphere, 16 litres of oxygen at the same temperature and pressure is consumed. The amount of heat released from this combustion in kJ

ΔH_{comb} (CH_4) = 890 kJ mol^{-1},
ΔH_{comb} (C_3H_8) = 2220 kJ mol^{-1} is

(a) 38 (b) 317
(c) 477 (d) 32

Karnataka NEET-2013

Ans. (b) : $\underset{x}{CH_4} + \underset{2x}{2O_2} \to CO_2 + 2H_2O$

$\underset{(5-x)}{C_3H_8} + \underset{5(5-x)}{5O_2} \to 3CO_2 + 4H_2O$

$2x + 5(5-x) = 16$

$\Rightarrow x = 3L$

∴ Heat released

$$= \frac{3}{22.4}\times 890 + \frac{2}{22.4}\times 2220 = 317\text{ kJ}$$

712. Enthalpy change for the reaction,
$4H_{(g)} \to 2H_{2(g)}$ is –869.6 kJ
The dissociation energy of H – H bond is

(a) – 434.8 kJ (b) – 869.6 kJ
(c) + 434.8 kJ (d) + 217.4 kJ

NEET-2011

Ans. (c) : Given,

$4H(g) \to 2H_2(g)$; $\Delta H = -869.6$ kJ

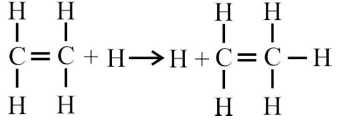
On reversing equation 1st and divided by 2 we get,

$$H_2 \to 2H_2 ; \Delta H = \frac{869.6}{2} = 434.8kJ$$

713. From the following bond energies :

H – H bond energy : 431.37 kJ mol^{-1}
C = C bond energy : 606.10 kJ mol^{-1}
C – C bond energy : 336.49 kJ mol^{-1}
C – H bond energy : 410.50 kJ mol^{-1}

Enthalpy for the reaction



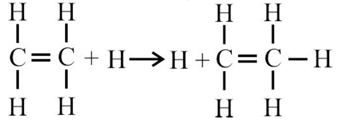
will be

(a) –343.6 kJ mol^{-1} (b) – 120.0 kJ mol^{-1}
(c) 553.0 kJ mol^{-1} (d) 1523.6 kJ mol^{-1}

NEET-2009

Ans. (b) : Given,

H-H Bond Energy = 431.37 kJ/mole
C = C Bond Energy = 606.10 kJ/mole
C – C Bond Energy = 336.44 kJ/mole
C – H Bond Energy = 410.5 kJ/mole



$\Delta H = (\Delta H)_{Reactant} - (\Delta H)_{Product}-$

$\Delta H = [1\times\Delta H_{(C=C)} + 4\times\Delta H_{(C-H)} + 1\times\Delta H_{(H-H)} -$
$6 \times\Delta H+_{(C-H)} + 1\times\Delta H_{(C-C)}]$

$\Delta H = [606.10 + 4\times410.50 + 431.37] - [6\times410.50 + 336.49]$

$= [606.1 + 1642 + 431.37] - [2463 + 336.49]$

$= 2679.47 - 2799.49 = -120.02$ kJ/mol

714. Bond dissociation enthalpy of H_2, Cl_2 and HCl are 434, 242 and 431 kJ mol^{-1} respectively. Enthalpy of formation of HCl is

(a) –93 kJ mol^{-1} (b) 245 kJ mol^{-1}
(c) 93 kJ mol^{-1} (d) –245 kJ mol^{-1}

NEET-2008

Ans. (a) $H_2 + Cl_2 \to 2HCl$

divided by 2 we get,

$$\frac{H_2}{2} + \frac{Cl_2}{2} \to HCl$$

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$$\Delta H = \sum H_R - \sum H_P$$

$$= \left(\frac{434}{2} + \frac{242}{2}\right) - 431 = -93\,\text{kJ/mol}$$

715. Consider the following reactions :

(i) $H^+_{(aq)} + OH^-_{(aq)} \rightarrow H_2O(l)$; $\Delta H = -X_1$kJ mol^{-1}

(ii) $H_{2(g)} + 1/2O_{2(g)} \rightarrow H_2O(l)$; $\Delta H = -X_2$kJ mol^{-1}

(iii) $CO_{2(g)} + H_{2(g)} \rightarrow CO_{(g)} + {}_2O_{(l)}$; $\Delta H = -X_3$kJ mol^{-}

(iv) $C_2H_{2(g)} + 5/2O_{2(g)} \rightarrow 2CO_{2(g)} + H_2O_{(l)}$; $\Delta H = +X_4$kJ mol^{-1}

Enthalpy of formation of $H_2O_{(l)}$ is

(a) $-X_2$ kJ mol^{-1} (b) $+X_3$ kJ mol^{-1}
(c) $-X_4$ kJ mol^{-1} (d) $+X_1$ kJ mol^{-1}

NEET-2007

Ans. (a) :Enthalpy of formation : The amount of heat evolved or absorbed during the formation of 1 mole of a compound form its constituent elements is known as Heat of formation. So, the correct answer is

$$H_2(g) + \frac{1}{2}O_2(g) \longrightarrow H_2O(l), \Delta H = -x_2 \text{ kJ mol}^{-1}$$

716. Standard enthalpy of vaporisation $\Delta_{vap}H^0$ for water at 100^0C is 40.66 kJ mol^{-1}. The internal energy of vaporisation of water at 100^0C (in kJ mol^{-1}) is

(a) + 37.56 (b) – 43.76
(c) + 43.76 (d) + 40.66

(Assume water vapour to behave like an ideal gas)

NEET-2012

Ans. (a) : $\Delta H = \Delta E + \Delta n_g RT$

$H_2O(g) \rightarrow H_2O(g)$

$\Delta n_g = 1 - 0 = 1$

$T = 100^oC + 273K = 373K$

$\Delta H_{vap} = \Delta E + \Delta n_g RT$

$\Delta E = \Delta H_{vap} - \Delta n_g RT$

$= 40.63 - (1 \times 8.314 \times 10^{-3} \times 373)$

$= 37.53$ kJ/ mol.

717. If ΔH is the change in enthalpy and ΔE, the change in internal energy accompanying a gaseous reaction, then

(a) ΔH is always greater than ΔE
(b) ΔH < ΔE only if the number of moles of the products is greater than the number of moles of the reactants
(c) ΔH is always less than ΔE
(d) ΔH < ΔE only if the number of moles of products is less than the number of moles of the reactants.

NEET-1990

Ans. (d) :$\Delta H = \Delta E + \Delta(PV)$

$\Delta H = \Delta E + \Delta(nRT)$ [$\therefore PV = nRT$]

When number of moles in product is less than number of moles in reaction so $\Delta n = -$ve

$\Delta H < \Delta E$

718. The molar heat capacity of water at constant pressure, C, is 75 J K^{-1} mol^{-1}. When 1.0 kJ of heat is supplied to 100 g of water which is free to expand, the increase in temperature of water is

(a) 1.2 K (b) 2.4 K
(c) 4.8 K (d) 6.6 K

NEET-2003

Ans. (b) : $q = nc_p\,\Delta T$

$q = 1kJ = 1000J.$

$$n = \frac{\text{mass}}{\text{mol. weight}} = \frac{100}{18}$$

$$1000 = \frac{100}{18} \times 75 \times \Delta T$$

$\Delta T = 2.4$ K

719. When 1 mol of gas is heated of constant volume temperature is raised from 298 to 308 K. Heat supplied to the gas is 500 J. Then which statement is correct?

(a) q = w = 500 J, ΔE = 0
(b) q = ΔE = 500 J, w = 0
(c) q = w = 500 J, ΔE = 0
(d) ΔE = 0, q = w = -500 J

NEET-2001

Ans. (b) : According to first law of thermodynamics,

$\Delta E = q + W$

For constant volume, work done (W) = 0

$\Delta E = q = 500J$

720. Consider the following reaction:

$C_6H_{12}O_{6(glucose)}(s) + 6O_2(g) \rightarrow 6CO_2(g) + 6H_2O_{(g)}$, $\Delta H = -2840$ kJ

Tell the amount of energy required to generate 0.36 gm glucose following the above reverse reaction.

(a) 56.8 kJ (b) 568 kJ
(c) 5.68 kJ (d) 0.568 kJ

Tripura JEE-2019

Ans. (c) :

$C_6H_{12}O_{6(glucose)}(s) + 6O_2(g) \rightarrow 6CO_2(g) + 6H_2O_{(g)}$; $\Delta H = -2840$ kJ

On reverse reaction we get,

$6CO_2(g) + 6H_2O(g) \rightarrow C_6H_{12}O_6(s) + 6O_2(g)$; $\Delta H = 2840$ kJ

Thus for production of 1 mole $C_6H_{12}O_6 = 72 + 12 + 96 = 180$ g

For production of 0.36 g of glucose,

$$\Delta H = \frac{2840}{180} \times 0.36 = 5.68\,\text{kJ}$$

721. The enthalpy of hydrogenation of cyclohexene is –119.5 kJ mol^{-1}. If resonance energy of benzene is –150.4 kJ mol^{-1}, its enthalpy of hydrogenation would be

(a) –269.9 kJ mol^{-1} (b) –358.5 kJ mol^{-1}
(c) –508.9 kJ mol^{-1} (d) –208.1 kJ mol^{-1}

UP CPMT-2013

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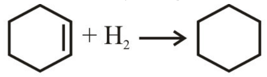
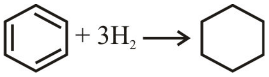
Ans. (d) : Hydrogenation of cyclohexene



Cyclohexene Cyclohexane

$\Delta H = -119.5$ kJ mol^{-1}

Hydrogenation of benzene :



$\Delta H = -3 \times 119.5$ kJ mol^{-1}

$= -358.5$ kJ mol^{-1}

The observed ΔH for hydrogenation of benzene

= ΔH + Energy needed to disturb resonance

$= -358.5 + 150.4 = -208.1$ kJ mol^{-1}

722. Given (i) $C(s)+O_2(g)\rightarrow CO_2(g)$; $\Delta H = -94.0$ kcal

(ii) $H_2(g)+\frac{1}{2}O_2(g)\rightarrow H_2O(l)$ $\Delta H = -68.4$ kcal

(iii) $CH_4(g)+O_2(g)\rightarrow CO_2(g)+2H_2O(l)$; $\Delta H = -212.4$ kcal

The heat of formation of CH_4 is

(a) –18.4 kcal (b) +18.4 kcal

(c) –443.2 kcal (d) +443.2 kcal

UP CPMT-2012

Ans. (a) : (i) $C+O_2\rightarrow CO_2$, $\Delta H = -94.0$ kcal

(ii) $H_2+\frac{1}{2}O_2\rightarrow H_2O, \Delta H = -68.4 kcal]\times 2$

(iii) $CH_4+2O_2\rightarrow CO_2+2H_2O$, $\Delta H = -212.4$ kcal

On multiplying Eq. (ii) with 2, add Eq. (i) and subtract Eq. (iii), we get

$C+2H_2+2O_2\rightarrow CO_2+2H_2O$, $\Delta H = -230.8$kcal

$CH_4+2O_2\rightarrow CO_2+2H_2O$, $\Delta H = -212.4$kcal

$C+2H_2 \rightarrow CH_4$, $\Delta H = -18.4$kcal

723. The heat of neutralisation of four acids A,B,C, and D when neutralized against a common base are 13.7, 9.4, 11.2, and 12.4 kcal respectively. The weakest and strongest among these acids are

(a) B and A respectively

(b) A and C respectively

(c) C and D respectively

(d) A and B respectively

UP CPMT-2012

Ans. (a) : Lower the value of heat of neutralisation weaker is the acid and vice-versa. Hence, B is the weakest and A is the strongest acid in the given options.

724. The enthalpy of dissolution of $BaCl_2$ (s) and $BaCl_2{\cdot}2H_2O(s)$ are –20.6 and 8.8 kJ mol^{-1} respectively. The enthalpy of hydration for

$$BaCl_2(s)+2H_2O(l)\longrightarrow BaCl_2\cdot 2H_2O(s) \text{ is}$$

(a) 29.4 kJ (b) –29.4 kJ

(c) –11.8 kJ (d) 38.2 kJ

UP CPMT-2011

Ans. (b) :

$BaCl_2(s)\rightarrow BaCl_2(aq)$; $\Delta H_1 = -20.6$ kJ …….(i)

$BaCl_2{\cdot}2H_2O(s)\rightarrow BaCl_2(aq)$; $\Delta H_2 = 8.8$ kJ …….(ii)

Substracting equation (ii) from (i) we get

$BaCl_2(s)\rightarrow BaCl_2\cdot 2H_2O(s)$; $\Delta H_1 - \Delta H_2 = -29.4$ kJ

725. The heat of combustion of methane, if the heat of formation of CH_4, CO_2, and H_2O are respectively –18.4 kcal, – 94.0 kcal, –68.4 kcal, is

(a) –212.4 kcal (b) +212.4 kcal

(c) –249.2 kcal (d) +249.2 kcal

UP CPMT-2010

Ans. (a) : $CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$

$$\Delta H_{comb} = (\Delta H_{f(CO_2)} + 2\times\Delta H_{f(H_2O)}) - (\Delta H_{f(CH_4)} + 2\times\Delta H_{f(O_2)})$$

$$=[-94.0+2\times(-68.4)-(-18.4+0)]$$

$$=-212.4 \text{ kcal}$$

726. Consider following reactions

I: $C(s)+\frac{1}{2}O_2(g)\longrightarrow CO(g), \Delta H_1 = a$

II: $CO(g)+\frac{1}{2}O_2(g)\longrightarrow CO_2(g), \Delta H_2 = b$

III: $C(s)+CO_2(g)\longrightarrow 2CO(g); \Delta H_3 = c$

Select correct Statement:

(a) Heat of formation of CO_2 is (a + b)

(b) Heat of combustion of C is (a + b)

(c) $\Delta H_3 = \Delta H_1 - \Delta H_2$

(d) All the above are correct statements

UP CPMT-2009

Ans. (d):

I: $C(s) + \frac{1}{2}O_2(g)\longrightarrow CO_2(g)$; $\Delta H_1 = a$

II: $CO(g)+\frac{1}{2}O_2(g)\longrightarrow CO_2(g)$; $\Delta H_2 = b$

III: $C(s) + CO_2(g) \longrightarrow 2CO(g)$; $\Delta H_3 = c$

On adding Eqs. I and II, we get

$$C(s) + O_2(g) \longrightarrow CO_2(g); \quad \Delta H = \Delta H_1 + \Delta H_2 = a + b$$

∴ Heat of formation of CO_2 = a + b

and heat of combustion of C = a + b

On subtracting Eqs II from I, we get

$$C(s) + CO_2(g) \longrightarrow 2CO(g); \Delta H_3 = \Delta H_1 - \Delta H_2$$

727. The heat of formation of CO (g) and CO_2 (g) are ΔH = –110 and ΔH = –393 kJ mol^{-1} Respectively. What is the heat of reaction (ΔH) (in kJ mol^{-1}) for the following reaction?

$$CO(g)+\frac{1}{2}O_2(g)\rightarrow CO_2(g)$$

(a) –504 (b) –142.5

(c) –283 (d) –504

UP CPMT-2008

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Ans. (c): $C + \frac{1}{2}O_2 \rightarrow CO, \Delta H = -110\,kJ\,mol^{-1}$ …..(i)

$C + O_2 \rightarrow CO_2, \Delta H = -393\ kJ\ mol^{-1}$ …..(ii)

On subtracting eq. (i) from eq. (ii), we get

$$CO + \frac{1}{2}O_2 \rightarrow CO_2$$

$\Delta H = -393 - (-110)$

$= -283\ kJ\ mol^{-1}$

728. The enthalpies of formation of $C_2H_2(g)$ and $C_6H_6(g)$ at 298 K are 230 and 85 kJ/mol respectively. The enthalpy change for the reaction is

(a) 605 kJ/mol
(b) 865 kJ/mol
(c) –605 kJ/mol
(d) –865 kJ/mol

UP CPMT-2001

Ans. (c) : Write the chemical reaction and then use the formula $\Delta H = H_P - H_R$ to find the enthalpy change for the reaction.

$3C_2H_2(g) \longrightarrow C_6H_6(g) \quad \Delta H = H_P - H_R$

Given, H_f of $C_2H_2 = 230$ kJ/mol

H_f of $C_6H_6 = 85$ kJ/mol

$\therefore \quad \Delta H = 85 - (3 \times 230)$

$= 85 - 690$

$= -605$ kJ/mol

729. The mass of carbon anode consumed (giving only carbon dioxide) in the production of 270 kg of alminium metal from bauxite by the Hall process is

(Atomic mass of Al = 27)

(a) 180 kg
(b) 270 kg
(c) 540 kg
(d) 90 kg

UPTU/UPSEE-2007

Ans. (d) : This equation shows,

$$2A1_2O_3 + \underset{3\times12=36}{3C} \longrightarrow \underset{4\times27=108}{4Al} + 3CO_2$$

$\because$ For 108 Kg of Al, 36 Kg of C is required in above reaction,

$\therefore$ For 270 kg of Al require amount of C $= \frac{36}{108} \times 270$

$= 90$ kg

730. Formation of a solution form two components can be considered as

(i) Pure solvent → separated solvent molecules, ΔH_1

(i) Pure solute → separated solute molecules, ΔH_2

(iii) Separated solvent and solute molecules → solution, ΔH_3

Solution so formed will be ideal if

(a) $\Delta H_{soln} = \Delta H_1 - \Delta H_2 - \Delta H_3$
(b) $\Delta H_{soln} = \Delta H_3 - \Delta H_1 - \Delta H_2$
(c) $\Delta H_{soln} = \Delta H_1 + \Delta H_2 + \Delta H_3$
(d) $\Delta H_{soln} = \Delta H_1 + \Delta H_2 - \Delta H_3$

UPTU/UPSEE-2007

Ans. (c) : This solution is an ideal

$\Delta H_{Sol.} = \Delta H_1 + \Delta H_2 + \Delta H_3$

Pure solvent + pure solute $\longrightarrow$ Solution

$$\boxed{\Delta H = \Delta H_1 + \Delta H_2 + \Delta H_3}$$

731. The enthalpies of combustion of carbon and carbon monoxide are – 393.5 and – 283 kJ mol^{-1} respectively. The enthalpy of formation of carbon monoxide per mole is

(a) 110.5 kJ
(b) 676.5 kJ
(c) – 676.5 kJ
(d) – 110.5 kJ

UPTU/UPSEE-2007

Ans. (d) :

$C + O_2 \rightarrow CO_2 \qquad \Delta H = -393.5\,KJ$ ____(i)

$CO + \frac{1}{2}O_2 \rightarrow CO_2 \qquad \Delta H = -283\,KJ$ ____(ii)

Sustracting from equation (i) to (ii)

$\Delta H = (-393.5) - (-283)$

$\Delta H = -110.5\,kJ$

732. If at 298 K the bond energies of C–H, C–C, C=C and H–H bonds are respectively 414, 347, 615 and 435 kJ mol^{-1}, the value of enthalpy change for the reaction

$H_2C = CH_2\,(g) + H_2\,(g) \longrightarrow H_3C - CH_3\,(g)$

at 298 K will be

(a) +250 kJ
(b) – 250 kJ
(c) + 125 kJ
(d) – 125 kJ

UPTU/UPSEE-2007

Ans. (d) : $H_2C = CH_2(g) + H_2(g) \longrightarrow H_3C - CH_3(g)$

H–H = 435 kJ mol^{-1}

2C–H = 2×(–414) kJ mol^{-1}

C=C = 615 kJ mol^{-1}

C–C = 347 kJ mol^{-1}

Total enthalpy change is,

$\rightarrow 435 + 615 - (2\times 4141) - 347$

$= -125$ kJ mol^{-1}

733. The heat of combustion of carbon monoxide at constant pressure and at constant volume at 27^oC will differ from one another by:

(a) 27 cal
(b) 54 cal
(c) 300 cal
(d) 600 cal

UPTU/UPSEE-2006

Ans. (c) : $C(s) + \frac{1}{2}O_2(g) \longrightarrow CO(g)$

$\Delta n_g = 1 - \frac{1}{2} = \frac{1}{2}$

T = 300 K

We know,

$\Delta H = \Delta U + \Delta n_g RT$

$\Delta H - \Delta U = \Delta n_g RT$

$\Delta H - \Delta U = \frac{1}{2} \times 2 \times 300$

= 300 cal.

@apna_pdf

734. The ΔH^o_f for $CO_2(g)$, CO(g) and $H_2O(g)$ are –393.5, –110.5 and –241.8 kJ/mol respectively, the standard enthalpy change (in kJ) for the reaction.

$CO_2(g) + H_2(g) \rightarrow CO\ (g) + H_2O\ (g)$ is :

(a) 524.1 (b) 41.2

(c) –262.5 (d) –41.2

UPTU/UPSEE-2005

Ans. (b) : Given that, ΔH for $CO_2(g)$ = –393.5

CO(g) = –110.5, H_2O = –241.8

$$\Delta H = \sum \Delta H^o_{f(products)} \quad - \quad \sum \Delta H^o_{f(reactants)}$$

$$= -110.5 - 241.8 \quad - \quad (-393.5)$$

$$= +41.2 \text{ kJ.}$$

735. Hess's law is used to calculate:

(a) enthalpy of reaction

(b) entropy of reaction

(c) work done in reaction

(d) All of the above.

UPTU/UPSEE-2005

Ans. (a) : Hess's law states that enthalpy changes during the process is independent of path. So, this law is used in calculating enthalpy.

736. Enthalpy of solution of NaOH (solid) in water is – 41.6 kJ mol^{-1}. When NaOH is dissolved in water, the temperature of water:

(a) Increases (b) Decreases

(c) Does not change (d) Fluctuates indefinitely

UPTU/UPSEE-2004

Ans. (a) : According to Le-chatir Principle although the dissolution process is overall exothermic, since solubility is determined only at the saturation point, the solubility increases with increases in temperature.

737. The heat of combustion of carbon to CO_2 is –393.5 kJ/mol. The heat released upon formation of 35.2 g of CO_2 from carbon and oxygen gas is:

(a) + 315 kJ (b) – 31.5 kJ

(c) – 315 kJ (d) + 31.85 kJ

UPTU/UPSEE-2004

Ans. (c) :

Number of moles in 35.2g of $CO_2 = \frac{35.2}{44} = 0.8$ mol

Thus heat of combustion for 0.8 mol of CO_2 is –393.5×0.8 = –315 kJ

738. Which of the following equations correctly represent the standard heat of formation ($\Delta H°_f$) of methane?

(a) C (diamond) + 4H(g) $\longrightarrow$ $CH_4(g)$

(b) C (diamond) + $2H_2(g)$ $\longrightarrow$ $CH_4(g)$

(c) C (graphite) + $2H_2(g)$ $\longrightarrow$ $CH_4(g)$

(d) C (graphite) + 4H(g) $\longrightarrow$ $CH_4(g)$

UPTU/UPSEE-2004

Ans. (c) : The heat of formation of a compound is the heat evolved or absorbed when one mole of the compound is formed from its elements in their standard state. For carbon, the standard state is graphite.

$$\boxed{\Delta H^o_f\ C_{(graphite)} = 0}$$

739. Why is the heat evolved in neutralisation of HF is highest ?

(a) Due to low hydration energy of F^- ion

(b) Due to high hydration energy of F^- ion

(c) HF is a strong acid

(d) None of the above

UPTU/UPSEE-2018

Ans. (b) : • HF is a weak acid

• HF have very high enthalpy change of neutralization.

• HF, heat evolved neutralization is highest due to high Hydration energy of F^- ion.

740. At 298 K what will be the change in standard internal energy change for the given reaction $OF_2(g) + H_2O(g) \rightarrow O_2(g) + 2HF(g)$;

(a) –312.5 kJ (b) –125.03 kJ

(c) –310 kJ (d) –156 kJ

UPTU/UPSEE-2018

Ans. (c) : $\Delta H = \Delta U + \Delta n_g RT$

$$\Delta n_g = \text{moles of product} - \text{mole of reactant}$$

$$3 - 2 = +1$$

$$\Delta n_g > O$$

$$\therefore \Delta U° = H° - \Delta n_g RT$$

$$\therefore \Delta U° = (-310 \times 10^3) - (1 \times 8.314 \times 298)$$

$$= -307522.42 \text{ J}$$

$$= -307.522 \times 10^3 \text{ J}$$

$$\therefore \Delta U \simeq -310 \text{ kJ}$$

741. The enthalpy of the formation of CO_2 and H_2O are –395 kJ and –285 kJ respectively and the enthalpy of combustion of acetic acid is 869 kJ. The enthalpy of formation of acetic acid is

(a) 340 kJ (b) 420 kJ

(c) 491 kJ (d) 235 kJ

UPTU/UPSEE-2017

Ans. (c) : $CH_3COOH + 2O_2 \rightarrow CO_2 + H_2O_2$

$$H_R = \sum H^o_{f(product)} \quad - \quad \sum H^o_{f(\ reactant)}$$

$$-869 = [2 \times H^°_{f\ (CO2)} + 2 \times H^°_{f\ (H2O)}]^- \ (H^o_{f(CH_3COOH)} + O)$$

$$-869 = [2 \times (-395) + 2 \times (-285)] - H^°_{f\ (CH3COOH)}$$

$$-869 = -790 - 5\ 70 - H^°_{f\ (CH3COOH)}$$

$$\therefore H^°_{f(CH_3\ COOH)} = 1360 - 869 = -491 \text{ kJ}$$

742. If enthalpies of formation for $C_2H_4(g)$, $CO_2(g)$ and $H_2O(l)$ at 25°C and 1 atm pressure be 52, –394 and –286 kJ mol^{-1} respectively, then the enthalpy of combustion of $C_2H_4(g)$ will be

(a) –141.2 kJ mol^{-1} (b) –1412 kJ mol^{-1}

(c) +141.2 kJ mol^{-1} (d) +1412 kJ mol^{-1}

UPTU/UPSEE-2016

Ans. (b): equation ____(i) $\Delta H_1 = -52 \text{ kJ mol}^{-1}$

equation ____(ii) $\Delta H_2 = -394 \text{ kJ mol}^{-1}$

equation ____(iii) $\Delta H_3 = -286 \text{ kJ mol}^{-1}$

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Reaction involved for combustion of C_2H_4 (g) IS,

$C_2H_4 + 3O_2 \rightarrow 2CO_2,\ \Delta H = ?$

2X [E.q (ii) + Eq. (iii)]– Eq(i), we get Eq. (iv)

$\Delta H = 2[\Delta H_2 + \Delta H_3] - \Delta H_1$

$= 2\,[-394 - 286] - 52$

$= -1360 - 52 = -1412$ kJ mol^{-1}

743. The enthalpy of combustion for the H_2, cyclohexene and cyclohexane are –241, –3800 and –3920 kJ mol^{-1}, respectively. Heat of hydrogenation of cyclohexene is

(a) 121 kJ mol^{-1} (b) – 121 kJ mol^{-1}

(c) + 242 kJ mol^{-1} (d) – 242 kJ mol^{-1}

UPTU/UPSEE-2015

Ans. (b) : $H_2 + \frac{1}{2}O_2 \rightarrow H_2O \quad -\ 241\,kJ\,mol^{-1}$

$C_6H_{10} + \frac{17}{2}O_2 \rightarrow 6CO_2 + 5H_2O - 3800\,kJ\,mol^{-1}$

$C_6H_{12} + 9O_2 \rightarrow 6CO_2 + 6H_2O - 3920\,kJ\,mol^{-1}$

Adding eqn.(1) and subtracting (3)

ΔH Hydrogen = –241+(–3800) – (–3920)

$= -121\ kJ\,mol^{-1}$

744. Heat of formation of H_2O is –188 kJ/mol and H_2O_2 is 286 kJ/mol. The enthalpy change for the reaction; $2H_2O_2 \longrightarrow 2H_2O + O_2$ is

(a) 196 kJ (b) –196 kJ

(c) 984 kJ (d) –984 kJ

UPTU/UPSEE-2014

Ans. (b) : $2H_2O_2 \rightarrow 2H_2O + O_2$

$H_2 + \frac{1}{2}O_2 \rightarrow H_2O \qquad \Delta H = -188 \quad (i)$

$H_2 + O_2 \rightarrow H_2O_2 \qquad \Delta H = 286 \quad (ii)$

$\Delta H°$ = Product – Reactant

= 2 × 188 – 2 × 286

= 376 – 572

$\Delta H° = -196$

745. For the reaction,

$$A(g) + 2B(g) \longrightarrow 2C(g) + 3D(g)$$

The change of enthalpy at 27°C is 19 kcal. The value of ΔE is

(a) 21.2 kcal (b) 17.8 kcal

(c) 18.4 kcal (d) 20.6 kcal

UPTU/UPSEE-2013

Ans. (b) : $\Delta n_g = 5 - 3 = 2$

$\Delta H = 19$ kcal

$= 19 \times 10^3$ cal.

$\Delta E = \Delta H - \Delta n_g RT$

$= 19 \times 10^3 - (2 \times 2 \times 300)$

= 17.8 kcal

746. If standard enthalpies of formation of CaCl (s) (hypothetical) and that of $CaCl_2$ (s) are – 188 J mol^{-1} and –795 kJ mol^{-1} respectively. calculate the value of standard heat of reaction for the following disproportionation reaction

$$2CaCl(s) \longrightarrow CaCl_2(s) + Ca(s)$$

(a) – 607 kJ mol^{-1} (b) + 607 kJ mol^{-1}

(c) – 419 kJ mol^{-1} (d) + 419 kJ mol^{-1}

UPTU/UPSEE-2012

Ans. (c) : Given that, ΔH_f^o (CaCl) = –188 kJ/mol

ΔH_f^o ($CaCl_2$) = –795 kJ/mol

Standard heat of reaction,

$\Delta H^{\circ} = \Delta H_P^{\circ} - \Delta H_R^{\circ}$

$= \Delta H_f^o(CaCl_2) + \Delta H_f^o(Ca) - 2\ \Delta H_f^o(CaCl)$

$= -795 + 0 - 2 \times (-188)$

$= -795 + 376 = -419\ kJ\,mol^{-1}$

747. Given, $H_2O\,(l) \rightarrow H_2O(g);\ \Delta H_1 = +43.7$ kJ $H_2O(s) \rightarrow H_2O(l);\ \Delta H_2 = +6.05$ kJ Calculate the enthalpy of sublimation of ice.

(a) 49. 75 kJ mol^{-1} (b) 37. 65 kJ mol^{-1}

(c) 43. 7 kJ mol^{-1} (d) 55. 23 kJ mol^{-1}

UPTU/UPSEE-2010

Ans. (a) : Given that,

$H_2O(l) \rightarrow H_2O(g)$, ΔH = +43.7 kJ

$H_2O(s) \rightarrow H_2O(l)$, ΔH = +6.05 kJ

We know that,

$\Delta H_{sublimation} = \Delta H_{fusion} + \Delta H_{vap.}$

= 43.7 + 6.05

= 49.75 kJ mol^{-1}

748. The heat of formations of CO_2(g), $H_2O(l)$ and CH_4(g) are –400 kJ mol^{-1}, –280 kJ mol^{-1} and –70 kJ mol^{-1} respectively. The heat of combustion of CH_4 in kJ mol^{-1} is

(a) 890 (b) –160

(c) –890 (d) –90

UPTU/UPSEE-2008

Ans. (c) : Given,

$\Delta H_f(CO_2, g) = -400$ kJ mol^{-1}

$\Delta H_f(H_2O, l) = -280$ kJ mol^{-1}

$\Delta H_f(CH_4, g) = -70$ kJ mol^{-1}

$\Delta H_c(CH_4, g) = ?$

$CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$

$\Delta H_r = \Delta H_f$ (product) – ΔH_f (reactant)

$= \Delta H_f(CO_2, g) + 2 \times \Delta H_f(H_2O, g) - [\Delta H_f(CH_4, g) + 2 \times \Delta H_f(O_2, g)]$

= [–400 + 2 × (–280)] – [–70 + 0]

= –400 – 560 + 70

= –890 kJ mol^{-1}

749. The value of ΔH for cooling 2 mole of an ideal monoatomic gas from 225°C to 125°C to at constant pressure will be $\left[\text{given } C_p = \frac{5}{2}R\right]$

(a) 250 R (b) –500 R

(c) 500 R (d) – 250 R

WB-JEE-2014

@apna_pdf

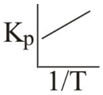
Ans. (b) : Given, $T_i = 225°C$, $T_f = 125°C$

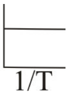
$$\Delta H = -nC_p \Delta T$$

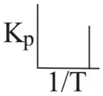
$$= -2\times\frac{5}{2}R(225-125)$$

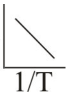
$$= -500R$$

750. Which of the following plots represent an exothermic reaction?

(a) ln K_p 

(b) ln K_p 

(c) ln K_p 

(d) ln K_p 

WB-JEE-2016

Ans. (a) : $\ln K_p = \frac{\Delta H}{2.303T}$

When log K_p is againest plotted 1/T, then the slope is $-\frac{\Delta H}{2.303T}$ and the intercept is constant.

For an exothermic reaction, ΔH is negative. So, when log K_p is plotted against 1/T, it's straight line with positive slope and positive intercept.

5. Bond Energy

751. Bond enthalpies of A_2, B_2 and AB are in the ratio 2 : 1 : 2. If bond enthalpy of formation of AB is –100kJ mol^{-1}. The bond enthalpy of B_2 is

(a) 100 kJ mol^{-1}
(b) 50 kJ mol^{-1}
(c) 200 kJ mol^{-1}
(d) 150 kJ mol^{-1}

Kerala-CEE-29.08.2021

Ans. (c) : Given that,

$A_2 : B_2 : AB = 2 : 1 : 2$

$$\Delta H_{AB} = -100\ kJmol^{-1}$$

The following reaction take place -

$$A_2 + B_2 \rightarrow 2AB$$

or $$\frac{1}{2}A_2 + \frac{1}{2}B_2 \rightarrow AB$$

We can calculate the bond enthalpy of B_2 by the give equation -

$$\frac{1}{2}\Delta H_{A_2} + \frac{1}{2}\Delta H_{B_2} - \frac{1}{2}\Delta H_{AB} = -100$$

or $$\frac{1}{2}\times 2x + \frac{x}{2} - 2x = -100$$

or $$x = 200\ kJmol^{-1}$$

752. Which one of the following arrangements shows the bonds H–H, C–C and Si–Si in order of increasing bond energy?

(a) Si–Si < C–C < H–H
(b) C–C < H–H < Si–Si
(c) H—H < Si–Si < C–C
(d) H—H < C–C < Si–Si

SCRA 2012

Ans. (a) : Si–Si = (340 kJ/mole)
C–C = (347 kJ/mole)
H–H = (432 kJ/mole)

Greater the size of the atom, greater is the bond length and less is the bond energy. Si has more size than C and H. So the bond length between Si-Si is more and the bond dissociation energy will be less. So, the correct order is Si-Si<C-C<H-H

753. If the mass defect of a nuclide is 3.32 × 10^{-26} g, its binding energy is .... MeV.

(a) 9.31
(b) 18.62
(c) 27.93
(d) 37.24

A.P.EAMCET/2003

Ans. (b) : Given mass defect = 3.32 × 10^{-26} gm.

or $$\text{mass defect} = \frac{3.32\times10^{-26}}{1.66\times10^{-24}}\ u$$
$$= 2 \times 10^{-2}\ u$$

∴ Binding energy = mass defect × 931 MeV
= 2 × 10^{-2} × 931 MeV
= 18.62 MeV

754. If the mass defect of $_5B^{11}$ is 0.081 u, its average binding energy (in MeV) is :

(a) 8.60
(b) 6.85
(c) 5.60
(d) 5.86

A.P.EAMCET/2008

Ans. (b) : Given : Δm = 0.081 u.
Number of nucleons = 11

∴ Binding energy = Δm × 931 MeV
= 0.081 × 931
= 75.411 MeV

and average binding energy

$$= \frac{\text{Binding energy}}{\text{Number of nucleons}}$$

$$= \frac{75.411}{11}$$

= 6.85 MeV.

755. Given, the bond energies of $N \equiv N, H-H$ and $N-H$ bonds as 945, 436 and 391 kJ/mol respectively, the enthalpy of the reaction $N_2(g) + 3H_2(g) \rightarrow 2NH_3(g)$, is

(a) – 93 kJ
(b) 102 kJ
(c) 90 kJ
(d) 105 kJ

(A.P.EAMCET-1992)

Ans. (a) : Given, the reaction is

$$N_2 + 3H_2 \longrightarrow 2NH_3$$

Bond energy of $N \equiv N = 945$ kJ/mole.

Bond energy of $3(H-H) = 3\times436 = 1308$ kJ / mole

Bond energy of $6(N-H) = 6\times391 = 2346$ kJ/mole

∴ Enthalpy of reaction = reactant – product

$$= 945 + 1308 - 2346$$
$$= 2253 - 2346$$
$$= -93\ kJmol^{-1}$$

756. Average C–H bond energy is 416 kJ mol^{-1}. Which of the following is correct?

(a) $CH_4(g) + 416kJ \longrightarrow C(g) + 4H(g)$

(b) $CH_4(g) \longrightarrow C(g) + 4H(g) + 416\ kJ$

@apna_pdf

(c) $CH_4(g) + 1664\text{ kJ} \longrightarrow C(g) + 4H(g)$

(d) $CH_4(g) \longrightarrow C(g) + 4H(g) + 1664\text{ kJ}$

(A.P.EAMCET-2004)

Ans. (c) : CH_4 consists of C-H bonds.
To break CH_4 into C and 4H, the energy required =
$4 \times 416 = 1664$ kJ
∴ The requirement satisfied by the following.
$CH_4(g) + 1664\text{ kJ} \rightarrow C(g) + 4H(g)$

757. Which one of the following order is correct for the bond energies of halogen molecules?

(a) $I_2 > Cl_2 > Br_2$ (b) $Br_2 > Cl_2 > I_2$
(c) $I_2 > Br_2 > Cl_2$ (d) $Cl_2 > Br_2 > I_2$

AP EAMCET (Engg.) 2001

Ans. (d) : Bond dissociation energy of halogen family decreases down the group as the size of atom increase

Bond energy of halogen $\propto \dfrac{1}{\text{size of halogens}}$

Therefore, the order of bond energy is,
$Cl_2 > Br_2 > I_2$

758. Find the ΔH^o for the reaction $H_2O(g) + Br_2(g) \rightarrow HBr(g) + HOBr(g)$ using:
Bond energy of O – H bond in Water = 463 kJ
Bond energy of Br– Br bond in Br_2= 192 kJ
Bond energy of O – Br bond in HOBr= 234 kJ
Bond energy of H–Br bond in HBr= 364 kJ

(a) 655 kJ. mol^{-1} (b) 598 kJ. mol^{-1}
(c) 57 kJ. mol^{-1} (d) 192 kJ. mol^{-1}

AP EAPCET-6 Sep. 2021, Shift-II

Ans. (c):
The heat of reaction can be calculated based on the standard heat of formation of all reactants involved.

$$\Delta H^o = [(234+364)-(463+192)]$$
$$= 598 - 655$$
$$= -57\text{ kJ mol}^{-1}$$

759. The decreasing order of bond dissociation energies of C–C, C–H and H–H bonds in

(a) H–H> –C–H> –C–C–
(b) –C–C–> C–H> H–H
(c) –C–H> –C–C–> H–H
(d) –C–C–> H–H> –C–H

AP EAMCET (Engg.) -2007

Ans. (a) : Bond dissociation energies depend on the strength of the bonds. Higher the strength, the greater is the energy.

The bond strength depend upon the extent of overlapping which is dependent on the size of each overlapping atom. smaller the size of the atom, more will be the bond strength.

H–H> –C–H> –C–C–

760. Find the approximate value of $(\Delta H - \Delta U)$ in J. mol^{-1}, for the formation of CO from its elements at 298 K. (R = 8.314. J.K^{-1}. mol^{-1})

(a) –1238 (b) 1238
(c) 2477 (d) –2477

AP EAPCET 20.08.2021 Shift-II

Ans. (b): Given that
T = 298K
R = 8·314 J.K^{-1}. mol^{-1}

$$C(s) + \frac{1}{2}O_2(g) \rightarrow CO(g)$$

$$\Delta n_g = 1 - \frac{1}{2} = 0.5$$

$\therefore \Delta H = \Delta U + \Delta n_g RT$ ....(1)
putting these value in eq^n. (i) we get-
$\Delta H - \Delta U = 0.5 \times 8.314 \times 298$
or $\Delta H - \Delta U = 1238$ J/mol

761. Assertion: For a reaction

$$\mathbf{2NH_3(g) \rightarrow N_2(g) + 3H_2(g); \Delta H > \Delta E}$$

Reason: Enthalpy change is always greater than internal energy change.

(a) If both Assertion and Reason are correct and the Reason is the correct explanation of Assertion.
(b) If both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.
(c) If Assertion is correct but Reason is incorrect.
(d) If both the Assertion and Reason are incorrect.

AIIMS-2008,2014

Ans. (c): $2NH_3(g) \longrightarrow N_2(g) + 3H_2(g)$

$$\Delta H = \Delta E + \Delta n_g RT$$
$$\Delta n_g = 4 - 2 = 2$$
$$\Delta_1 H = \Delta E + 2RT$$
$$\boxed{\Delta H > \Delta E}$$

When Δn_g is negative, then enthalpy may be less than internal energy. so, reason is incorrect.

762. AB, A_2 and B_2 are diatomic molecules. If the bond enthalpies of A_2, AB and B_2 are in the ratio 1:1:0.5 and enthalpy of formation of AB from A_2 and B_2 is – 100kJ mol^{-1}. What is the bond energy of A_2:

(a) 200kJ mol^{-1} (b) 100kJ mol^{-1}
(c) 300kJ mol^{-1} (d) 400kJ mol^{-1}

AIIMS-2012

Ans. (d): Bond energy of A_2 be X then bond energy of AB is also X and bond energy of B_2 is X/2
$A_2 + B_2 \longrightarrow 2AB,$

$$= \frac{1}{2}A_2 + \frac{1}{2}B_2 \rightarrow AB$$

$$\Delta H = -100\text{ kJ}$$

$$\text{Or} - 100 = \left(\frac{X}{2} + \frac{X}{4}\right) - X$$

$$\Rightarrow \quad -100 = \left(\frac{2X + X}{4}\right) - X$$

$$-100 = \frac{2X + X - 4X}{4}$$

$$\boxed{X = 400\text{ kJ}}$$

@apna_pdf

763. Given that $\Delta H_f(H) = 218$ kJ/mol, express the H–H bond energy in kcal/mol.

(a) 52.15 (b) 911
(c) 104 (d) 52153

VITEEE- 2009
AP EAMCET (Engg.)-2009

Ans. (c) : Given : $\Delta H_f(H) = 218$ kJ/mol

$\Delta H_f(H_2) = 2 \times 218 = 436$ kJ/mol

1kcal = 4.184 kJ

$$436 \text{ kJ/mol} = \frac{1}{4.184} \times 436$$

= 104 kcal/mol

Hence, H–H energy is 104.3 kcal/mol

764. The bond energies of F_2, Cl_2, Br_2 and I_2 are 155, 244, 193 and 151kJ/mol. The weakest bond will be in

(a) Cl_2 (b) I_2
(c) Br_2 (d) F_2

AMU 2002

Ans. (b) : I_2 has weakest bond among the halogens because due to big size of iodine, the bond length is 266pm. As well as bond length decreases, the bond dissociation energy increases- Hence, the correct option is (b).

765. The bond dissociation energies of four bonds C-A, C-B, C-D and C-E respectively 240, 382, 276, 486 kJ mol^{-1}. The atom with smallest size is

(a) A (b) B
(c) D (d) E

Assam CEE-2020

Ans. (d) : C–E bond has highest bond Energy, it means that the covalent bond C–E will be strongest. Smaller is the size of atom, stronger is the covalent bond.

We can see that C–D bond has the highest bond dissociation energy of 486 kJ mol^{-1}. Hence, it is most difficult to break

766. The bond dissociation enthalpy of gaseous H_2, Cl_2 and HCl are 435, 243 and 431 kJ mol^{-1} respectively. In the same unit, enthalpy of formation of HCl gas is

(a) – 92 (b) – 184
(c) + 92 (d) + 184

Assam CEE-2018

Ans. (a) : $H_2 + Cl_2 \rightarrow 2HCl$

For 1 mole of HCl-

$$\frac{1}{2}H_2 + \frac{1}{2}Cl_2 \longrightarrow HCl$$

Enthalpy of formation:

$$= \frac{1}{2}\left(BDE_{H_2} + BDE_{Cl_2}\right) - BDE_{HCl}$$

$$= 431 - \frac{1}{2}(435 + 243)$$

= –92 kJ.

767. The H – H bond energy is 430 kJ mol^{-1} and Cl – Cl bond energy is 240 kJ mol^{-1}, ΔH for HCl is –90 kJ, The H – Cl bond energy is about :

(a) 180 kJ mol^{-1} (b) 360 kJ mol^{-1}
(c) 213 kJ mol^{-1} (d) 425 kJ mol^{-1}

BCECE-2006

Ans. (d) : Given, Bond energy,

$H_2(g) \rightarrow 2H(g)$ $\Delta H_{(H)} = +430$ kJ mol^{-1}

$Cl_2(g) \rightarrow 2Cl(g)$ $\Delta H_{(Cl)} = +240$ kJ mol^{-1}

$\Delta H_{(HCl)} = -90$ kJ

$HCl(g) \rightarrow H(g) + Cl(g)$

$$\frac{1}{2}H_2 + \frac{1}{2}Cl_2 \rightarrow HCl$$

$\Delta H_{HCl} = \Delta H_{BE}$(Reactant) + ΔH_{BE}(Product) – BE of HCl

$$-90 = \frac{1}{2} \times 430 + \frac{1}{2} \times 240 - \text{BE of HCl}$$

B.E. of HCl = 215+120+90 = 305 + 120 = 425 kJ mol^{-1}

768. $CH_2 = CH_2(g) + H_2(g) \rightarrow CH_3 - CH_3(g)$

The heat of reaction is [bond energy of $C - C = 80$ kcal, $C = C = 145$ kcal, $C - H = 98$ kcal, $H - H = 103$ kcal]

(a) –14 kcal (b) –28 kcal
(c) –42 kcal (d) – 56 kcal

BCECE-2004

Ans. (b) : Bond energy of C–C = 80 kcal

C=C = 145 kcal

C–H = 98 kcal

H–H = 103 kcal

Bond energy of reactant,

= BE of (1 × C=C + 4 × C–H + H–H)

= 145 + 4 × 98 + 103

= 640 kcal

Bond energy of product = BE of (C–C + 6 × C–H)

= (80 + 6 × 98)

= 668

ΔH_0 (Reaction) = Σbond energy of react – Σbond energy of product

= 640 – 668

= –28 kcal

769. Internal energy is sum of

(a) kinetic energy and potential energy
(b) all types of energy of the system
(c) energy of internal system
(d) None of the above

BCECE-2008

Ans. (b) : Internal energy is the energy associated with every substance, depending on the chemical nature, temperature, pressure and volume. It is the sum of many Pressure and volume. It is the sum of many type of energies such as translational energy, rational energy vibrational energy, electronic energy etc.

$U = U_{trans} + U_{rotat} + U_{vib} + U_{bonding} + U_{electronic}$

770. The C–C bond dissociation energy in kcal/mol is–

(a) 8.1 (b) 0.81
(c) 81 (d) 810

BCECE-2009

Ans. (c) : C–C Bond the amount of bond dissociation Energy is 81 kcal/mol (or 347 kJ/mol).

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771. The following is endothermic reaction

(a) Decomposition of water
(b) Conversion of graphite to diamond
(c) Dehydrogenation of ethane to ethylene
(d) All of the above

BCECE-2010

Ans. (d) : The reaction during which heat is observed known as endothermic reaction.
(A) Combustion is always an exothermic procure.
(B) Decomposition of H_2O requires energy
(C) Dehydrogenation is an endothermic reaction.
(D) Graphite is more stable than diamond and energy in needed to convert graphite into diamond.

772. The energy that opposes dissolution of a solvent is

(a) hydration energy (b) lattice energy
(c) internal energy (d) bond energy

BITSAT 2006

Ans. (b) : Lattice energy opposes dissolution of a solvent. Lattice energy is the amount of energy required to dissociate 1 mole of ionic crystals into ions. If hydration energy of solid is more than lattice energy, then solid dissolves.

773. At 298 K temperature the activation energy for the reaction $x_2 + y_2 \rightarrow 2xy + 20kJ$ is 15 kJ.

What will be the activation energy for the reaction $2xy \rightarrow x_2 + y_2$?

(a) – 15 kJ (b) + 35 kJ
(c) –5 kJ (d) – 35 kJ

GUJCET-2017

Ans. (b) : ΔH_R = activation energy of forward reaction– activation energy of backward reaction–

∵ $-20 = 15 - x$

So, $x = +35$ kJ

774. The following reaction is performed at 298K

$$2NO(g) + O_2(g) \rightleftharpoons 2NO_2(g)$$

The standard free energy of formation of NO(g) is 86.6 kJ/mol at 298 K. What is the standard free energy of formation of NO_2 (g) at 298 K? ($K_p = 1.6 \times 10^{12}$)

(a) $R(298)\ In\ (1.6\times10^{12}) - 86600$
(b) $86600 + R(298)\ In\ (1.6\times10^{12})$
(c) $86600 - \dfrac{In(1.6\times10^{12})}{R(298)}$
(d) $0.5\ [2\times86600 - R\ (298)\ 1n\ (1.6\times10^{12})]$

[JEE Main 2015]

Ans. (d) : Given, $\Delta G^\circ_{f(NO)} = 86.6 kJ/mol$

$\Delta G^\circ_{f(NO_2)} = ?$, $K_p = 1.6 \times 10^{12}$

For the given reaction, $2NO(g) + O_2(g) \rightleftharpoons 2NO_2(g)$

$\Delta G^\circ = -RT\ InK_p$ ____(1)

$\Delta G^\circ_{rex.} = 2\,\Delta G^o_{f\ (NO2)} - 2\,\Delta G^o_{f\ (NO)}$ ____(2)

From equation (1) and (2)

$2\,\Delta G^o_{f\ (NO2)} - 2\,\Delta G^o_{f\ (NO)} = -RT\ InK_p$

$\Delta G^o_{f\ (NO2)} = 0.5 \times [2\,\Delta G^o_{f\ (NO)} - RT\ InK_p]$

$\Delta G^o_{f\ (NO2)} = 0.5 \times [\ 2\times86600 - R\ (298)\ ln\ 1.6\times10^{12}]$ J/mol

775. If at 298 K, the bond energies of $C—H, C—C, C=C$ and $H—H$ bonds are respectively 414,347,615 and 435 kJ mol^{-1}, the value of enthalpy change for the reaction,

$H_2C=CH_2\ (g) + H_2\ (g) \longrightarrow H_3C—CH_3$ at 298 K will be

(a) +250 kJ (b) –250 kJ
(c) +125 kJ (d) –125 kJ

AIEEE-2003

Ans. (d) : Given, $H_2C = CH_2 + H_2 \rightarrow H_3C - CH_3$

C–H = 414 kJ/mol
C – C = 347 kJ/mol
C = C = 615 kJ/mol
H – H = 435 kJ/mol

$\Delta H = 4\Delta H_{C-H} + \Delta H_{C=C} = \Delta H_{H-H} - \Delta H_{C-C} - 6\Delta H_{C-H}$

$\Delta H_{C=C} = \Delta H_{H-H} - \Delta H_{C-C} - 2\Delta H_{C-H}$

$= 615 + 435 - 347 - 2 \times 414 = -125$ kJ

776. Assuming that water vapour is an ideal gas, the internal energy change (ΔE) when 1 mole of water is vaporised at 1 bar pressure and 100°C, (Given : molar enthalpy of vaporisation of water at 1 bar and 373 K = 41 kJ mol^{-1} and R = 8.3 J mol^{-1} K^{-1}) will be

(a) 4.100 kJ mol^{-1} (b) 3.7904 kJ mol^{-1}
(c) 37.904 kJ mol^{-1} (d) 41.00 kJ mol^{-1}

AIEEE-2007

Ans. (c) : Given that,

Enthalpy, ΔH = 41 kJ/mol
= 41000 J/mol

Temperature = 100°C
= 373 K

n_g = 1mol – 0 mol = 1mol

R = 8.314 J/mol °K

So, we know that, $\Delta H = \Delta U + n_gRT$

$\Delta U = \Delta H - n_gRT$
$= 41000 - 1 \times 8.314 \times 373$
$= 41000 - 3101.122$
$= 37.89$ kJ/mol

777. The standard enthalpy of formation of NH_3 is –46.0 kJ mol^{-1}. If the enthalpy of formation of H_2 from its atoms is –436 kJ mol^{-1} and that of N_2 is –712 kJ mol^{-1}, the average bond enthalpy of N – H bond in NH_3 is

(a) –964 kJ mol^{-1} (b) +352 kJ mol^{-1}
(c) +1056 kJ mol^{-1} (d) –1102 kJ mol^{-1}

AIEEE-2010

Ans. (b) : Given, $\Delta H^\circ_f(NH_3) = 46\,kJ\,mol^{-1}$

$\Delta H^\circ_f(H_2) = -436\,kJ\,mol^{-1}$

And, $\Delta H^\circ_f(N_2) = -712\,kJ\,mol^{-1}$

$\frac{1}{2}N_2 + \frac{3}{2}H_2 \rightarrow NH_3\ ;\ \Delta H = -46.0$ KJ ....(i)

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$2H \rightarrow H_2$; $\Delta H = -436$ KJ ....(ii)
$2N \rightarrow N_2$; $\Delta H = -712$ KJ ....(iii)

By equation (i) + $\left(\frac{3}{2}\times(ii)\right) + \left(\frac{1}{2}\times(iii)\right)$

Thus,

$3H + N \rightarrow NH_3$;

$$\Delta H = -46.0 + \frac{3}{2}\times(-436.0) + \frac{1}{3}\times(-712)$$
$$= -46 - 654 - 356.0$$
$$= -1056$$

$\therefore$ N–H bond energy = $\frac{+1056}{3} = +352\,KJ$

778. What will be the enthalpy of formation of NO_2 from the given bond dissociation enthalpy values? The bond dissociation enthalpy values for O_2, NO and NO_2 are as follows, $O_{2(g)}$: 0kJ/mol, $NO_{(g)}$: 90.25 kJ/mol and $NO_{2(g)}$: 33.18 kJ/mol respectively.

(a) +114.1kJ (b) +52.7kJ
(c) −52.7kJ (d) −114.1kJ

J & K CET-(2018)

Ans. (d) : Given, $O_2(g)$ = 0 kJ/mol, NO(g) = 90.25 kJ/mol, $NO_2(g)$ = 33.18 kJ/mol

$$2\,NO\,(g) + O_2(g) \rightleftharpoons 2NO_2\,(g)$$

$\Delta H^o_{Reaction} = \Sigma\Delta H_f$ (product) − ΔH_f (reactants)

= (2×33.18) − (2×90.25+0)

$\Delta H^o_{Reaction} = -114.1$ kJ

779. The bond energy of an O–H bond is 109 kcal/mol. When a mole of water is formed, then

(a) 109 kcals is released
(b) 218 kcals is absorbed
(c) 109 kcals is absorbed
(d) 218 kcals is released

J & K CET-(2003)

Ans. (d) : Bond energy of a O – H bond = 109 kcal/mol

When one mole of H_2O is formed, energy will be released.

Therefore, heat released = −109×2
= −218 kcal/mol

$\therefore$ Energy released in the formation of 1 mole of water = 218 kcal/mol

780. The dissociation energy of CH_4 and C_2H_6 to convert them into gaseous atoms are 360 and 620 kcal/mol respectively. The bond energy of C-C bond is

(a) 130 kcal/mol (b) 80 kcal/mol
(c) 180 kcal/mol (d) 260 kcal/mol

J & K CET-(1998)

Ans. (b) : Given,

Dissociation energy of CH_4 = 360 kcal/mol

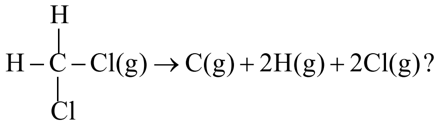
B.E. of C–H $= \frac{360}{4} = 90\,kcal$

Bond energy of ethane (C_2H_6),

1(C–C) + 6(C–H) = 620 kcal/mol
C–C + 6 × 90 = 620
C–C = 620 – 540
C–C = 80 kcal/mol

Bond energy of C–C bond = 80 kcal/mol

781. What is the △H of the reaction



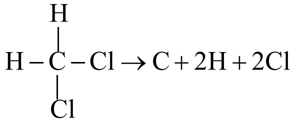
$$H-\overset{H}{\underset{Cl}{C}}-Cl(g) \rightarrow C(g) + 2H(g) + 2Cl(g)?$$

The average bond energies of C–Cl bond and C–H bond are 416 kJ and 325 kJ mol^{-1} respectively.

(a) 1482 kJ (b) 1482 J
(c) 1492 kJ (d) 1492 J

JIPMER-2010

Ans. (a): Given, Bond energy of C–Cl = 416 kJ/mol and bond energy of C–H = 325 kJ/mol



$$H-\overset{H}{\underset{Cl}{C}}-Cl \rightarrow C + 2H + 2Cl$$

$\Delta H = \Sigma BE_R - \Sigma BE_P$
$= 2 \times BE_{(C-H)} + 2BE_{(C-Cl)}$
$= 2 \times 416 + 2 \times 325$
$= 832 + 650$
$= 1482$ kJ

782. Given that, for the reaction,

$$\mathbf{\frac{1}{2}H_2 + \frac{1}{2}Cl_2 \rightarrow HCl}$$

$\Delta H_{f(HCl)} = -93$ kJ/mol
$B.E_{(H_2)} = 434$ kJ/mol
$B.E_{(Cl_2)} = 242$ kJ/mol

The bond dissociation energy of HCl is

(a) 232 kJ/mol (b) 331 kJ/mol
(c) 431 kJ/mol (d) 530 kJ/mol

JIPMER-2018

Ans. (c) : $\frac{1}{2}H_2 + \frac{1}{2}Cl_2 \rightarrow HCl$

BE = Reactant – Product
$\Delta H_{f\,(HCl)} = -93$ kJ/mole
$BE_{(H-H)} = 434$ kJ /mole
$BE_{(Cl-Cl)} = 242$ kJ /mole
Bond dissociation energy of HCl is

$$\Delta H_{f(H-Cl)} = \left(\frac{1}{2}BE_{(H-H)} + \frac{1}{2}BE_{(Cl-Cl)}\right) - BE_{(HCl)}$$

$$-93 = \left(\frac{1}{2}\times 434 + \frac{1}{2}\times 242\right) - BE_{(HCl)}$$

$-93 = (217 + 121) - BE_{(HCl)}$
$BE_{(HCl)} = 338 + 93$
$\Delta H = 431$ kJ/mol

783. Two moles of an ideal gas is expanded isothermally and reversibly at 300 K from 1L to 10 L. The enthalpy change in kJ is

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(a) 11.4 kJ (b) 4.8 kJ
(c) –11.4 kJ (d) zero kJ

MHT CET-02.05.2019, SHIFT-II

Ans. (d) : We know,

$$\Delta H = \Delta U + \Delta n_g RT$$

Given, process is isothermal (i.e. $\Delta T = 0$)

Hence, Internal energy is also zero because it is a function of temperature.

$$\Delta H = 0 + 0 = 0$$

784. Identify the equation in which change in enthalpy is equal to change in internal energy

(a) $2H_2O_2(l) \rightarrow 2H_2O(l) + O_2(g)$
(b) $C(s) + O_2(g) \rightarrow CO_2(g)$
(c) $PCl_5(g) \rightarrow PCl_3(g) + Cl_2(g)$
(d) $N_2(g) + 3H_2(g) \rightarrow 2NH_3(g)$

MHT CET-02.05.2019, SHIFT-II

Ans. (b) : Change in enthalpy and internal energy given as–

$\Delta H = \Delta U + \Delta n_g RT$
(a) $2H_2O_2(l) \rightarrow 2H_2O(l) + O_2(g)$
$\Delta n_g = 1$
$\Delta H = \Delta U + \Delta n_g RT$
$\therefore$ $\Delta H = \Delta U + RT$
(b) $C(S) + O_2(g) \rightarrow CO_2(g)$
$n_g = 1 - 1 = 0$
$\Delta H = \Delta U + \Delta n_g RT$
$\Rightarrow$ $\Delta H = \Delta U$
(c) $PCl_5(g) \rightarrow PCl_3(g) + Cl_2(g)$
$\Delta n_g = 2 - 1 = 1$
$\Delta H = \Delta U + \Delta n_g RT$
$\Delta H = \Delta U + RT$
(d) $N_2(g) + 3H_2(g) \rightarrow 2NH_3(g)$
$\Delta n_g RT = 2 - 3 = -1$
$\Delta H = \Delta U + \Delta n_g RT$
$\Delta H = \Delta U - RT$

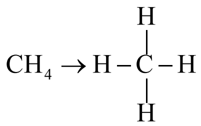
Equation given in option (b) has enthalpy change equal to internal energy change.

785. The bond energy is the energy required to

(a) dissociate one mole of the substance
(b) dissociate bond in 1 kg of the substance
(c) break one mole of similar bonds
(d) break bonds in one mole of substance

MHT CET-2007

Ans. (c) : Bond Energy is the measures of Bond strength in a chemical Bond it is the energy or Heat required to break one mole of molecule into their individual atom.



$$CH_4 \rightarrow H-\overset{\displaystyle H}{\underset{\displaystyle H}{\overset{|}{\underset{|}{C}}}}-H$$

786. If the bond energies of H–H, Br–Br, and H–Br are 433, 192 and 364 kJ mol^{-1} respectively, the ΔH^0 for the reaction $H_2(g) + Br_2(g) \rightarrow 2HBr(g)$ is

(a) –261 kJ (b) + 103 kJ
(c) + 261 kJ (d) – 103 kJ

Karnataka-CET-2016
NEET-2004

Ans. (d) : Given, Bond energy –

$BE_{H-H} = 433 kJ/mole = \Delta H$
$BE_{Br-Br} = 192$ kJ/Mole $= \Delta H$
$BE_{H-Br} = 364$ kJ/mole $= \Delta H$
$H_2(g) + Br_2(g) \rightarrow 2HBr(g)$
ΔH^o for the reaction
$\Delta H^o = \Sigma B.E_R - \Sigma B.E_P$
$= (BE_{(H-H)} + BE_{(Br-Br)}) - 2BE_{(H-Br)}$
$= (433+192) - 2(364)$
$= 625-728$
$\Delta H° = -103$ kJ

787. Given that bond energies of H – H and Cl – Cl are 430 kJ mol^{-1} and 240 kJ mol–1 respectively and ΔH_f for HCl is –90 kJ mol^{-1}, bond enthalpy of HCl is

(a) 380 kJ mol^{-1} (b) 425 kJ mol^{-1}
(c) 245 kJ mol^{-1} (d) 290 kJ mol^{-1}

NEET-2007

Ans. (b) : $H_2 + Cl_2 \rightarrow 2HCl$

$BE_{(H-H)} = 430$ kJ/mol
$BE_{(Cl-Cl)} = 240$ kJ/mol
$\Delta H(_{f\,HCl}) = -70$ kJ/mol
$\frac{1}{2}H_2 + \frac{1}{2}Cl_2 \rightarrow HCl$
$\Delta H_f = -90$ kJ/mol
$\Delta H_f = \frac{1}{2} BE_{(H-H)} + \frac{1}{2} BE_{(Cl-Cl)} - BE_{(HCl)}$
$-90 = \frac{1}{2} \times 430 + \frac{1}{2} \times 240 - BE_{(HCl)}$
$BE_{(HCl)} = 215 + 120 + 90$
$= 425$ kJ/mol

788. For the reaction

$$\mathbf{A(g) + 2B(g) \longrightarrow 2C(g) - 3D(g)}$$

the change of enthalpy at 27^o C is 19 kcal. The value of ΔE is: (R = 2.02 cal K^{-1} mol^{-1})

(a) 21.2 kcal (b) 17.8 kcal
(c) 18.4 kcal (d) 20.6 kcal

UPTU/UPSEE-2006

Ans. (b) : We know that, $\Delta H = \Delta E + \Delta n_g RT$

$\Delta n_g = 5 - 3 = 2$
$\Delta H = 19$ kcal
$= 19 \times 10^3$ cal.
$\Delta E = \Delta H - \Delta n_g RT$
$= 19 \times 10^3 - (2 \times 2 \times 300)$
$= 19000-1200 = 17800$ cal
$\simeq 17.8$ kcal

789. C-H bond energy is about 101 Kcal/mol for methane, ethane and other alkanes but is only 77 kcal/mol for C-H bond of CH_3 in toluene. this is because:

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(a) of inductive effect due to -CH_3 in toluene of
(b) of the presence of benzene ring in toluene
(c) of resonance among the structures of benzyl radical in toluene
(d) aromaticity of toluene

UPTU/UPSEE-2005

Ans. (c) : C–H bond in toluene has partial double bond character due to resonance.

∴ C–H bond in toluene has less energy as compared to others.

6. Gibbs Energy Change and Equilibrium

790. Given below are two statements:

Statement I: According to the Ellingham diagram, any metal oxide with higher ΔG^o is more stable than the one with lower ΔG^o

Statement II: The metal involved in the formation of oxide placed lower in the Ellingham diagram can reduce the oxide of a metal placed higher in the diagram.

In the light of the above statements, choose the most appropriate answer from the options given below:

(a) Both Statement I and Statement II are correct.
(b) Both Statement I and Statement II are incorrect
(c) Statement I is correct but Statement II is incorrect.
(d) Statement I is incorrect but Statement II is correct.

JEE Main-26.06.2022, Shift-I

Ans. (d) : Higher value of ΔG^o like HgO, Ag_2O are less stable.

- In Ellingham diagram lower situated metals is more reactive, it can reduce higher metal oxide.

791. Standard entropies of X_2, Y_2 and XY_3 are 60, 40 and 50 /K/ mol respectively. At what temperature the following reaction will be at equilibrium.

$$\frac{1}{2}X_2+\frac{3}{2}Y_2 \rightleftharpoons XY_3, \Delta H = -30kJ$$

(a) 500 K
(b) 750 K
(c) 1000 K
(d) 1250 K

AP EAPCET 19-08-2021 Shift-I

Ans. (b) : Given, Standard entropies,

$S_{X_2} = 60\ Jk^{-1}\ mol^{-1}$ and $\Delta H = -30\ kJ$

$S_{Y_2} = 40\ Jk^{-1}\ mol^{-1}$

$S_{XY_3} = 50\ Jk^{-1}\ mol^{-1}$

$$\frac{1}{2}X_2+\frac{3}{2}Y_2 \rightleftharpoons XY_3$$

$$\Delta S = \sum S_{(Product)} - \sum S_{(Reactant)}$$

$$\therefore \Delta S_{Reaction} = 50 - \frac{3}{2}\times 40 - \frac{1}{2}\times 60 = 50 - 60 - 30$$

$$= -40\ Jk^{-1}\ mol^{-1}$$

From the Gibb's free energy equation-

$\Delta G = \Delta H - T\Delta S$ (for equilibrium $\Delta G = 0$)

$\therefore \quad \Delta H = T\Delta S$

$$\text{Or } T = \frac{\Delta H}{\Delta S} = \frac{-30\times 1000}{-40} = 750K$$

792. The temperature of K at which $\Delta G = 0$, for a given reaction with $\Delta H = -20.5\ kJ\ mol^{-1}$ and $\Delta S = -50.0\ JK^{-1}\ mol^{-1}$ is

(a) – 410
(b) 410
(c) 2.44
(d) 0.36

AP EAMCET (Engg.) -2014

Ans. (b) : Given, $\Delta H = -20.5\ kJ\ mol^{-1}$

$\Delta S = -50\ Jk^{-1}\ mol^{-1}$

$\Delta G = \Delta H - T\Delta S$

$0 = -(20500) - T(-50) \quad (\Delta G = 0)$

$20500 = 50T$

$\boxed{T = 410K}$

793. An endothermic reaction is found to have +ve entropy change. The reaction will be

(a) possible at high temperature
(b) possible only at low temperature
(c) not possible at any temperature
(d) possible at any temperature.

COMEDK-2015

Ans. (a) : Given, $\Delta S = +ve$ and $\Delta H = +ve$

Now, $\Delta G = \Delta H - T\Delta S$

For a reaction to be spontaneous, ΔG should be –ve, which is only possible at high temperature i.e. when $T\Delta S > \Delta H$.

794. The standard enthalpy of the decomposition of N_2O_4 to NO_2 is 58.04 kJ and standard entropy of this reaction is 176.7 J/K. Therefore the standard free energy changes for this reaction at 25°C is

(a) –5.39 kJ
(b) 539 kJ
(c) 5.39 kJ
(d) –539 kJ

COMEDK-2017

Ans. (c) : Given, that

Standard enthalpy of decompositions $(\Delta H) = 58.04kJ$;

Standard entropy $(\Delta S) = 176.7\ J/K$

$= 176.7\times 10^{-3}\ kJ/K.$

And temperature (T)= 25°C + 273 = 298K.

Change in free energy $(\Delta G) = \Delta H - T\Delta S$

$$= 58.04 - 298\times(176.7\times 10^{-3}) = 58.04 - 52.65$$

$$= 5.39\ kJ$$

795. The equilibrium constant of a reaction is 0.008 at 298 K. The standard free energy change of the reaction at the same temperature is

(a) +11.96 kJ
(b) –11.96 kJ
(c) –5.43 kJ
(d) –8.46 kJ

COMEDK-2020

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Ans. (a) : Given, Equilibrium constant (K) = 0.008
Temperature (T) = 298 K, R = 8.314 J mol^{-1} K^{-1}

$$\Delta G^\circ = -2.303 RT \log K$$

$$\Delta G^\circ = -2.303 \times 8.314 \times 298 \times \log(0.008)$$

$$\Delta G^\circ = -5705.84 \times -2.09$$

$$\Delta G^\circ = 11964.65 = 11.96 \text{ kJ}$$

796. For the reaction

$$\mathbf{A(g) \rightleftharpoons B(g) \text{ at } 495\text{ K}, \Delta_r G^\circ = -9.478 \text{ kJ mol}^{-1}}$$

If we start the reaction in a closed container at 495 K with 22 millimoles of A, the amount of B in the equilibrium mixture is _____ millimoles. (Round off to the Nearest Integer).

$$\mathbf{\left[R = 8.314 \text{ J mol}^{-1} \text{ K}^{-1}; \ln 10 = 2.303\right]}$$

JEE Main 16.03.2021, Shift-I

Ans. (20) : Given, T = 495 K, $\Delta_r G = -9.478$ kJ mol^{-1}
R = 8.314 J mol^{-1} K^{-1}

For the reaction–

$$A(g) \rightleftharpoons B(g)$$

Now, From the relation between Gibb's free energy and rate constant—

$$\Delta G = -RT \ln(K)$$

$$-9.478 \times 10^3 = -8.321 \times 495 \times \ln(K)$$

or

$$\ln(K) = 2.203$$

or $\quad 2.303 \ln_{10}(K) = \ln 10 \qquad (\ln = 2.303)$

or

$$K = 10$$

Now, $\quad A(g) \rightleftharpoons B(g)$

$$t = 0 \quad 22 \qquad 0$$

$$t = T \quad 22 - x \qquad x$$

$$\therefore K = \frac{x}{22 - x} = 10$$

or

$x = 220 - 10x$ or $x = 20$

797. For the reaction A(g) → B(g), the value of the equilibrium constant at 300K and 1 atm is equal to 100.0. The value of $\Delta_r G$ for the reaction 300K and 1 atm in J mol^{-1} is – x R, where x is _____. (Rounded off to the interger) [R = 8.31 mol^{-1} K^{-1} and ln10 = 2.3]

JEE Main 24.02.2021, Shift-I

Ans. : (1380) Given that a reaction–

$$A(g) \rightarrow B(g)$$

K = 100
T = 300K
P = 1 atm
$\Delta G^\circ = -xR$ (J mol^{-1})
x = ?
Now,

$$\Delta G^\circ = -RT \ln(K)$$

or $\quad -8.31 \times 300 \times \log(10^2)$

$$\Delta G^\circ = -1380 R$$

Where, x = 1380R

798. Following reaction occurrs in an automobile

$$\mathbf{2C_8H_{18}(g) + 25O_2(g) \rightarrow 16CO_2(g) + 18H_2O(g)}$$

The sign of $\Delta H, \Delta S$ and ΔG would be

(a) +,–,+ (b) –,+,–
(c) –,+,+ (d) +,+,–

AIIMS-2015
NEET-1994

Ans. (b): For all combustion reaction ΔH is negative. As the number of gaseous molecules increases, entropy also increases i.e. +ve.
For a spontaneous process ΔG must be negative.

799. For a reaction to be spontaneous at all temperatures,

(a) $\Delta G = -ve, \Delta H = +ve$ and $\Delta S = +ve$
(b) $\Delta G = +ve, \Delta H = -ve$ and $\Delta S = +ve$
(c) $\Delta G = -ve, \Delta H = -ve$ and $\Delta S = -ve$
(d) $\Delta G = -ve, \Delta H = -ve$ and $\Delta S = +ve$

AIIMS-2008

Ans. (d): For Spontaneous reaction ΔG < O

$$\Delta G = (\Delta H - T\Delta S)$$

For spontanceous

$$\Delta G = -ve$$

$$\Delta H = -ve$$

$$\Delta S = +ve$$

800. A certain reaction is non spontaneous at 298K. The entropy change during the reaction is 121 JK^{-1}. Is the reaction is endothermic or exothermic ? The minimum value of ΔH for the reaction is

(a) endothermic, ΔH = 36.06 kJ
(b) exothermic, ΔH = – 36.06 kJ
(c) endothermic, ΔH = 60.12 kJ
(d) exothermic, ΔH = – 60.12 kJ

VITEEE, 2017

Ans. (a) : Given, For non spontaneous reaction
ΔG = + ve, ΔS = 121 JK^{-1}, ΔG = ΔH – TΔS
ΔG = + ve, Hence the reaction is endothermic.
The minimum value of ΔH can be obtained by putting ΔG = 0

$\therefore \quad \Delta H = T\Delta S$

$$\Delta H = 298 \times 121$$

$$\Delta H = 36.06 \text{ kJ.}$$

801. Standard entropies of X_2 , Y_2 and XY_3 are 60, 30 and 50 $JK^{-1}mol^{-1}$ respectively. For the reaction $\frac{1}{2}X_2 + \frac{3}{2}Y_2 \rightleftharpoons XY_3, \Delta H = -30$ kJ to be at equilibrium, the temperature should be:

(a) 750 K (b) 1000 K
(c) 1250 K (d) 500 K

AIPMT-2010

Ans. (a) : Given reaction is

$$\frac{1}{2}X_2 + \frac{3}{2}Y_2 \rightleftharpoons XY_3$$

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$\Delta S = \Sigma S_{(product)} - \Sigma S_{(reactant)}$

$\Delta S = 50 - (60 + 30) = -40\ JK^{-1}\ mol^{-1}$

$\Delta H = -30\ KJ$

For equilibrium $\Delta G = 0$

$\Delta G = \Delta H - T\Delta S$

$\Delta H = T\Delta S$

$$T = \frac{\Delta H}{\Delta S} = \frac{-30\times10^3}{-40} = 750\,K.$$

802. The standard Gibb's free energy change, ΔG° is related to equilibrium constant, K_p as

(a) $K_p = -RT\ln\Delta G°$
(b) $K_p = \left[\frac{e}{RT}\right]^{\Delta G°}$
(c) $K_p = -\frac{\Delta G}{RT}$
(d) $K_p = e^{-\Delta G°/RT}$

VITEEE- 2010

Ans. (d) : According to Gibb's free energy.

$\Delta G = \Delta G° + RT\ln K_p$

For equilibrium condition $\Delta G = 0$

$\Delta G° = -RT\ln K_p$

$$\Rightarrow \ln K_p = \frac{-\Delta G°}{RT} \Rightarrow K_p = e^{-\Delta G°/RT}$$

ΔG° = Standard change in Gibb's free energy

K_p = Equilibrium constant

R = Universal gas constant

T = Temperature in Kelvin

803. For a cell reaction to be spontaneous, the standard free energy change of the reaction must be

(a) zero
(b) positive
(c) infinite
(d) negative

CGPET-2007
VITEEE- 2006

Ans. (d) : For spontaneous reaction free energy change is negative.

$\Delta G = -nFE$

Where F = Faraday constant

E = emf of the cell

804. For a reaction at equilibrium,

(a) $\Delta G = \Delta G° = 0$
(b) $\Delta G = 0$ but not $\Delta G°$
(c) $\Delta G° = 0$ but not ΔG
(d) $\Delta G = \Delta G° \neq 0$

SRMJEEE – 2008

Ans. (b) : As we know, Gibb's free change for any reaction in equilibrium condition is 0 i.e.

$\Delta G = \Delta G° + nRT\ln K$

or

$\Delta G° = -nRT\ln K$

805. Calculate ΔG° for the following cell reaction.

$$Zn(s) + Ag_2O(s) + H_2O(\ell) \rightarrow Zn_n^{2+}(aq.) + 2Ag(s) + 2OH^-(aq.)$$

$$E°_{Ag^+/Ag} = +0.80V \text{ and } E°_{Zn^{2+}/Zn} = -0.76V$$

(a) – 305 kJ/mol
(b) – 301 kJ/mol
(c) 305 kJ/mol
(d) 301 kJ/mol

AP-EAMCET (Engg.) 2015

Ans. (b) : Given that,

$Zn(s) + Ag_2O(s) + H_2O(l) \rightarrow Zn^{2+}(aq) + 2Ag(s) + 2OH^-(aq)$

$E°_{Ag^+/Ag} = +0.80V$ and $E°_{Zn^{2+}/Zn} = -0.76V$

$E°_{cell} = E°_{cathode} - E°_{anode}$

$\therefore\ E°_{cell} = 0.80 - (-0.76) = 1.56$ Volt

$\therefore\ \Delta G° = -nF E°_{cell}$

$\Delta G° = -2 \times 96500 \times 1.56$ (n = 2, F = 96500)

or $\Delta G° = -301$ kJ/mole

806. For the equilibrium, $PCl_5(g) \rightleftharpoons PCl_3(g) + Cl_2(g)$ at 298K. $K_c = 1.8\times10^{-7}$ then, ΔG for this reaction will be _____ [Given log 4.5 = 0.6484]

(a) $14.56\ kJ.\ mol^{-1}$
(b) $13.82\ kJ.\ mol^{-1}$
(c) $16.24\ kJ.\ mol^{-1}$
(d) $19.12\ kJ.\ mol^{-1}$

AP- EAPCET- 07-09-2021, Shift-I

Ans. (d) : Given $K_c = 1.8\times10^{-7}$

$\Delta G° = -RT\ln K_c$

$\Delta G° = -2.303RT\log_{10} K_c$

$\Delta G° = -2.303\times 8.31 \times 298\log_{10}(1.8\times10^{-7})$

$\Delta G° = -5703.103 \times \log_{10}(\log 1.8 + \log 10^{-7})$

$\Delta G° = -5703.103 \times (0.2553 - 7)$

$\Delta G° = 38465.87$

$\Delta G° = 38.46\ kJ\ mol^{-1}$

Note : The correct answer is 38.48 kJ/mole but official answer is 19.12 kJ/mole

807. In the process of ice melting at –15°C at atmospheric pressure,

(a) $\Delta G < 0$
(b) $\Delta G > 0$
(c) $\Delta G = 0$
(d) $\Delta G = \infty$

AMU – 2008

Ans. (b) : $\Delta G = \Delta H - T\Delta S$

ΔG = Positive (It means, Process is non spontaneous)

Then, Melting of ice below (0 °C / 273 k)

$\Delta G > 0$

808. The standard free energy change (ΔG°) is related to equilibrium constant (K) as

(a) $\Delta G° = -2.303\ RT\log K$
(b) $\Delta G° = RT\log K$
(c) $\Delta G° = 2.303\ RT\log K$
(d) $\Delta G° = -2.303\ RT\ln K$

Manipal-2018
AMU 2002

Ans. (a) : The relation between standard free energy change (ΔG°) and equilibrium constant (K) is given below-

$$\Delta G° = -2.303\ RT\log K$$

809. For a process to occur spontaneously

(a) $(\Delta H - T\Delta S)$ must be negative
(b) $(\Delta H + T\Delta S)$ must be negative
(c) ΔH must be negative
(d) ΔS must be negative

Assam CEE-2014

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Ans. (a) : For a process to occurs spontaneously–

ΔG Must be Negative

$\Delta G < O$ (Negative)

$\Delta G = \Delta H - T\Delta S$

If ΔG = Negative

Then,

$(\Delta H - T\Delta S)$ must be Negative.

810. For the reduction of Ag^+ ions with copper metal the Standard cell potential was found to be 0. 46 V at 25° C. The value of standard Gibb's free energy will be

(a) -89.0 kJ mol^{-1} (b) -890 J mol^{-1}

(c) -44.5 kJ mol^{-1} (d) -98.0 kJ mol^{-1}

Assam CEE-2019

Ans. (a) : Given, $E^o_{cell} = 0.46$ V

$$Cu + 2Ag^+ \rightarrow Cu^{2+} + 2Ag$$

We know,

$$\Delta G^o = -nFE^o_{cell}\ (n = 2, F = 96500)$$
$$= -2\times 96500 \times 0.46 = -88780\ J]$$
$$= -88.780\ kJ \simeq -89kJ$$

811. For $CaCO_3(s) \rightleftharpoons CaO(s) + CO_2(g)$ at 927°C, $\Delta H = 176kJ\ mol^{-1}$ then ΔE is :

(a) 180 kJ (b) 186.4 kJ

(c) 166.0 kJ (d) 160 kJ

BCECE-2006

Ans. (c) : Given, $\Delta H = 176kJ\ mol^{-1}$,

$$T = 927°C + 273 = 1200\ K$$
$$\Delta H = \Delta E + \Delta n_g RT$$
$$176 = \Delta E + 8.314 \times 10^{-3} \times (273+927)$$
$$176 = \Delta E + 9.9768$$
$$\Delta E = 166\ KJ$$

812. For $A \longrightarrow B, \Delta H = 4k\ cal\ mol^{-1}$ $\Delta S = 10\ cal\ mol^{-1}$ reaction is spontaneous when temperature can be :

(a) 400 K (b) 300 K

(c) 500 K (d) none of these

BCECE-2004

Ans. (c) : Given, $\Delta H = 4k\ cal\ mol^{-1}$

$$\Delta S = 10\ cal\ mol^{-1}$$
$$\Delta G = \Delta H - T\Delta S$$

For spontaneous reaction, $\Delta G = -Ve$

$$T\Delta S > \Delta H$$

or $$T > \frac{\Delta H}{\Delta S} = \frac{4\times1000}{10}$$

$$T > 400$$

It means temperature Should be greater then 400K

813. For a system in equilibrium

(a) $\Delta G = 0$ (b) $\Delta G > 0$

(c) $\Delta G < 0$ (d) $\Delta H = 0$

BCECE-2009

Ans. (a) : If $\Delta G > 0$, then $K < 0$, and the reaction must proceed to the left to reach equilibrium.

If $\Delta G = 0$, then $K = 0$, and the reaction is at equilibrium.

When $\Delta G < 0$, then $K > 0$, it means reaction is spontaneous.

814. For a chemical reaction, ΔG is always less than zero (ΔG <0) if

(a) ΔH and $T\Delta S$ both are positive

(b) ΔH and $T\Delta S$ both are negative

(c) ΔH is negative and $T\Delta S$ is positive

(d) ΔH is positive and $T\Delta S$ is negative

CG PET -2019

Ans. (c) : For a chemical Reaction It $\Delta G < 0$ or Negative then

$$\Delta G = (\Delta H - T\Delta S)$$
$$\Delta G = -\Delta H + T\Delta S$$
$$\because \Delta H = -ve \text{ and } T\Delta S = +ve$$

815. Cell reaction is spontaneous when

(a) ΔG° is negative (b) ΔG° is positive

(c) ΔE°_{red} is positive (d) ΔE°_{red} is negative

CG PET -2007

Ans. (a) : $\Delta G = -NF\ E_{cell}$

E_{cell} is an intensive property but ΔG is an extensive property.

If the electrode potential is assumed to be positive then,

When $\Delta G < 0$, the spontaneous cell reaction.

When $\Delta G > 0$, the non-spontaneous cell reaction.

816. Which of the following relation is correct?

(a) $\Delta H = \Delta G + T\Delta S$ (b) $\Delta H = -\Delta G - T\Delta S$

(c) $\Delta H = \Delta G - T\Delta S$ (d) $\Delta H = -\Delta G + T\Delta S$

CG PET -2004

Ans. (a) :

Gibbs Free Energy

$$\Delta H = \Delta G + T\Delta S$$

Where, ΔH = enthalpy change

ΔS = entropy change

T = temperature

$$\Delta H = \Delta G + T\Delta S$$
$$\Delta G = \Delta H - T\Delta S$$

817. For a spontaneous reaction, the ΔG, equilibrium constant (K) and E°_{cell} will be respectively

(a) –ve, > 1, –ve (b) –ve, <1, –ve

(c) +ve, >1, –ve (d) –ve, >1, +ve

AIEEE-2005

Ans. (d) : We know

$\Delta G^o = -2.303\ RT \log K$

$\Delta G^o = -nFE^0_{cell}$

For spontaneous process

$K > 1$ and $E_{cell} = +ve$

and $\Delta G^o = -ve$

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818. In an irreverible process taking place at constant T and p and in which only pressure-volume work is being done, the change in Gibbs free energy (dG) and change in entropy (dS), satisfy the criteria

(a) $(dS)_{V,E} < 0, (dG)_{T,p} < 0$
(b) $(dS)_{V,E} > 0, (dG)_{T,p} < 0$
(c) $(dS)_{V,E} = 0, (dG)_{T,p} = 0$
(d) $(dS)_{V,E} = 0, (dG)_{T,p} > 0$

AIEEE-2003

Ans. (b) : An irreversible process (i.e. spontaneous process)
$(ds)_{V,E}$ (change in entropy) = + ve > 0
$(dG)_{T,p}$ (change in Gibbs free energy) = –ve < 0

819. The correct relationship between free energy change in a reaction and the corresponding equilibrium constant K_c is

(a) $\Delta G = RT\ 1n\ K_c$
(b) $-\Delta G = RT\ 1nK_c$
(c) $\Delta G° = RT\ 1nK_c$
(d) $-\Delta G° = RT\ 1nK_c$

AIEEE-2003

Ans. (d) : $\Delta G = \Delta G° + RT\ln K_c$

K_c = Reaction quotient at equilibrium

$\Delta G = 0$ (at equilibrium)

Then,

$$\boxed{-\Delta G^o = RT\ln K_c}$$

820. A reaction is non-spontaneous at the freezing point of water but is spontaneous at the boiling point of water, then

	ΔH	**ΔS**
(a)	+ve	+ve
(b)	–ve	–ve
(c)	–ve	+ve
(d)	+ve	–ve

AIEEE-2002

Ans. (a) : We know,

$\Delta G = \Delta H - T\Delta S$

At lower temperature, process is non spontaneous. It means $\Delta G > 0$ and $\Delta H > 0$.
At high temperature, process is spontaneous. It means $\Delta G > 0$ and $\Delta S > 0$

821. In a fuel cell, methanol is used as fuel and oxygen gas is used as an oxidiser. The reaction is

$$CH_3OH(l) + \frac{3}{2}O_2(g) \longrightarrow CO_2(g) + 2H_2O(l)$$

At 298 K standard Gibb's energies of formation for $CH_3OH(l)$, $H_2O(l)$ and CO_2 (g) are –166.2, –237.2 and –394.4 kJ mol^{-1}, respectively. If standard enthalpy of combustion of methanol is –726 kJ mol^{-1}, efficiency of the fuel cell will be

(a) 80%
(b) 87%
(c) 90%
(d) 97%

AIEEE-2009

Ans. (d) : Given that,

$$\Delta G^o_{f(CH_3OH)} = -166.2 kJ\,mol^{-1}$$

$$\Delta G^o_{f(H_2O)} = -237.2\ kJ\ mol^{-1}$$

$$\Delta G^o_{f(CO_2)} = -394.4 kJ\,mol^{-1}$$

$$\Delta H = -726\ kJ\ mol^{-1}$$

$$\because \Delta G = \Sigma\Delta G^o_{f(products)} - \Sigma\Delta G^o_{f(reactant)}$$

$= -394.4 - 2\ (237.2) + 166.2$
$= -702.6\ kJ\ mol^{-1}$

now efficiency of fuel cell

$$= \frac{\Delta G}{\Delta H} \times 100$$

$$= \frac{702.6}{726} \times 100$$

$= 97\%$

822. The incorrect expression among the following is

(a) $\dfrac{\Delta G_{system}}{\Delta G_{total}} = -T$

(b) In isothermal process,

$$W_{reversible} = -nRT\ In \frac{V_f}{V_i}$$

(c) $\ln K = \dfrac{\Delta H° - T\Delta S°}{RT}$

(d) $K = e^{-\Delta G°/RT}$

AIEEE-2012

Ans. (c) : $\Delta G° = -RT\ lnK$ (i)

$\Delta G° = \Delta H° - T\Delta S°$ (ii)

from equation (i) and (ii)

$-(\Delta H° + T\Delta S°) = RT\ ln\ K$

$$\ln K = \frac{\Delta H° - T\Delta S°}{RT}$$

823. The standard reaction Gibbs energy for a chemical reaction at an absolute temperature T is given by,

$\Delta_r G° = A - BT$

Where A and B are non-zero constants.

Which of the following is true about this reaction?

(a) Endothermic if, A < 0 and B > 0
(b) Exothermic if, B < 0
(c) Exothermic if, A > 0 and B < 0
(d) Endothermic if, A > 0

JEE Main-2019, Shift-II

Ans. (d) : Given, $\Delta_r G° = A - BT$ ….(i)
We know that the relation,
$\Delta G° = \Delta H - T\Delta S$ ….(ii)
Comparing the equation.
$A = \Delta H,\ B = \Delta S$
If $\Delta H > 0$ it means reaction is endothermic

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824. For the chemical reaction, $X \rightleftharpoons Y$, the standard reaction Gibbs energy depends on temperature T (in K) as

$\Delta_r G°$ (in kJ mol^{-1}) $= 120 - \frac{3}{8}T$

The major component of the reaction mixture at T is

(a) Y if T = 280 K (b) X if T = 350 K
(c) X if T = 315 K (d) Y if T = 300 K

JEE Main-2019, Shift-I

Ans. (c) : $\Delta_r G°$ (in kJ mol^{-1}) $= 120 - \frac{3}{8}T$

At equilibrium $\Delta G = 0$

$\therefore$ $T = 320$ K

$X \rightleftharpoons Y$

If $T > 320$ K

ΔG becomes negative

$\Delta G = -ve$

$Y > X$

$T < 320$

$X > Y$

825. A process will be spontaneous at all temperature if

(a) $\Delta H > 0$ and $\Delta S < 0$ (b) $\Delta H < 0$ and $\Delta S > 0$
(c) $\Delta H < 0$ and $\Delta S < 0$ (d) $\Delta H > 0$ and $\Delta S > 0$

JEE Main-2019, Shift-I

Ans. (b) : For spontaneous process at all temperature.
$\Delta G < 0$ and $\Delta H < 0$ and $\Delta S > 0$

826. The incorrect match in the following is

(a) $\Delta G° < 0, K > 1$ (b) $\Delta G° = 0, K = 1$
(c) $\Delta G° > 0, K < 1$ (d) $\Delta G° < 0, K < 1$

JEE Main-2019, Shift-II

Ans. (d) : $\Delta G = \Delta G^o + RT\ln K$

At equilibrium ($\Delta G = 0$)

$\Delta G^o + RT\ln K = 0$

$\Delta G^o = -RT\ln K$

If $K<1$

Then $\Delta G^o > 0$

827. For a dimerisation reaction

$2A(g) \longrightarrow A_2(g)$,

at 298 K, $\Delta U^\Theta = -20$ kJ mol^{-1},

$\Delta S^\Theta = -30$ JK^{-1} mol^{-1}, then the ΔG^Θ will be ....J.

JEE Main-2020, Shift-II

Ans. (13538)

Given that,

$\Delta G = \Delta H - T\Delta S$ ....(i)

$\Delta H = \Delta U + \Delta n_g RT$ ....(ii)

and

Δn_g = change gaseous moles of (product – reactant)

$\Delta n_g = (2–2) = -1$

$\Delta H = -20\times10^3 + (-1)(8.314)\times298$

$\Delta H = -22477.52$ J

and

$\Delta G = \Delta H - T\Delta S$

$= -22477.52 - (298) \times (-30)$

$= -13537.5$ J

$\simeq 13538$ J

828. For the reaction; $A(l) \longrightarrow 2B(g)$

$\Delta U = 2.1$ kcal, $\Delta S = 20$ cal K^{-1} at 300 K.

Hence, ΔG in kcal is..........

JEE Main-2020, Shift-I

Ans. (2.70) Given, R = 2 cal/mol-K

$\Delta U = 2.1$ kcal $= 2100$ cal

$\Delta S = 20$ cal K^{-1}

$T = 300$ K

$\Delta H = \Delta U + \Delta n_g RT$ ($\Delta n_g = 2–0 = 2$)

$= 2100 + 2 \times 2 \times 300$

$= 3300$ cal

$\Delta G = \Delta H - T\Delta S$

$= 3300 - 300 \times 20$

$= 2700$ cal

$= 2.7$ kcal

829. Which is the correct Gibb's Helmholtz equation?

(a) $\Delta H = \Delta G - T.\Delta S$ (b) $\Delta S = \frac{1}{T}[\Delta G - \Delta H]$

(c) $\Delta S = \frac{1}{T}[\Delta H - \Delta G]$ (d) $-\Delta G = \Delta H - T.\Delta S$

JCECE - 2003

Ans. (c): Equation of Gibb's free Energy

$\Delta G = \Delta H - T\Delta S$

$T\Delta S = \Delta H - \Delta G$

$\Delta S = \frac{1}{T}(\Delta H - \Delta G)$

830. If equilibrium constant is 2.6×10^{-8} at 298 K, then find the value of ΔG^o.

(a) - 43.36 kJ (b) - 63.2 kJ
(c) - 23.3 kJ (d) + 40 kJ

JIPMER-2019

Ans. (a) : Given, $K = 2.6\times10^{-8}$, $T = 298$ K

$R = 8.314$ J/k mol

$\Delta G^o = -2.303\, RT \log K$

$\Delta G^o = -2.303 \times 8.314 \times 298 \log(2.6 \times 10^{-8})$

$\Delta G^o = 432790.01$

$\Delta G^o = 43.27$ kJ

$\simeq 43.27$ kJ $\simeq 43.36$ kJ

831. When compared to ΔG^o for the formation of Al_2O_3, the ΔG^o for the formation of Cr_2O_3 is

(a) Higher (b) Lower
(c) Unpredicted (d) Same

Karnataka-CET, 2008

Ans. (a) : Between Al_2O_3 and Cr_2O_3, Al_2O_3 is more stable, so its ease of formation is high i.e., ΔG^o is negative or less than that of Cr_2O_3.
Hence, ΔG^o of $Cr_2O_3 > \Delta G^o$ of Al_2O_3.

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832. In equilibrium state the value of ΔG is

(a) zero
(b) negative
(c) positive
(d) may be negative or positive

Karnataka-CET-2007

Ans. (a) : In the equilibrium state the value of ΔG is zero.

833. Which of the following can help predict the rate of a reaction if the standard Gibbs free energy of reaction (ΔG) is known?

(a) Equilibrium constant
(b) ΔH
(c) ΔU
(d) Heat liberated during the course of reaction in calorimeter
(e) Both (a) and (b)

Kerala-CEE-2018

Ans. (a) : We know, ΔG^o (Gibbs free energy) is related to K (equilibrium constant)

$\Delta G° = -2.303\ RT \log_{10} K$

K = Equilibrium const.

R = Gas constant

T = Temperature (K)

by knowing the value of K we can find out the rate of a reaction.

834. The equilibrium constant for a reaction is 10. ΔG^o will be the value of $\Delta G^\ominus$ (R = 8.314 JK^{-1} mol^{-1}, T = 300 K)

(a) – 5527 kJ mol^{-1}
(b) – 5.527 kJ mol^{-1}
(c) – 55.27 kJ mol^{-1}
(d) + 5.527 kJ mol^{-1}

Manipal-2017

Ans. (b) : $\Delta G^\ominus = -2.303RT \log K$

$\Delta G^\ominus = -2.303 \times 8.314 \times 300 \log 10$

$= -57441.4\ J\ mol^{-1}$

$\Delta G^\ominus = -5.74\ kJ/mole^{-1}$

835. The criterion for a spontaneous process is

(a) $\Delta G > 0$
(b) $\Delta G < 0$
(c) $\Delta G = 0$
(d) $\Delta S_{total} < 0$

MHT CET-2016

Ans. (b) :

For spontaneous process ΔS = +ve (Because of disorderness or randomness)

For a process to be spontaneous $\Delta G < 0$.

836. Enthalpy of hydrogenation of one mole of benzene to cyclohexane is [Resonance energy of benzene = – 150.4 kJ/mole.

Enthalpy of hydrogenation of cyclohexene = – 119.5 kJ/mole]

(a) –208.1 kJ/mole
(b) –358.1 kJ/mole
(c) +150.4 kJ/mole
(d) –269.9 kJ/mole

TS EAMCET 04.08.2021, Shift-I

Ans. (a) : Enthalpy of hydrogenation of cyclohexene = – 119.5 kJ/mol

Calculated enthalpy of benzene = 3 × (–119.5) = 338.5 kJ/mol

Resonance energy of benzene = – 150.4 kJ/mol

Actual value of enthalpy = Cal. enthalpy – resonance energy

= (–358.5) – (–150.4)

= – 208.1 kJ/mol

Hence, the enthalpy of hydrogenation of benzene is – 208.1 kJ/mol

837. $PbO_2 \rightarrow PbO, \Delta G_{298} < 0$

$SnO_2 \rightarrow SnO, \Delta G_{298} > 0$

Most probable oxidation state of Pb and Sn will be

(a) Pb^{4+}, Sn^{4+}
(b) Pb^{4+}, Sn^{2+}
(c) Pb^{2+}, Sn^{2+}
(d) Pb^{2+}, Sn^{4+}

NEET-2001

Ans. (d) : Given, $\overset{+4}{PbO_2} \longrightarrow \overset{+2}{PbO},\ \Delta G_{298} < 0$

ΔG = –ve means reaction is spontaneous in forward direction.

Thus, stability of $Pb^{2+} > Pb^{4+}$

$\overset{+4}{SnO_2} \rightarrow \overset{+2}{SnO} \quad \Delta G_{298} > 0,$

ΔG = +ve thus, backward reaction is spontaneous.

Thus, stability of $Sn^{4+} > Sn^{2+}$

Thus, Pb^{2+} and Sn^{4+}.

838. Standard enthalpy and standard entropy changes for the oxidation of ammonia at 298 K are – 382.64 kJ mol–1 and –145.6 J mol–1, respectively Standard Gibbs' energy change for the same reaction at 298 K is

(a) -221.1 kJ mol^{-1}
(b) -339.3 kJ mol^{-1}
(c) -439.3 kJ mol^{-1}
(d) –523.2 kJ mol^{-1}

NEET-2004

Ans. (b) : Given that,

$\Delta H = -382.64\ kJ, \Delta S = -145.6J = -145.6 \times 10^{-3}\ kJ$

$T = 298\ K, \Delta G = ?$

$\Delta G = \Delta H - T\Delta S$

$= -382.64 - 298 \times (-145.6 \times 10^{-3})$

$= -382.640 + 43.38$

$= -339.3\ kJ\ mol^{-1}$

839. Identify the correct statement for change of Gibb's energy for a system (ΔG_{system}) at constant temperature and pressure.

(a) if $\Delta G_{system} > 0$, the process is spontaneous.
(b) if $\Delta G_{system} = 0$, the system has attained equilibrium
(c) if $\Delta G_{system} = 0$, the system is still moving in particular direction
(d) if $\Delta G_{system} < 0$, the process is not spontaneous.

NEET-2006

Ans. (b) : If the Gibbs free energy for a system (ΔG_{system}) is equal to zero, then system is present in equilibrium at a constant temperature and pressure.

$\Delta G = \Delta_r G^o + RT \ln K\ ;\ \Delta G = 0$

$\Delta_r G^o = -RT \ln K$

K = equilibrium constant

If $\Delta G_{system} < 0$, then the process is spontaneous

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840. For vaporization of water at 1 atmospheric pressure, the values of ΔH and ΔS are 40.63 kJ mol^{-1} and 108.8 J K^{-1} mol^{-1}, respectively. The temperature when Gibbs' energy change (ΔG) for this transformation will be zero, is

(a) 273.4 K (b) 393.4 K

(c) 373.4 K (d) 293.4 K

NEET-2010

Ans. (c) : Given ΔH = 40.63 kJ/mol, ΔS = 108.8 J/K–mol

According to Gibbs equation

$$\Delta G = \Delta H - T\Delta S$$

Given, $\Delta G = 0$

$\Delta H = T\Delta S$

$$T = \frac{40.63\times10^3}{108.8}$$

$T = 373.4$ K

841. For the reaction, $X_2O_4(l) \to 2XO_2(g)$

$\Delta U = 2.1$ kcal, $\Delta S = 20$ cal K^{-1} at 300 K

hence, ΔG is

(a) 2.7 kcal (b) – 2.7 kcal

(c) 9.3 kcal (d) –9.3 kcal

NEET-2014

Ans. (b) : Given that,

$\Delta U = 2.1$ kcal $= 2.1 \times 10^3$ cal

$\Delta S = 20$ cal K^{-1}

$T = 300$ K

$R = 2$ cal/mol K

We know,

$\Delta H = \Delta U + \Delta n_g RT$ .....(i)

$(\Delta n_g = 2 - 0 = 2)$

$\Delta H = 2.1 \times 1000 + 2 \times 2 \times 300$

$= 3300$ cal

Gibbs free energy,

$\Delta G = \Delta H - T\Delta S$

$= 3300 - 300 \times 20$

$= -2700$ cal

$= -2.7$ kcal

842. A reaction having equal energies of activation for forward and reverse reactions has

(a) $\Delta H = 0$ (b) $\Delta H = \Delta G = \Delta S = 0$

(c) $\Delta S = 0$ (d) $\Delta G = 0$

NEET, 2013

Ans. (a) : Change in Enthalpy

$\Delta H = \Delta E$

$\Delta H = E_{af} - E_{ab}$

$(E_a)_f \longrightarrow$ Activation energy for Forward reaction

$(E_a)_b \longrightarrow$ Activation Energy for Backward reaction

$(Ea)_f = (Ea)_b$

It $\Delta H = 0$

then

$(Ea)_f = (Ea)_b$

843. In which of the following reactions, standard reaction entropy change (ΔS^0) is positive and standard Gibbs energy change (ΔG^0) decrease sharply with increasing temperature?

(a) $C_{(graphite)} + \frac{1}{2}O_2(g) \to CO(g)$

(b) $CO(g) + \frac{1}{2}O_2(g) \to CO_2(g)$

(c) $Mg(s) + \frac{1}{2}O_2(g) \to MgO(g)$

(d) $\frac{1}{2}C_{(graphite)} + \frac{1}{2}O_2(g) \to CO(g)$

NEET-2012

Ans. (a) : (a) $C_{(graphite)} + \frac{1}{2}O_2(g) \to CO(g)$

$$\Delta n_g = 1 - \frac{1}{2} = \frac{1}{2}$$

(b) $CO(g) + \frac{1}{2}O_2(g) \to CO_2(g)$

$$\Delta n_g = 1 - \frac{3}{2} = \frac{-1}{2}$$

(c) $Mg(s) + \frac{1}{2}O_2(g) \to MgO(g)$

$$\Delta n_g = \frac{-1}{2}$$

(d) $\frac{1}{2}C_{(graphite)} + \frac{1}{2}O_2(g) \to CO(g)$

$$\Delta n_g \ \frac{1}{2} - \frac{1}{2} = 0$$

The change in Δn_g highest which indicate the more gaseous product is formed

844. Which of the following relation is incorrect?

(a) $\Delta G^o = -RT \ln k$ (b) $k = e^{\frac{-\Delta G^o}{RT}}$

(c) $e^{\frac{-\Delta G^o}{2.303RT}}$ (d) $\ln k = -\frac{\Delta G^o}{RT}$

UP CPMT-2014

Ans. (c) : $\Delta G° = -RT \ln k$

$$\ln k = -\frac{\Delta G^o}{RT}$$

$$K = e^{-\Delta G^o/RT}$$

$$K = e^{\frac{-\Delta G^0}{2.303RT}}$$

845. The reaction, A + B ⇌ C + D, is studied in 1 L vessel at 250°C. The initial concentration of A was 3n and that of B was n. When equilibrium was attained, equilibrium concentration of C was found to be equal to the equilibrium concentration B, then concentration of D at equilibrium will be

(a) $\frac{n}{2}$ (b) $\left(3n - \frac{1}{2}\right)$

(c) $\left(n - \frac{n}{2}\right)n$ (d) n

UP CPMT-2013

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Ans. (a) : Given equilibrium is,

$$A + B \rightleftharpoons C + D$$

Initial concentration: 3n n 0 0

at equilibrium 3n – x n – x x x

At equilibrium the concentration of C is equal to concentration of B

$$(n - x) = x$$
$$n = 2x$$
$$x = \frac{n}{2}$$

So, the concentration of $C\left(\frac{n}{2}\right)$ is equal to the concentration of D.

Thus, the concentration of $D(x) = \frac{n}{2}$

846. What will be the value of ΔG and ΔG^0 for the reaction, $A + B \rightleftharpoons C + D$ at 27^0C for which K = 10^2 ?

(a) $\Delta G = 0; \Delta G^0 = -11.48$ kJ mol^{-1}

(b) $\Delta G = 0; \Delta G^0 = 11.48$ kJ mol^{-1}

(c) $\Delta G = -11.48$ kJ mol^{-1}; $\Delta G^0 = 0$

(d) $\Delta G = 11.48$ kJ mol^{-1}; $\Delta G^0 = 0$

UPTU/UPSEE-2018

Ans. (c) : $\Delta G = \Delta G^\circ + RT$

At equilibrium

$\Delta G = 0$

$0 = \Delta G^\circ + 2.303\ R \times T \times \log K_{eq.}$

$\Delta G^\circ = -2.303\ RT \log K_{eq.}$

$= -2.303 \times 8.314 \times 10^{-3} \times 300 \times \log_{10} 10^2$

$= -2.303 \times 8.314 \times 10^{-3} \times 300 \times 2$

$\Delta G^\circ = -11.48$ kJ

7. Enthalpy and standard Enthalpies For Different Types of Reaction

847. At 25°C and 1 atm pressure , the enthalpy of combustion of benzene (*l*) and acetylene (g) are –3268 kJmol^{-1} and –1300 kJmol^{-1}, respectively. The change in enthalpy for the reaction $3C_2H_2(g) \rightarrow C_6H_6(l)$, is

(a) + 324 kJ mol^{-1} (b) + 632 kJ mol^{-1}

(c) – 632 kJ mol^{-1} (d) – 732 kJmol^{-1}

JEE Main-25.06.2022, Shift-II

Ans. (c) : $3C_2H_2(g) \longrightarrow C_6H_6(l)$

$$\Delta H \text{ of } C_6H_6 = -3268\,\text{kJ/mol}$$
$$\Delta H \text{ of } C_2H_2 = -1300\,\text{kJ/mol}$$
$$\Delta_c^\circ H = \sum(\Delta H)_{\text{Reactant}} - \sum(\Delta H)_{\text{Product}}$$
$$= 3 \times \Delta H_{C_2H_2} - \Delta H_{C_6H_6}$$
$$= 3 \times (-1300) - (-3268)$$
$$= -632\,\text{kJ/mol}$$

848. For combustion of one mole of magnesium in an open container at 300 K and 1 bar pressure $\Delta_c H^{-}$ = –601.70 kJmol^{-1}, the magnitude of change in internal energy for the reaction is _____ kJ. (Nearest integer)
(Given : R = 8.3 J K^{-1} mol^{-1})

JEE Main-28.06.2022, Shift-II

Ans. (600) : Given that, ΔH = –601. 70 kJ, R = 8.3 JK^{-1} mol^{-1}, T = 300 K

$$Mg(s) + \frac{1}{2}O_2(g) \longrightarrow MgO(s)$$
$$\Delta n_g = 1 - \left(\frac{1}{2} + 1\right) = -1/2$$

Since, $\Delta H = \Delta U + \Delta n_g RT$

$\Delta U = \Delta H - \Delta n_g RT$

$= -601.70 + \frac{1}{2} \times 8.3 \times 300 \times 10^{-3}$

$= -601.70 + 1.245$

$= -600.455$ kJ $\simeq -600$ kJ

849. For complete combustion of methanol the

$$CH_3OH(l) + \frac{3}{2}O_2(g) \rightarrow CO_2(g) + 2H_2O(l)$$

amount of heat produced as measured by bomb calorimeter is 726 kJmol^{-1} at 27^{o}C. The enthalpy of combustion for the reaction is –x kJmol^{-1}, where x is ____. (Nearest integer)
(Given: R=8.3 JK^{-1} mol^{-1})

JEE Main-26.06.2022, Shift-I

Ans. (727) : Given that, ΔU = – 726 kJ/mol

R = 8.3 JK^{-1} mol^{-1}, T = 27 + 273 = 300 K

$$CH_3OH(l) + \frac{3}{2}O_2(g) \longrightarrow CO_2(g) + 2H_2O(l)$$
$$\Delta n_g = 1 - \frac{3}{2} = -\frac{1}{2}$$

$\Delta H = \Delta U + \Delta n_g RT$

$= -726 + \left(-\frac{1}{2}\right) \times 8.3 \times 300 \times 10^{-3}$

$= -727.245$ KJ/mol ≈ -727 KJ/mol

Then x is 727.

850. The standard enthalpy of formation of CH_4(g), CO_2(g) and H_2O(l) are –75 kJ mol^{-1}, –393 kJ mol^{-1} and –286 kJ mol^{-1} respectively. The amount of heat liberated (in kJ) when 3.2 g of methane gas is burnt under standard conditions is

(a) 89 (b) 278

(c) 890 (d) 965

(e) 178

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Ans. (e) : $CH_4(g) + 2O_2(g) \rightarrow CO_2(g) + 2H_2O(g)$

$\Delta H_c = \sum \Delta H_{f\,(\text{products})} - \sum \Delta H_{f\,(\text{reactants})}$

$= -393 - 572 + 75$

$= -890$ KJ/mol

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1 mole methane of heat liberated = 890 kJ

16 gm of CH_4 on combustion liberate

$$=\frac{800}{16}\times 3.2$$

$$=178\,\text{KJ}$$

851. **$2O_3(g) = 3O_2(g)$**

At 300 K, ozone is fifty percent dissociated. The standard free energy change at this temperature and 1 atm pressure is (–) _____ J mol^{-1}. (Nearest integer)

[Given: In 1.35 = 0.3 and R = 8.3 J K^{-1}mol^{-1})

JEE Main-24.06.2022, Shift-I

Ans. (747) :

$$\underset{(1-0.5)=0.5}{\overset{1}{2O_3(g)}} \longrightarrow \underset{\frac{3}{2}\times 0.5=0.75\,\text{mole}}{\overset{0}{3O_2(g)}}$$

Total moles = 1.25

$$K_p=\frac{\left(P_{O_2}\right)^3}{\left(P_{O_3}\right)^2}=\frac{\left(\frac{0.75}{1.25}\right)^3}{\left(\frac{0.5}{1.25}\right)^2}=\frac{(3/5)^3}{(2/5)^2}=\frac{0.216}{0.16}=1.35$$

$\Delta G^o = -RT \ln K_p$

$= -8.3 \times 300 \ln (1.35)$

$= -8.3 \times 300 \times 0.3$

$= -747$ J/mole

852. **A fish swimming in water body when taken out from the water body is covered with a film of water of weight 36 g. When it is subjected to cooking at 100°C, then the internal energy for vaporization in kJ mol^{-1} is ———. [nearest integer]**

[Assume steam to be an ideal gas. Given $\Delta_{vap}H^-$ for water at 373 K and 1 bar is 41.1 kJ mol^{-1}; R=8.31 J K^{-1} mol^{-1}]

JEE Main-26.06.2022, Shift-II

Ans. (38) : Given that, Weight of water = 36 gm

Mole of water $= \frac{36}{18} = 2$ moles

T = 373 K, $\Delta_{vap}H° = 41.1$ kJ/mol

$\because \quad \Delta V = \Delta H - nRT$

$= 41.1 - 3.31 \times 373 \times 10^{-3}$

$= 38$ kJmol^{-1}

853. **The standard entropy change for the reaction $4Fe(s) + 3O_2(g) \longrightarrow 2Fe_2O_3(s)$ is –550 J K^{-1} at 298 K.**

[Given: The standard enthalpy change for the reaction is –165 kJ mol^{-1}]. The temperature in K at which the reaction attains equilibrium is______. (Nearest integer)

JEE Main-25.06.2022, Shift-I

Ans. (300) :

$4Fe(s) + 3O_2(g) \rightarrow 2FeO_3(s)$; $\Delta S = -550$ J/K

At equilibrium, $\Delta G^o = 0$

$\Delta G^o = \Delta H^o - T\Delta S^o$

$= \Delta H^o - T\Delta S^o$

$T\Delta S^o = \Delta H^o$

$$T=\frac{\Delta H^o}{\Delta S^o}=\frac{-165\times 10^3}{-550}=300$$

$$\boxed{T=300\text{K}}$$

854. **17.0 g of NH_3 completely vapourises at –33.42°C and 1 bar pressure and the enthalpy change in the process is 23.4kJ mol^{-1}. The enthalpy change for the vapourisation of 85g of NH_3 under the same conditions is ——— kJ.**

JEE Main-29.06.2022, Shift-I

Ans. (117) : ΔH_{vap} of 17 gm of NH_3 = 23.4 kJ mol^{-1}

So, $\quad \Delta H_{vap}$ of 85 gram $= \frac{23.4}{17}\times 85$

$= 23.4 \times 5 = 117$ kJ

855. $N_2(g)+3H_2(g) \rightleftharpoons 2NH_3(g)$

Then ΔH is equal to :

(a) ΔU + 2RT (b) ΔU – 2RT

(c) ΔU + RT (d) ΔU – RT

CG PET-22.05.2022

Ans. (b) : $N_2(g)+3H_2(g) \rightleftharpoons 2NH_3(g)$

$\Delta n_g = 2 - (1 + 3) = -2$

$\because \quad \Delta H = \Delta U + \Delta n_g RT$

$= \Delta U + (-2) RT$

$\Delta H = \Delta U - 2 RT$

856. **At 25°C and 1 atm pressure, the enthalpies of combustion are as given below :**

Substance	**H_2**	**C(graphite)**	**$C_2H_6(g)$**
$\frac{\Delta_c H^-}{\text{kJ mol}^{-1}}$	**–286.0**	**–394.0**	**–1560.0**

The enthalpy of formation of ethane is

(a) +54:0 kJ mol^{-1} (b) –68.0 kJ mol^{-1}

(c) –86.0 kJ mol^{-1} (d) +97.0 kJ mol^{-1}

JEE Main-24.06.2022, Shift-II

Ans. (c) : Given that,

(i) $C_2H_6(g) + \frac{7}{2}O_2(g) \longrightarrow 2CO_2(g) + 3H_2(l)$ ΔH° = –1560 kJ/mol

(ii) $C(s) + O_2(g) \longrightarrow CO_2(g)$ ΔH° = – 394 kJ/mol

(iii) $H_2(g)+\frac{1}{2}O_2(g) \longrightarrow H_2O(g)$ ΔH° = – 286 kJ/mol

For ethane,

$2C(s) + 3H_2(g) \longrightarrow C_2H_6(g)$

$\Delta H_r^o = \Delta H^o$ (reactant) – ΔH^o (Product)

$= 2 \times (-394) + 3(-286) - (-1560)$

$= -788 - 858 + 1560$

$= -86$ kJ/mole.

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07.

Chemical Equilibrium

1. Law of Chemical Equilibrium and Equilibrium Constant

1. 2 moles of PCl_5 is decomposed in 2 litre closed vessel. At Equilibrium the percentage decomposition of PCl_5 is 40% . The value of Equilibrium constant is:

(a) 0.267 (b) 0.0267
(c) 2.67 (d) 26.7

CG PET-22.05.2022

Ans. (a) :

$$PCl_5 \rightleftharpoons PCl_3 + Cl_2$$

$$\frac{2\times 60}{100} \quad \frac{2\times 40}{100} \quad \frac{2\times 40}{100}$$

∵ Volume of container = 2 liter

$$K_c = \frac{\left(\frac{2\times 40}{100\times 2}\right)^2}{\frac{2\times 60}{100\times 2}}$$

$$\because K_c = 0.267$$

2. For a given chemical reaction
$\gamma_1A + \gamma_2B \rightarrow \gamma_3C + \gamma_4D$
Concentration of C changes from 10 m mol dm^{-3} to 20 m mol dm^{-3} in 10 seconds. Rate of appearance of D is 1.5 times the rate of disappearance of B, which is twice the rate of disappearance of A. The rate of appearance of D has been experimentally determined to be 9 mmol dm^{-3} s^{-1}. Therefore the rate of reaction is_______mmol dm^{-3} s^{-1}. (Nearest Integer)

JEE Main-25.06.2022, Shift-I

Ans. (1m mol dm^{-3} S^{-1}) : For given chemical reation

$$\gamma_1A + \gamma_2B \longrightarrow \gamma_3C + \gamma_4D$$

$$\text{Given, } +\frac{d[D]}{dt} = \frac{-3}{2}\frac{d[B]}{dt}$$

$$\Rightarrow \quad \frac{-1}{2}\frac{d[B]}{dt} = \frac{+1}{3}\frac{d[D]}{dt}$$

$$\Rightarrow \quad \frac{-d[B]}{dt} = -2\frac{d[A]}{dt}$$

$$\Rightarrow \quad -\frac{1}{2}\frac{[B]}{dt} = \frac{-d(A)}{dt} + \frac{d[B]}{dt}$$

$$= 9\text{m mol dm}^{-3}\ S^{-1}$$

$$\Rightarrow \quad \frac{+d[C]}{dt} = \frac{20-10}{10} = 1\text{m mol dm}^{-3}S^{-1}$$

$$\frac{+d[C]}{dt} = \frac{1}{9}\times\frac{+d[D]}{dt}$$

$$9A + 2B \rightarrow \frac{1}{3}C + 3D$$

$$\Rightarrow \quad 3A + 6V \rightarrow C + 9D$$

$$\text{Rate of reaction} = \frac{+d[C]}{dt}$$

$$= 1\text{m mol dm}^{-3}\ S^{-1}$$

3. The standard free change ($\Delta G°$) for 50% dissociation of N_2O_4 into NO_2 at 27°C and 1 atm pressure is –X J mol^{-1}. The value of X is____. (Nearest Integer).
[Given: R = 8.31 J K^{-1} mol^{-1}, log 1.33 = 0.1239, In 10 = 2.3]

JEE Main-25.06.2022, Shift-I

Ans. (710) : $N_2O_4 \rightleftharpoons 2NO_2(g)$

$$1-\alpha \qquad 2\alpha$$

$$K_p = \frac{4\alpha^2P}{1-\alpha} = \frac{4\times(0.5)^2\times 1}{1-(0.5)^2} = \frac{1}{0.75}$$

$$K_p = \frac{4}{3}$$

$$\Delta G^o = -2.3RT\log K_p$$

$$= -2.3 \times 8.31 \times 300 \times \log(1.33)$$

$$= -710.4J\ mol^{-1}$$

$$= -710\ J\ mol^{-1}$$

$$= 710\ mol^{-1}$$

4. $2NOCl(g) \rightleftharpoons 2NO(g) + Cl_2\ (g)$
In an experiment, 2.0 moles of NOCl was placed in a one-litre flask and the concentration of NO after equilibrium established was found to be 0.4 mol/L. The equilibrium constant ag 30°C is_____10^{-4}.

JEE Main-27.06.2022, Shift-I

Ans. (125 × 10^{-4}) :

	$2NOCl$	$\rightleftharpoons 2NO$	$+\ Cl_2$
At initially	2mole	0	0
At equilibrium	$(2-0.4)$	0.4	0.2

$$K_c = \frac{(NO)^2(Cl_2)}{(NOCl)^2} = \frac{(0.4)^2(0.2)}{(1.6)^2}$$

$$= 0.0125$$

$$= 125 \times 10^{-4}$$

5. Some of the reactions and their equilibrium constants K_c are given. Choose the reaction which proceeds rarely at the given temperature.

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(a) $2H_2(g) + O_2(g) \rightleftharpoons 2H_2O(g)$; $K_c = 2.4 \times 10^{47}$ at 500 K

(b) $H_2(g) + I_2(g) \rightleftharpoons 2HI(g)$; $K_c = 57.0$ at 700 K

(c) $H_2(g) + Cl_2(g) \rightleftharpoons 2HCl(g)$; $K_c = 4.0\times10^{31}$ at 300 K

(d) $N_2(g) + O_2(g) \rightleftharpoons 2NO(g)$; $K_c = 4.8 \times 10^{-31}$ at 298 K

(e) $H_2(g) + Br_2(g) \rightleftharpoons 2HBr(g)$; $K_c = 5.4\times10^{18}$ at 300 K

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Ans. (d) :

$N_2(g)+O_2(g) \rightleftharpoons 2NO(g); K_c = 4.8\times10^{-31}$ at 298 K

This reaction is proceeds rarely at the given temperature (at 298K).

6. The equilibrium constants for the following two reactions at 298 K are given below

$$2A \rightleftharpoons B + C \,;\; K_1 = 16$$

$$2B + C \rightleftharpoons 2X \,;\; K_2 = 25$$

What is the value of K for the reaction,

$$A+\frac{1}{2}B \rightleftharpoons X \text{ at } 298\,K\,?$$

(a) $\frac{1}{5}$ (b) $\frac{1}{40}$ (c) $\frac{5}{4}$ (d) $\frac{4}{5}$

(e) 20

Kerala CEE -03.07.2022

Ans. (e) : Given that $2A \rightleftharpoons B+C$, $K_1 = 16$

$$K_1 = \frac{[B][C]}{[A]^2} \qquad \ldots\ldots\ (1)$$

$$2B+C \rightleftharpoons 2X,\ K_2 = 25$$

$$K_2 = \frac{[X]^2}{[B]^2[C]}$$

$$\text{Or } [x] = \left(K_2[B]^2[C]\right)^{1/2} \qquad \ldots\ldots(2)$$

$$\therefore \quad A + \frac{1}{2}B \rightleftharpoons X$$

$$K = \frac{[X]}{[A][B]^{1/2}} \qquad \ldots\ldots\ (3)$$

Putting the value of [x] in equation (3)

$$K = \frac{\left(K_2[B]^2[C]\right)^{1/2}}{[A][B]^{1/2}}, \qquad K = \frac{\sqrt{25}\times[B][C]^{1/2}}{[A][B]^{1/2}}$$

$$K = \frac{5\times[B]^{1/2}[C]^{1/2}}{[A]} \qquad \ldots\ldots(4)$$

From equation (1) and (4) we get

$$K = 5\times(K_1)^{1/2}$$

$$= 5\times(16)^{1/2} = 5\times4 = 20$$

7. PCl_5 dissociates as

$PCl_5\,(g) \rightleftharpoons PCl_3\,(g) + Cl_2\,(g)$

5 moles of PCl_5 are placed in a 200 litre vessel which contains 2 moles of N_2 and is maintained at 600 K. The equilibrium pressure is 2.46 atm. The equilibrium constant K_p for the dissociation of PCl_5 is_____× 10^{-3} (nearest integer)

(Given : R = 0.082 L atm K^{-1} mol^{-1}; Assume ideal gas behaviour)

JEE Main-24.06.2022, Shift-II

Ans. (1107) : Given that, P = 2.46 atm

R = 0.082 L atm K^{-1} mol^{-1}
T = 600 K
V = 200 liter

	$PCl_5(g) \rightleftharpoons$	$PCl_3(g) +$	$Cl_2(g)$
Initial mole	5 mole	0	0
At equi.	(5–x)	x	x

$$n_{total} = (5+x)+n_{N_2} = (5+x)+2 = (7+x)$$

At equilibrium

$$PV = nRT$$

$$n_{total} = \frac{PV}{RT} = \frac{2.46\times200}{0.082\times600} = 10$$

$$n_{total} = (7+x) = 10\ ;\ x = 3$$

$$\therefore \quad K_p = \frac{\left(\frac{3}{10}\times2.46\right)\left(\frac{3}{10}\times2.46\right)}{\left(\frac{2}{10}\times2.46\right)}$$

$$= \frac{3}{10\times2}\times2.46\times3$$

$$= \frac{9\times2.46}{10\times2}$$

$= 1107$

8. 1 mole of HI is heated in a closed container of capacity of 2 L. At equilibrium half a mole of HI is dissociated. The equilibrium constant of the reaction is

(a) 0.25 (b) 0.35
(c) 1 (d) 0.5

Karnataka CET-17.06.2022, Shift-II

Ans. (a) :

	$2HI \rightleftharpoons$	H_2 +	I_2
At initial	1	0	0
At equilibium	0.5	0.25	0.25

$$K_c = \frac{[H_2][I_2]}{[HI]^2}$$

$$K_c = \frac{\frac{0.25\times0.25}{2}}{\frac{0.5\times0.5}{2}}$$

$$= \frac{1}{4}$$

$= 0.25$

@apna_pdf

9. Consider the following gaseous equilibria with equilibrium constants K_1 and K_2 respectively.

$$SO_2(g)+\frac{1}{2}O_2(g) \rightleftharpoons SO_3(g)$$

$$2SO_3(g) \rightleftharpoons 2SO_2(g)+O_2(g)$$

The equilibrium constants are related as

(a) $K_1^2=\frac{1}{K_2}$ (b) $2K_1=K_2^2$

(c) $K_2=\frac{2}{K_1^2}$ (d) $K_2^2=\frac{1}{K_1}$

BCECE 2018, COMDEK-2017
UPTU/UPSEE 2016
Karnataka-CET, 2010, 2011
WB-JEET 2011, CGPET 2010

Ans. (a) : For the reaction,

$$SO_2(g)+\frac{1}{2}O_2(g) \rightleftharpoons SO_3(g)$$

Equilibrium constant, $K_1=\frac{[SO_3]}{[SO_2][O_2]^{1/2}}$ … (i)

For the reaction,

$$2SO_3(g) \rightleftharpoons 2SO_2(g)+O_2(g)$$

Equilibrium constant, $K_2=\frac{[SO_2]^2[O_2]}{[SO_3]^2}$ … (ii)

On squaring both sides in equation (i), we get–

$$K_1^2=\frac{[SO_3]^2}{[SO_2]^2[O_2]} \quad \text{… (iii)}$$

From equation (ii) × equation (iii), we get–

$$K_1^2 \times K_2=1$$

or $K_2=\frac{1}{K_1^2}$

or $K_1^2=\frac{1}{K_2}$

10. Equilibrium constants K_1 and K_2 for the following equilibria

$$NO(g)+\frac{1}{2}O_2 \overset{K_1}{\rightleftharpoons} NO_2(g)$$

and $2NO_2(g) \overset{K_2}{\rightleftharpoons} 2NO(g)+O_2(g)$ are related as

(a) $K_2=\frac{1}{K_1}$ (b) $K_2=K_1^2$

(c) $K_2=\frac{K_1}{2}$ (d) $K_2=\frac{1}{K_1^2}$

JIMPER–2017, Karnataka- CET -2016
JCECE – 2012, NEET - 2005

Ans. (d) : (i) $NO(g)+\frac{1}{2}O_2(g) \overset{K_1}{\rightleftharpoons} NO_2(g)$

For this reaction equilibrium constant–

$$K_1=\frac{[NO_2]}{[NO][O_2]^{1/2}} \quad \text{…(i)}$$

(ii) $2NO_2(g) \overset{K_2}{\rightleftharpoons} 2NO+O_2(g)$

For this reaction equilibrium constant–

$$K_2=\frac{[NO]^2[O_2]}{[NO_2]^2} \quad \text{…(ii)}$$

Squaring equation (i), we get–

$$K_1^2=\frac{[NO_2]^2}{[NO]^2[O_2]}$$

or $\frac{1}{K_1^2}=\frac{[NO]^2[O_2]}{[NO_2]^2}$ …(iii)

From equation (ii) and (iii), we get–

$$K_2=\frac{1}{K_1^2}$$

11. A reversible chemical reaction is having two reactants, in equilibrium. If the concentration of the reactants are doubled then the equilibrium constant will

(a) be doubled (b) become one fourth

(c) be halved (d) remain the same

COMEDK-2020
WB JEE-2012
JCECE - 2010

Ans. (d) : Equilibrium constant depends only upon the temperature, not depend upon the concentration of reactant. Thus, on doubling concentration, equilibrium constant remains the same.

12. The equilibrium constant of the following are

$$N_2+3H_2 \rightleftharpoons 2NH_3; \quad K_1$$

$$N_2+O_2 \rightleftharpoons 2NO; \quad K_2$$

$$H_2+\frac{1}{2}O_2 \rightleftharpoons H_2O; \quad K_3$$

The equilibrium constant (K) of the reaction:

$2NH_3+\frac{5}{2}O_2 \overset{K}{\rightleftharpoons} 2NO+3H_2O$ will be

(a) $K_2K_3^3/K_1$ (b) K_2K_3/K_1

(c) $K_2^3K_3/K_1$ (d) $K_1K_3^3/K_2$

WB JEE-2018, CGPET-2016
NEET-2007, 2007, 2003

Ans. (a) : $N_2+3H_2 \rightleftharpoons 2NH_3;\ K_1$ …. (i)

$N_2+O_2 \rightleftharpoons 2NO;\ K_2$ …. (ii)

$H_2+\frac{1}{2}O_2 \rightleftharpoons H_2O;\ K_3$ ….(iii)

Multiply by 3 in equation (iii), we get –

$3H_2+\frac{3}{2}O_2 \rightleftharpoons 3H_2O;\ K_3^3$ …(iv)

Add eq^n. (ii) and (iv) and then subtract eq^n.(i), we get –

$$2NH_3+\frac{5}{2}O_2 \overset{K}{\rightleftharpoons} 2NO+3H_2O$$

$$\therefore\ K=\frac{K_2K_3^3}{K_1}$$

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13. For the reaction, $N_2(g) + O_2(g) \rightleftharpoons 2NO(g)$, the equilibrium constant is K_1. The equilibrium constant is K_2 for the reaction, $2NO(g) + O_2(g) \rightleftharpoons 2NO_2(g)$. What is K for the reaction, $NO_2(g) \rightleftharpoons \frac{1}{2}N_2(g) + O_2(g)$?

(a) $1/(4K_1K_2)$ (b) $(1/K_1K_2)^{1/2}$
(c) $1/(K_1,K_2)$ (d) $1/(2K_1,K_2)$

JIMPER-2014
NEET 2011

Ans. (b) : The reaction –

$N_2 + O_2 \rightleftharpoons 2NO;$ K_1 ... (i)

$2NO + O_2 \rightleftharpoons 2NO_2;$ K_2 ...(ii)

Add the equation (i) and (ii) and reversed then divided by 2, we get–

$$NO_2 \rightleftharpoons \frac{1}{2}N_2 + O_2$$

Hence, the expression for the net reaction becomes –

$$K = \sqrt{\frac{1}{K_1.K_2}} \text{ or } \frac{1}{(K_1 \cdot K_2)^{1/2}}$$

14. The equilibrium constant for a reaction,

$$N_2(g) + O_2(s) \rightleftharpoons 2NO(g)$$

is 4×10^{-4} at 2000 K. In the presence of catalyst, the equilibrium is attained 10 times faster. The equilibrium constant in presence of catalyst at 2000K is–

(a) 10×10^{-4} (b) 4×10^{-2}
(c) 4×10^{-4} (d) 40×10^{-4}

Karnataka-CET 2017
BCECE-2010

Ans. (c) : The equilibrium constant in the presence of a catalyst at 2000K is same as the equilibrium constant in the absence of catalyst at 2000K. It is 4×10^{-4}

The presence of catalyst does not affect the value of the equilibrium constant. It only increases the rates of forward and reverse reaction to equal extent.

15. In the reaction,

$$Fe(OH)_3(s) \rightleftharpoons Fe^{3+}(aq) + 3OH^-(aq)$$

if the concentration of OH^- ions is decreased $\frac{1}{4}$ by times, then the equilibrium concentration of Fe^{3+} will increase by

(a) 8 times (b) 16 times
(c) 64 times (d) 4 times

Karnataka-CET-2016
NEET 2008

Ans. (c) : $Fe(OH)_3(s) \rightleftharpoons Fe^{3+}(aq) + 3OH^-(aq)$

$$K_{eq} = \frac{[Fe^{3+}][OH^-]^3}{[Fe(OH)_3]} = \frac{[Fe^{3+}][OH^-]^3}{1}$$

When $[OH^-]$ is decreased by $\frac{1}{4}$ times, K becomes.

$$K_{eq} = [Fe^{3+}]\left(\frac{1}{4}[OH^-]\right)^3$$

$$= [Fe^{3+}]\frac{1}{64}[OH^-]^3$$

To keep the value of K_{eq} constant, the $[Fe^{3+}]$ must be increased by 64 times. So, that K_{eq} remains as such.

$$K_{eq} = 64 \times \frac{1}{64}[Fe^{3+}][OH^-]^3$$

$$K_{eq} = [Fe^{3+}]\,[OH^-]^3$$

16. If K_1 and K_2 are respective equilibrium constants for two reactions

$$XeF_6(g) + H_2O(g) \rightleftharpoons XeOF_4(g) + 2HF(g)$$

$$XeO_4(g) + XeF_6(g) \rightleftharpoons XeOF_4(g) + XeO_3F_2(g)$$

the equilibrium constant for the reaction

$$XeO_4(g) + 2HF(g) \rightleftharpoons XeO_3F_2(g) + H_2O(g)$$

will be

(a) $\frac{K_1}{K_2^2}$ (b) $K_1.K_2$

(c) $\frac{K_1}{K_2}$ (d) $\frac{K_2}{K_1}$

BITSAT 2006
NEET-1998

Ans. (d) : For the reaction –

$XeF_6(g) + H_2O(g) \rightleftharpoons XeOF_4(g) + 2HF(g)$

Equilibrium constant (K_1) –

$$K_1 = \frac{[XeOF_4][HF]^2}{[XeF_6][H_2O]} \quad \text{... (i)}$$

And for the reaction –

$XeO_4(g) + XeF_6(g) \rightleftharpoons XeOF_4(g) + XeO_3F_2(g)$

Equilibrium constant (K_2) –

$$K_2 = \frac{[XeOF_4][XeO_3F_2]}{[XeO_4][XeF_6]} \quad \text{... (ii)}$$

For reaction

$XeO_4(g) + 2HF(g) \rightleftharpoons XeO_3F_2(g) + H_2O(g)$

$$K = \frac{[XeO_3F_2][H_2O]}{[XeO_4][HF]^2}$$

Clearly, from equation (i) and (ii) the new equilibrium constant (K) –

$$K = \frac{K_2}{K_1}$$

17. For the reaction,

$A + B \rightleftharpoons C + D$,

the initial concentrations of A and B are equal. The equilibrium concentration of C is two times the equilibrium concentration of A. The equilibrium constant is

(a) 4 (b) $\frac{1}{4}$

(c) 9 (d) $\frac{1}{9}$

COMEDK-2012
CG PET- 2010
JIMPER-2006

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Ans. (a) : For the given reaction–

	A	+ B ⇌	C	+ D
Initial	x	x	0	0
At equi.	0	0	2x	2x

Hence, equilibrium constant–

$$K_c = \frac{[C][D]}{[A][B]}$$

$$K_c = \frac{[2x][2x]}{[x][x]}$$

$$K_c = 4$$

18. The reaction,

$$\mathbf{2A(g) + B(g) \rightleftharpoons 3C(g) + D(g)}$$

Is begain with the concentrations of A and B both at an initial value of 1.00 M. When equilibrium is reached, the concentration of D is measured and found to be 0.25 M. The value for the equilibrium constant for this reaction is given by the expression

(a) $[(0.75)^3(0.25)] \div [(1.00)^2(1.00)]$
(b) $[(0.75)^3(0.25)] \div [(0.50)^2(0.75)]$
(c) $[(0.75)^3(0.25)] \div [(0.50)^2(0.25)]$
(d) $[(0.75)^3(0.25)] \div [(0.75)^2(0.25)]$

VITEEE- 2012
NEET Mains-2010

Ans. (b) : The reaction is given as–

	2A(g) +	B(g) ⇌	3C(g) +	D(g)
Initial	1	1	0	0
At eq.	(1 – 0.50)	(1 – 0.25)	3 × 0.25	0.25

The value of equilibrium constant is given by–

$$K_c = \frac{[C]^3[D]}{[A]^2[B]} \quad \text{or } K_c = \frac{(0.75)^3(0.25)}{(0.50)^2(0.75)}$$

19. For a reversible reaction, if the concentration of the reactants is reduced to half, the equilibrium constant will be ....

(a) doubled
(b) halved
(c) reduced to one-fourth
(d) remains same

AP EAMCET (Engg.) 18.09.2020, Shift-I
AP EAMCET (Engg.) 21.09.2020, Shift-II

Ans. (d) : The value of equilibrium constant K_{eq} is independent of initial concentrations of reactants and products. So, options (a), (b) and (c) are not correct, i.e. for a reversible reaction, if the concentration of the reactants is reduced to half, the equilibrium constant will be remains same.

20. $\mathbf{H_2(g) + 2AgCl(s) \rightleftharpoons 2Ag(s) + 2HCl(aq)}$

E^0_{cell} at 25 ^{0}C for the cell is 0.22 V. The equilibrium constant at 25^{0}C is

(a) 2.8×10^7 (b) 5.2×10^8
(c) 2.8×10^5 (d) 5.2×10^4

Karnataka-CET-2021
Kerala-CEE-29.08.2021

Ans. (a) : Given that, $E^\circ_{Cell} = 0.22V$

For the reaction-

$$H_2(g) + 2AgCl(s) \rightleftharpoons 2Ag(s) + 2HCl(aq)$$

Here n=2 (as, $Ag^{2+} + 2e^- \rightarrow 2Ag$)

We know that,

$$E^\circ_{Cell} = \frac{0.0591}{n}\log K$$

$$\log K = \frac{n}{0.0591}E^\circ_{cell}$$

$$\log K = \frac{2}{0.0591} \times 0.22$$

$$\log K = 7.44$$

$$K = \text{antilog}\,(7.44)$$

$$K = 2.8 \times 10^7$$

21. The equilibrium constant for the equilibrium $PCl_5(g) \rightleftharpoons PCl_3(g) + Cl_2(g)$ at a particular temperature is 2×10^{-2} mol dm^{-3}. The number of moles of PCl_5 that must be taken in a one-litre flask at the same temperature to obtain a concentration of 0.20 mol of chlorine at equilibrium is

(a) 2.0 (b) 2.2
(c) 1.8 (d) 0.2
(e) 0.1

Kerala-CEE-2020, 2015

Ans. (b) : Given that,
Equilibrium constant (K_c) = 2×10^{-2} mol dm^{-3}

	$PCl_5(g)$ ⇌	$PCl_3(g)$ +	$Cl_2(g)$
Initial :	x	0	0
At equi. :	(x – 0.2)	0.2	0.2

∴ $$K_c = \frac{[PCl_3][Cl_2]}{[PCl_5]}$$

or $$K_c = \frac{0.2 \times 0.2}{x - 0.2}$$

or $$2 \times 10^{-2} = \frac{0.2 \times 0.2}{x - 0.2}$$

or $$x - 0.2 = \frac{0.2 \times 0.2}{0.2 \times 10^{-1}}$$

or $$x = 2 + 0.2 = 2.2$$

22. For the reaction $A(g) \rightleftharpoons C(g) + D(g)$; ΔH = –Q kJ.
The equilibrium constant cannot be disturbed by

(a) Addition of A
(b) Addition of D
(c) Increasing of pressure
(d) Increasing of temperature

Kerala-CEE-29.08.2021

Ans. (c) : The equilibrium constant cannot be disturbed by increasing the pressure. the addition of catalyst also does not affect equilibrium. Equilibrium constant is directly proportional to temperature.

@apna_pdf

23. The equilibrium constant (K_p) for the formation of ammonia from its constituent elements at 27°C is 1.2 × 10^{-4} and at 127°C is 0.60 × 10^{-4}. Calculate the mean heat of formation of ammonia mole in this temperature range.

(a) –82.64 Cal (b) –826.4 Cal
(c) –1652.8 Cal (d) –165.2 Cal

TS EAMCET 05.08.2021, Shift-I

Ans. (b): Given that,

$K_1 = 1.2 \times 10^{-4}$, $K_2 = 0.60 \times 10^{-4}$

$T_1 = 27^0C = 300K$, $T_2 = 127^0C = 400K$

From van't Hoff's equation –

$$\log\frac{K_2}{K_1} = \frac{-\Delta H}{2.303\times R}\left(\frac{1}{T_1}-\frac{1}{T_2}\right)$$

or $$\log\frac{0.60\times10^{-4}}{1.2\times10^{-4}} = \frac{-\Delta H}{2.303\times8.314}\left(\frac{1}{300}-\frac{1}{400}\right)$$

or $$\log 0.5 = \frac{-\Delta H}{19.147}\left(\frac{100}{300\times400}\right)$$

or $$\Delta H = -0.3010\times19.147\times300\times4$$

$$= -\ 6915.8964J$$

$$= -1654.52 \text{ Cal}$$

Hence, the mean heat of formation of ammonia mole

$$= \frac{-1654.52}{2} = 827.26 \approx -826.4\,\text{Cal}$$

24. The number of moles of NH_3, that must be added to 2L of 0.80 M $AgNO_3$ in order to reduce the concentration of Ag^+ ions to 5.0×10^{-8} M ($K_{formation}$ for $[Ag(NH_3)_2]^+ = 1.0\times10^8$) is .... (Nearest integer)

[Assume no volume change on adding NH_3]

JEE Mains-27.08.2021, Shift-I

Ans. (4) $Ag^+_{(aq.)} + 2NH_{3(aq.)} \rightleftharpoons Ag(NH_3)^+_{2(aq.)}$

$$\begin{array}{llll} t=0 & 0.8 & \left(\frac{a}{2}\right) & 0 \\ t=\infty & 5\times10^{-8} & \left(\frac{a}{2}-1.6\right) & 0.8 \end{array}$$

$$K = \frac{[Ag(NH_3)_2^+]}{[NH_3]^2[Ag^+]}$$

$$\therefore \quad \frac{0.8}{(5\times10^{-8})\left(\frac{a}{2}-1.6\right)^2} = 10^8$$

$$\frac{a}{2}-1.6 = 0.4$$

$$a = 4$$

25. For the following three reactions (i), (ii) and (iii), equilibrium constants are given

$CO(g) + H_2O(g) \rightleftharpoons CO_2(g) + H_2(g)$;K_1

$CH_4(g) + H_2O(g) \rightleftharpoons CO(g) + H_2(g)$;K_2

$CH_4(g) + 2H_2O(g) \rightleftharpoons CO_2(g) + 4H_2(g)$;K_3

Which of the following relations is correct?

(a) $K_1\sqrt{K_2} = K_3$ (b) $K_1K_3 = K_2$
(c) $K_3 = K_1K_2$ (d) $K_3 = (K_2)^3(K_1)^2$

TS EAMCET 10.08.2021, Shift-I

Ans. (c) $CO(g) + H_2O(g) \rightleftharpoons CO_2(g) + H_2(g); K_1$ ...(i)

$CH_4(g) + H_2O(g) \rightleftharpoons CO(g) + 3H_2(g); K_2$ .....(ii)

After adding equation (i) and (ii), we get–

$CH_4(g) + 2H_2O(g) \rightleftharpoons CO_2(g) + 4H_2(g); K_3$ .....(iii)

Which is equal to equation (iii), so,

$K_3 = K_1K_2$

26. A catalyst is a substance which

(a) Changes the equilibrium concentration of the products
(b) Changes the energy of the reactants
(c) Shortens the time to reach equilibrium
(d) Changes the equilibrium constant

AP EAPCET 24.08.2021 Shift-II

Ans. (c): A catalyst is a substance which shortens the time to reach equilibrium. A catalyst increases the rate of the chemical reaction by making available a new low energy pathway for the conversion of reactants to product.

27. The reaction $N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$ is exothermic and reversible. A mixture of $N_2(g)$, $H_2(g)$ and $NH_3(g)$ is at equilibrium in a closed container. When a certain quantity of extra $H_2(g)$ is introduced into the container, while keeping the volume constant, then which statement among the following is true ?

(a) The pressure inside the container will not change
(b) Equilibrium condition will not change
(c) The temperature will increase
(d) The temperature will decrease

AP EAPCET 24.08.2021 Shift-II

Ans. (c): The reaction $N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$ is reversible and exothermic (means heat released) and extra $H_2(g)$ is introduced into a container while keeping the volume constant then the temperature will increase.

28. When reaction is carried out at standard states then at the equilibrium ______

(a) $\Delta H^0 = 0$
(b) $\Delta S^0 = 0$
(c) Equilibrium Const K = 0
(d) Equilibrium Const K = 1

AP EAPCET 23-08-2021 Shift-I

Ans. (d) : The reaction is carried out at standard states then at the equilibrium constant (K) is equal to 1.

$$\text{i.e. } K = \frac{[\text{Product}]}{[\text{Reactant}]}$$

∵ At equilibrium, [product] = [reactant] = 1

$$\therefore \quad K = \frac{1}{1} = 1$$

29. For the following Assertion and Reason, the correct option is

Assertion (A) When Cu (II) and sulphide ions are mixed, they react together extremely quickly to give a solid.

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Reason (R) The equilibrium constant of Cu^{2+} (aq) + S^{2-} (aq) $\rightleftharpoons$ CuS(s) is high because the solubility product is low

(a) Both (A) and (R) are false.
(b) Both (A) and (R) are true and (R) is the explanation for (A)
(c) Both (A) and (R) are true but (R) is not the explanation for (A)
(d) (a) is false and (R) is true.

[JEE Mains 2020, 2 Sep Shift-I]

Ans. (c) : When Cu (II) and sulphide ions are mixed, they react together extremely quickly to give a solid. Hence, the equilibrium constant of Cu^{2+} is high because the solubility product is low.

30. In the equilibrium mixture, $KI + I_2 \rightleftharpoons KI_3$; the concentration of KI and I_2 is made two fold and three fold respectively. The concentration of KI_3 becomes :

(a) two fold (b) three fold
(c) five fold (d) six fold

Manipal-2020

Ans. (a) : $KI+I_2 \rightarrow KI_3$ or $I^-+I_2 \rightarrow I_3^-$ from KI
On increasing concentration of KI and I_2 two fold and three fold respectively, the concentration of KI_3 becomes two fold.

31. The equilibrium constant for the following reactions are given at 25°C

$2A \rightleftharpoons B+C$, $K_1 = 1.0$

$2B \rightleftharpoons C+D$, $K_2 = 16$

$2C+D \rightleftharpoons 2P$, $K_3 = 25$

The equilibrium constant for the reaction

$P \rightleftharpoons A + \frac{1}{2}B$ at 25°C is

(a) $\frac{1}{20}$ (b) 20
(c) $\frac{1}{42}$ (d) 21

WB-JEE-2020

Ans. (a) : Given that,

$$2A \rightleftharpoons B+C, \quad K_1=10$$

$$K_1 = \frac{[B][C]}{[A]^2}$$

$$2B \rightleftharpoons C+D, \quad K_2=16$$

$$K_2 = \frac{[C][D]}{[B]^2}$$

$$2C+D \rightleftharpoons 2P, \quad K_3=25$$

$$K_3 = \frac{[P]^2}{[C]^2[D]}$$

Required reaction is:

$$P \rightleftharpoons A+\frac{1}{2}B$$

$$K_4 = \frac{[A][B]^{1/2}}{[P]}$$

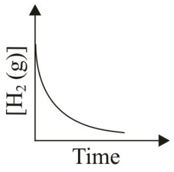
$$\therefore K_4 = \sqrt{\frac{1}{K_3}\times\frac{1}{K_2}\times\frac{1}{K_1}}$$

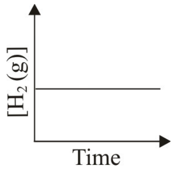
$$K_4 = \sqrt{\frac{1}{25}\times\frac{1}{16}\times\frac{1}{1.0}}$$

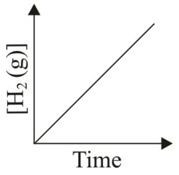
$$K_4 = \frac{1}{5}\times\frac{1}{4}\times 1$$

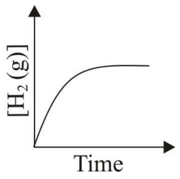
$$K_4 = \frac{1}{20}$$

32. Consider the following equilibrium system
$2NH_3$ (g) → N_2(g) +$3H_2$ (g)
Which of the following graphs represents [H_2(g)] after equilibrium has been established?

(a)


(b)


(c)


(d)


Assam CEE-2019

Ans. (b) : In the given reaction–

$$2NH_3(g) \rightarrow N_2(g)+3H_2(g)$$

At equilibrium concentration of product with constant with time.

33. Assertion: If value of equilibrium constant is K_c for $A+B \rightleftharpoons C$. If chemical reaction is reversed $C \rightleftharpoons A+B$, then value of equilibrium constant will be $1/K_c$.
Reason: Equilibrium constant depends upon the expression of chemical reaction.

(a) If both Assertion and Reason are correct and Reason is the correct explanation of Assertion.
(b) If both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.
(c) If Assertion is correct but Reason is incorrect.
(d) If both the Assertion and Reason are incorrect.

AIIMS 25 May 2019 (Evening)

Ans. (a) Given the equilibrium constant (K_c) of reaction,

$$A + B \rightleftharpoons C, K_c$$

$$C \rightleftharpoons A + B, \frac{1}{K_c}$$

The value of equilibrium constant depend upon the expression are chemical reaction.
The value of equilibrium constant depend on the stoichiometry equation.

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34. 2 moles PCl_5 were introduced in a 2 L flask and heated at 625 K to establish equilibrium when 60% of PCl_5 was dissociated into PCl_3 and Cl_2. The equilibrium constant is

(a) 0.90 (b) 1.8

(c) 0.128 (d) 0.53

AMU-2019

Ans. (a) : The given reaction is – $PCl_5 \rightleftharpoons PCl_3 + Cl_2$

Initial conc.	1	0	0
At equi.	(1 – 0.6)1	0.6	0.6

[∵ Initial concentration of $PCl_5 = \frac{2\,\text{mole}}{2\,\text{L}} = 1$ mole/L]

$$\text{Now, } K = \frac{[PCl_3][Cl_2]}{[PCl_5]}$$

$$= \frac{0.6 \times 0.6}{0.4} = 0.09 \times 10 = 0.9$$

35. At a certain temperature, equilibrium constant (K_c) is 16 for the reaction.

$$SO_2(g) + NO_2(g) \rightleftharpoons SO_3(g) + NO(g)$$

If one mole of each of the four gases are taken in one litre container, the equilibrium concentration of NO will be

(a) 0.4 mole (b) 1.6 mole

(c) 0.6 mole (d) 0.66 mole

AMU-2019

Ans. (b) : Given that, $K_c = 16$

The reaction is –

	$SO_2(g)$ +	$NO_2(g)$ ⇌	$SO_3(g)$ +	$NO(g)$
Initial conc.	1	1	1	1
At equi.	(1 – x)	(1 – x)	(1+ x)	(1 + x)

$$\text{So, } \frac{[NO][SO_3]}{[SO_2][NO_2]} = 16$$

$$16 = \frac{(1+x)(1+x)}{(1-x)(1-x)}$$

$16\,(1 - x)^2 = (1 + x)^2$

$4\,(1 - x) = (1 + x)$

$5x = 3$

$x = 3/5$

$$\text{So, conc. of NO} = (1 + x) = \left(1 + \frac{3}{5}\right) = \frac{8}{5} = 1.6 \text{ mole}$$

36. The equilibrium constant for the reaction, $N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$ and , $2N_2(g) + 6H_2 \rightleftharpoons 4NH_3(g)$ are K_1 and K_2, respectively. The relationship between K_1 and K_2 is

(a) $K_2 = K_1^2$ (b) $K_2 = K_1^{-2}$

(c) $K_2 = K_2^2$ (d) $K_2 = \sqrt{K_1}$

(e) $K_2 = \sqrt{K_2}$

Kerala-CEE-2019

Ans. (a) : The equilibrium constant for the given reaction–

$$K_1 = \frac{[NH_3]^2}{[N_2][H_2]^3} \quad \text{..... (1)}$$

$$K_2 = \frac{[NH_3]^4}{[N_2]^2[H_2]^6} = \left(\frac{[NH_3]^2}{[N_2][H_2]^3}\right)^2 \quad \text{..... (2)}$$

Putting value of K_1 in eq^n. (2), we get –

$K_2 = (K_1)^2$ Or $K_2 = K_1^2$

37. In the equilibrium, $H_2 + I_2 \rightleftharpoons 2HI$, if at a given temperature the concentrations of the reactants are increased, the value of the equilibrium constant, K_c, will

(a) increase

(b) decrease

(c) remain the same

(d) cannot be predicted with certainty

WB-JEE-2019

Ans. (c) : Equilibrium constant does not depend on the molar concentration of reactants. It is only affected by the change in temperature.

So, the equilibrium constant will remain the same.

38. Change in volume of the system does not alter the number of moles in which of the following equilibrium ?

(a) $N_2(g) + O_2(g) \rightleftharpoons 2NO(g)$

(b) $PCl_5(g) \rightleftharpoons PCl_3(g) + Cl_2(g)$

(c) $N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$

(d) $SO_2Cl_2(g) \rightleftharpoons SO_2(g) + Cl_2(g)$

BCECE-2018

Ans. (a) : According to Le chatlier's principal if some changes are made in a system then the system will move in that direction where it can get released from any stress.

The change in volume will not affect the system if the change in the number of moles is zero.

$N_2(g) + O_2(g) \rightarrow 2NO(g)$

In this reaction $\Delta n = 2 - 2 = 0$

So, change in volume will not affect the system.

$PCl_5 \rightarrow PCl_3 + Cl_2$

In this reaction $\Delta n = 2 - 1 = 1$

So, change in volume will not affect the system.

$N_2(g) + 3H_2(g) \rightarrow 2NH_3(g)$

In this reaction $\Delta n = 2 - 4 = -2$

So, change in volume will affect the system.

$SO_2Cl_2(g) \rightarrow SO_2(g) + Cl_2(g)$

In this reaction $\Delta n = 2 - 1 = 1$

So, change in volume will affect the system.

39. For $2N_2O_5 \rightarrow 4NO_2 + O_2$, rate and rate constants are 2×10^{-3} and 4×10^{-4} respectively. Then the concentration of N_2O_5 at that time will be

(a) 0.5×10^{-4} (b) 0.5×10^{-3}

(c) 2 (d) 5

JCECE - 2018

Ans. (d) : $2N_2O_5 \rightarrow 4NO_2 + O_2$ … (i)

The given reaction is an example of first order reaction.

Rate = 2×10^{-3}

Rate constant = 4×10^{-4}

Hence,

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∵ Rate = k $[N_2O_5]$

$2 \times 10^{-3} = 4 \times 10^{-4}[N_2O_5]$

∴ $\frac{2\times10^{-3}}{4\times10^{-4}} = [N_2O_5]$

$0.5 \times 10 = [N_2O_5]$

$5 = [N_2O_5]$

The concentration of N_2O_5 at that time will be 5.

40. Consider the equilibrium $X_2 + Y_2 \rightleftharpoons P$.

Find the stoichiometric coefficient of the P using the data given in the following table:

X_2/mol L^{-1}	Y_2/mol L^{-1}	P/mol L^{-1}
1.14×10^{-2}	0.12×10^{-2}	2.52×10^{-2}
0.92×10^{-2}	0.22×10^{-2}	3.08×10^{-2}

(a) 1 (b) 2

(c) 3 (d) 0.5

(e) 4

Kerala-CEE-2018

Ans. (b) : Given that

$$X_2 + Y_2 \rightleftharpoons xP$$

Let the coefficient of P be x

So, $K = \frac{[P]^x}{[X_2][Y_2]}$

According to the question

$$K_1 = \frac{(2.52\times10^{-2})^x}{(1.14\times10^{-2})\times(0.12\times10^{-2})}$$

and,

$$K_2 = \frac{(3.08\times10^{-2})^x}{(0.92\times10^{-2})\times(0.22\times10^{-2})}$$

Now substitute the values of x given in option one by one

(a) $K_1 = \frac{(2.52\times10^{-2})}{(1.14\times10^{-2})\times(0.12\times10^{-2})} = 1842.10$

$K_2 = \frac{(3.08\times10^{-2})}{(0.92\times10^{-2})\times(0.22\times10^{-2})} = 1521.73$

$\because K_1 \neq K_2$ thus option (a) is incorrect.

(b) $K_1 = \frac{(2.52\times10^{-2})^2}{(1.14\times10^{-2})\times(0.12\times10^{-2})} = 46.42$

$K_2 = \frac{(3.08\times10^{-2})^2}{(0.92\times10^{-2})\times(0.22\times10^{-2})} = 46.86$

$\because K_1 \approx K_2$

Hence, the stoichiometric coefficient is 2.

41. A certain reaction occurs in two steps as

(i) $2SO_2(g) + 2NO_2(g) \longrightarrow 2SO_3(g) + 2NO(g)$

(ii) $2NO(g) + O_2(g) \longrightarrow 2NO_2(g)$

(a) $NO_2(g)$ is intermediate

(b) NO(g) is intermediate

(c) NO(g) is catalyst

(d) $O_2(g)$ is intermediate

MHT CET-2018

Ans. (b) : NO(g) is intermediate as it is produced in the first step and consumed in the second step. A catalyst may be consumed in the first step and produced in the second step.

42. There are two statements, one labeled as Assertion (A) and the other as Reason (R) Examine both the statements carefully and mark the correct choice.

(A) At equilibrium, the mass of each of the reactants and products remains constant

(R) At equilibrium, the rate of forward reaction is equal to the rate of backward reaction.

(a) Both (A) and (R) are correct and (R) is the correct explanation of (A).

(b) Both (A) and (R) are correct but (R) is not the correct explanation of (A).

(c) (A) is correct but (R) is wrong.

(d) (A) is wrong but (R) is correct.

J & K CET-(2017)

Ans. (a) : At equilibrium the concentration of each of the reactants and products becomes constant. Thus the mass of the reactants and products remains constants as the rate of forward reaction is equal to the rate of backward reaction.

43. The equilibrium constant (K_c) for the following equilibrium

$2SO_2(g) + O_2(g) \rightleftharpoons 2SO_3(g)$

at 563 K is 100. At equilibrium, the number of moles of SO_3 in the 10 litre flask is twice the number of moles of SO_2, then the number of moles of oxygen is

(a) 0.4 (b) 0.3

(c) 0.2 (d) 0.1

AP EAMCET-2017

Ans. (a) : Given that, equilibrium constant (K_c) =100

According to the equilibrium equation-

$$\begin{array}{lccc} & 2SO_2(g) & + O_2(g) & \rightleftharpoons 2SO_3(g) \\ \text{Initially} & x & y & 0 \\ \text{At equil.} & \frac{2x}{10} & \frac{y}{10} & \frac{2x}{10} \end{array}$$

Let, y be the no. of moles of oxygen.

$$\therefore K_{eq} = \frac{(2x/10)^2}{(x/10)^2 \times \left(\frac{y}{10}\right)}$$

or $100 = \frac{40}{y} \Rightarrow y = 0.4$

44. (i) $H_3PO_4(aq) \rightleftharpoons H^+(aq) + H_2PO_4^-(aq)$

(ii) $H_2PO_4^-(aq) \rightleftharpoons H^+(aq) + HPO_4^{2-}(aq)$

(ii) $HPO_4^{2-}(aq) \rightleftharpoons H^+(aq) + PO_4^{3-}(aq)$

The equilibrium constants for the above reactions at a certain temperature are K_1, K_2 and K_3 respectively. The equilibrium constant for the reaction.

$H_3PO_4 \rightleftharpoons 3H^+(aq) + PO_4^{3-}(aq)$ in terms of K_1, K_2, and K_3 is

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(a) $K_1 + K_2 + K_3$ (b) $\frac{K_1}{K_2 + K_3}$

(c) $\frac{K_3}{K_1 K_2}$ (d) $K_1 K_2 K_3$

AP EAMCET-2017

Ans. (d) : The equilibrium reactions are -

$H_3PO_4(aq) \rightleftharpoons H^+(aq) + H_2PO_4^-(aq)$

$$\therefore K_1 = \frac{[H^+][H_2PO_4^-]}{H_3PO_4} \quad ......(1)$$

$$H_2PO_4^-(aq) \longrightarrow H^+(aq) + HPO_4^{2-}(aq)$$

$$K_2 = \frac{[H^+][HPO_4^{2-}]}{[H_2PO_4^-]} \quad ....(2)$$

and $HPO_4^{2-}(aq) \longrightarrow H^+(aq) + PO_4^{3-}(aq)$

$$K_3 = \frac{[H^+][PO_4^{3-}]}{[HPO_4^{2-}]} \quad ....(3)$$

Multiply equation (1), (2), and (3), we get

$K_1 \times K_2 \times K_3 =$

$$\frac{[H^+][H_2PO_4^-]}{[H_3PO_4]} \times \frac{[H^+][HPO_4^{2-}]}{[H_2PO_4^-]} \times \frac{[H^+][PO_4^{3-}]}{HPO_4^{2-}}$$

$$K_1K_2K_3 = \frac{3[H^+][PO_4^{3-}]}{[H_3PO_4]}$$

$K_1K_2K_3 = K$

45. For the reaction, $2HI(g) \rightleftharpoons H_2(g)+I_2(g)$ the degree fo dissociation (α) of HI (g) is related to equilibrium constant K_p by the expression

(a) $\sqrt{\frac{1+2K_p}{2}}$ (b) $\sqrt{\frac{2K_p}{1+2K_p}}$

(c) $\frac{2\sqrt{K_p}}{1+2\sqrt{K_p}}$ (d) $\frac{1+2\sqrt{K_p}}{2}$

UPTU/UPSEE-2017

Ans. (c) : For the reaction:

$$2HI(g) \rightleftharpoons H_2(g) + I_2(g)$$

	$2HI(g)$	$H_2(g)$	$I_2(g)$
initial	1	0	0
at eq.	$1-\alpha$	$\frac{\alpha}{2}$	$\frac{\alpha}{2}$

∵ Partial pressure = mole fraction × total pressure

and $K_p = \frac{P_{H_2} \times P_{I_2}}{P_{HI}^2}$

$$\Rightarrow P_{H_2} = \left(\frac{\alpha}{2}\right)P_T$$

$$P_{I_2} = \left(\frac{\alpha}{2}\right)P_T$$

$$P_{HI} = (1-\alpha)P_T$$

$$\text{Hence, } K_p = \frac{\left[\left(\frac{\alpha}{2}\right)P_T\right]^2}{[(1-\alpha)^2.P_T^2]}$$

$$\frac{\alpha}{1-\alpha} = 2\sqrt{K_p}$$

$$\alpha = 2\sqrt{K_p}(1-\alpha)$$

$$2\sqrt{K_p} - 2\sqrt{K_p}.\alpha = \alpha$$

$$2\sqrt{K_p} = \alpha(1+2\sqrt{K_p})$$

$$\alpha = \frac{2\sqrt{K_p}}{1+2\sqrt{K_p}}$$

46. Equlilbrium constants for the following reactions at 1200 K are given

$2H_2O(g) \rightleftharpoons 2H_2(g) + O_2(g), K_1 = 6.4 \times 10^{-8}$

$2CO_2(g) \rightleftharpoons 2CO(g) + O_2(g), K_2 = 1.6 \times 10^{-6}$

The equilibrium constant for the reactions $H_2(g)+CO_2(g) \rightleftharpoons CO(g)+H_2O(g)$, at 1200 K will be

(a) 0.05 (b) 20 (c) 0.2 (d) 5.0

WB-JEE-2017

Ans. (d) : For the given reaction:

$2H_2O(g) \rightleftharpoons 2H_2(g) + O_2(g),$ $K_1 = 6.4\times10^{-8}$

or $H_2O(g) \rightleftharpoons H_2(g) + \frac{1}{2}O_2(g),$ $K_1' = \sqrt{K_1}$

Reverse the above reaction, we get–

$H_2(g) + \frac{1}{2}O_2(g) \rightleftharpoons H_2O(g),$ $K_1'' = \frac{1}{K_1}$ .....(i)

$2CO_2(g) \rightleftharpoons 2CO(g) + O_2(g),$ $K_2 = 1.6\times10^{-6}$

$CO_2(g) \rightleftharpoons CO(g) + \frac{1}{2}O_2(g),$ $K_2' = \sqrt{K_2}$ .....(ii)

On adding eq^n. (i) and (ii)

$$H_2(g) + CO_2(g) \rightleftharpoons CO(g) + H_2O(g)$$

$$K = \frac{\sqrt{K_2}}{K_1} = \frac{\sqrt{1.6\times10^{-6}}}{\sqrt{6.4\times10^{-8}}}$$

$$K = \frac{\sqrt{10^2}}{\sqrt{4}} = \sqrt{25} = 5$$

47. Among the following, the equilibrium which is not affected by an increase in pressure is

(a) $C(s) + H_2O(g) \rightleftharpoons CO(g) + H_2(g)$

(b) $3Fe(s) + 4H_2O(g) \rightleftharpoons Fe_3O_4(s) + 4H_2(g)$

(c) $2SO_3(g) \rightleftharpoons 2SO_2(g) + O_2(g)$

(d) $H_2(g) + I_2(s) \rightleftharpoons 2HI(g)$

UPTU/UPSEE-2016

Ans. (b): As several moles of gaseous species are equal on both sides. Hence, for option (b) equilibrium is not affected by an increase in pressure.

48. For the reaction,

$A(S) + B(g) + Heat \rightleftharpoons 2C(s) + 2D(g)$

at equilibrium, if pressure of B is doubled, then to re-establish the equilibrium, the factor by which concentration of D changes, will be

(a) 2 (b) $\sqrt{2}$

(c) 3 (d) $\sqrt{3}$

BCECE-2016

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Ans. (b) : For the given reaction–

$$A(s) + B(g) + Heat \rightleftharpoons 2C(s) + 2D(g)$$

Equilibrium constant k_p is–

$$K_p = \frac{(P_D)^2}{P_B} \qquad ...(i)$$

When the pressure of B is doubled –

$P'_B = 2P_B$

Then, new equilibrium constant–

$$K_p = \frac{(P'_D)^2}{2P_B} \qquad ...(ii)$$

On comparing (i) and (ii) we get

$$P'_D = \sqrt{2}P_D$$

49. Two equilibrium, $AB \rightleftharpoons A^+ + B^-$ and $AB + B^- \rightleftharpoons AB_2^-$ are simultaneously maintained in a solution with equilibrium constants, K_1 and K_2 respectively. The ratio of $[A^+]$ to $[AB_2^-]$ in the solution is

(a) directly proportional to $[B^-]$
(b) inversely proportional to $[B^-]$
(c) directly proportional to the square of $[B^-]$
(d) inversely proportional to the square of $[B^-]$

KEAM- 2013

Ans. (d): If two equilibria $AB \rightleftharpoons A^+ + B^-$ and $AB + B^- \rightleftharpoons AB_2^-$ are simultaneously maintained in a solution with equilibrium constant K_1 and K_2 respectively then.

$$K_1 = \frac{[A^+][B^-]}{[AB]}, K_2 \frac{[AB_2^-]}{[AB][B^-]}$$

Dividing K_1 by K_2, we get–

$$\therefore \quad \frac{K_1}{K_2} = \frac{[A^+][B^-]^2}{[AB_2]^-}$$

$$\therefore \quad \frac{[A^+]}{[AB_2]} \times \frac{1}{[B^-]^2}$$

50. The equilibrium constant values, under the same conditions of temperature and pressure, for the equilibria $A_2 + 3B_2 \rightleftharpoons 2AB$ and $AB_3 \rightleftharpoons \frac{1}{2}A_2 + \frac{3}{2}B_2$ are respectively, x mol^{-2} L^2 and y mol L^{-1}. The correct relation between x and y is

(a) $x = 2y$
(b) $y = 2x$
(c) $x = y^{1/2}$
(d) $y = x^{-1/2}$

J & K CET-(2016)

Ans. (d) : For this reaction–

$$A_2 + 3B_2 \rightleftharpoons 2AB_2$$

Equilibrium constant–

$$K_1 = x \text{ mol}^{-2}L^2 \qquad ...(i)$$

$$AB_3 \rightleftharpoons \frac{1}{2}A_2 + \frac{3}{2}B_2$$

Equilibrium constant–

$$K_2 = y \text{ mol } L^{-1} \qquad ...(ii)$$

Equation (ii) is obtained by reversing equation (i) and then diving by 2,

$$\therefore \quad K_2 = \frac{1}{\sqrt{K_1}}$$

$$\Rightarrow \quad y = \frac{1}{\sqrt{x}}$$

$y = x^{-1/2}$

51. For a reaction,

$$\mathbf{A + B \rightleftharpoons C + D,}$$

at equilibrium, one third of A and B are consumed. The value of equilibrium constant will be

(a) 0.5
(b) 0.25
(c) 0.025
(d) 5

JCECE - 2016

Ans. (b) : Reaction given is.

	A	$+$	B	$\rightleftharpoons C$	$+D$
initial	C		C	0	0
at equilibrium	$C\left(1-\frac{1}{3}\right)$		$C\left(1-\frac{1}{3}\right)$	$\frac{C}{3}$	$\frac{C}{3}$

Also, at equilibrium (V same for all)

[A] = [B] and [C] = [D]

Therefore, equilibrium constant is–

$$K = \frac{\text{Concentration of product}}{\text{Concentration of reactant}}$$

$$K = \frac{\left[\frac{C}{3V}\right]\left[\frac{C}{3V}\right]}{\left[\frac{2C}{3V}\right]\left[\frac{2C}{3V}\right]}$$

$$= \frac{1}{4} = 0.25$$

52. If the equilibrium constant for $N_2(g) + O_2(g) \rightleftharpoons 2NO(g)$ is K the equilibrium constant for $\frac{1}{2}N_2(g) + \frac{1}{2}O_2(g) \rightleftharpoons NO(g)$ will be

(a) $\frac{1}{2}K$
(b) K
(c) K^2
(d) $K^{1/2}$

NEET-2015

Ans. (d) : For the reaction –

$$N_2(g) + O_2(g) \rightleftharpoons 2NO(g)$$

Equilibrium constant–

$$K = \frac{[NO]^2}{[N_2][O_2]}$$

And, $\frac{1}{2}N_2(g) + \frac{1}{2}O_2(g) \rightleftharpoons NO(g)$

For this reaction now equilibrium reaction–

$$K' = \frac{[NO]}{[N_2]^{1/2}[O_2]^{1/2}}$$

On, squaring both sides –

$$(K')^2 = \frac{[NO]^2}{[N_2][O_2]}$$

$(K')^2 = K$

$K' = K^{1/2}$

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53. For the reaction, $A(s) + 2B^+(aq) \rightarrow A^{2+}(aq) + 2B(s)$, the E^0 is 1.18 V. Then equilibrium constant for the reaction is

(a) 10^{10} (b) 10^{20}
(c) 10^{40} (d) 10^{60}

J & K CET-(2015)

Ans. (c) : Given the reaction –

$A(s) + 2B^+(aq) \rightarrow A^{2+}(aq) + 2B(s)$

$E^o = 1.18$ V.

$$\text{So, } \log_{10} K = \frac{nE^o_{cell}}{0.059}$$

$$= \frac{2\times1.18}{0.059}$$

$$\log_{10}K = 40$$

$$K = 10^{40}$$

54. Equilibrium constants are given for the following two equilibria.

$$\textbf{(i)}\ A_2(g) + B_2(g) \rightleftharpoons 2AB(g);$$

$$K = 2\times10^{-4}\ L\ mol^{-1}$$

$$\textbf{(ii)}\ 2AB(g) + C_2(g) \rightleftharpoons 2ABC(g);$$

$$K = 2\times10^{-2}\ L\ mol^{-1}$$

Calculate the equilibrium constant for the following equilibrium.

$$ABC(g) \rightleftharpoons \frac{1}{2}A_2(g) + \frac{1}{2}B_2(g) + \frac{1}{2}C_2(g)$$

(a) 500 $mol^{1/2}\,L^{1/2}$ (b) 4×10^{-6} $mol^{1/2}\,L^{1/2}$
(c) 500 $mol^{-1/2}\,L^{1/2}$ (d) 200 $mol^{1/2}\,L^{-1/2}$
(e) 500 $mol^{1/2}\,L^{-1/2}$

Kerala-CEE-2015

Ans. (c) :

$$A_2(g) + B_2(g) \rightleftharpoons 2AB(g)$$

$$K_1 = \frac{[AB]^2}{[A_2][B_2]}$$

$$2\times10^{-4} = \frac{[AB]^2}{[A_2][B_2]} \ \ldots\ldots\ldots\ldots\ldots\text{(i)}$$

$$2AB(g) + C_2(g) \rightleftharpoons 2ABC(g)$$

$$K_2 = \frac{[ABC]^2}{[AB]^2[C_2]}$$

$$2\times10^{-2} = \frac{[ABC]^2}{[AB]^2[C_2]} \ \ldots\ldots\ldots\ldots\ldots\text{(ii)}$$

$$ABC(g) \rightleftharpoons \frac{1}{2}A_2(g) + \frac{1}{2}B_2(g) + \frac{1}{2}C_2(g)$$

$$K_3 = \frac{[A_2]^{1/2}[B_2]^{1/2}[C_2]^{1/2}}{[ABC]}$$

Eq^n. (i) and eq^n. (ii) are added, reversed and divided by 2 then we get eq^n. (iii)

$$\text{Therefore,}\quad K_3 = \frac{1}{\sqrt{K_1\times K_2}}$$

$$= \frac{1}{\sqrt{2\times10^{-4}\times2\times10^{-2}}}$$

$$= \frac{1000}{2}$$

$$= 500\ M^{-1/2}L^{1/2}$$

55. HA is a weak acid. At 25^0C, the molar conductivity of 0.02 MHA is $150\Omega^{-1}$ cm^2 mol^{-1}, If its Λ^o_m is 300 Ω^{-1} cm^2 mol^{-1} the equilibrium constant of HA dissociation is

(a) 0.0001 (b) 0.005
(c) 0.01 (d) 0.02

J & K CET-(2015)

Ans. (c) : Given that,

molar conductivity (Λ_m) = $300\Omega^{-1}$ cm^2 mol^{-1}

Limiting molar conductivity ($\Lambda^o{}_m$) = $150\Omega^{-1}$ cm^2 mol^{-1}

Concentration (c) = 0.02 m

$$\therefore \text{ Degree of dissociation } (\alpha) = \frac{\Lambda_m}{\Lambda^o_m} = \frac{150}{300} = 0.5$$

Now, we can determine the value of its dissociation constant.

$$K_a = \frac{C\alpha^2}{(1-\alpha)}$$

$$K_a = \frac{0.02\times(0.5)^2}{(1-0.5)}$$

$$K_a = \frac{0.02\times0.5\times0.5}{0.5}$$

$$K_a = 0.01$$

56. If the value of equilibrium constant for a particular reaction is 1.6×10^{12}, then at equilibrium the system will contain

(a) Mostly products
(b) Similar amounts of reactions and products
(c) All reactions
(d) Mostly reactions

NEET-2015 Cancelled

Ans. (a) : Given that

The value of equilibrium constant K is 1.6×10^{12} which is very high.

$$K = \frac{[\text{Product}]}{[\text{Reactants}]}$$

This indicates the ratio of product concentration to reactant concentration is very high.

Hence, the reaction mixture mostly contains products.

57. For the following equilibrium (omitting charges).

I. $M + Cl \rightarrow MCl$, $K_{eq} = \beta_1$
II. $MCl + Cl \rightarrow MCl_2$, $K_{eq} = \beta_2$
III. $MCl_2 + Cl \rightarrow MCl_3$, $K_{eq} = \beta_3$
IV. $M + 3Cl \rightarrow MCl_3$, $K_{eq} = K$

then relationship between K, β_1, β_2 and β_3 is

(a) $K = \beta_1\,\beta_2\beta_3$
(b) $\log K = \log\beta_1 + \log\beta_2 + \log\beta_3$
(c) $pK = p_{\beta_1} + p_{\beta_2} + p_{\beta_3}$
(d) All of the above

JIMPER-2015

Ans. (d) : When the add reactions (i), (ii) and (iii) we get reaction (iv).

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When individual reactions are added their equilibrium constant values are multiplied.

$K = \beta_1\beta_2\beta_3$

Taking log on both sides –

$\log K = \log\beta_1 + \log\beta_2 + \log\beta_3$

But, $pK = -\log K$

Hence, $pK = p\beta_1 + p\beta_2 + p\beta_3$

58. If $Ag^+ + 2NH_3 \rightleftharpoons Ag(NH_3)_2^+; K_1 = 1.7 \times 10^7$

$Ag^+ + Cl^- \rightleftharpoons AgCl; K_2 = 5.4 \times 10^9$

Then, for $AgCl + 2NH_3 \rightleftharpoons \left[Ag(NH_3)_2^+\right] + Cl^-$ equilibrium constant will be

(a) 4.68×10^{-3} (b) 5.2×10^{-17}

(c) 0.31×10^{-2} (d) 3.1×10^{-2}

JIMPER-2015

Ans. (c) : For the reaction–

$Ag^+ + Cl^- \rightleftharpoons AgCl; \quad K_2 = 5.4 \times 10^9$

Now, reverse the above reaction –

$AgCl \rightleftharpoons Ag^+ + Cl^-$

New, equilibrium constant–

$$K_2 = \frac{1}{5.4 \times 10^9} = 1.85 \times 10^{-10} \quad \text{...(i)}$$

$Ag^+ + 2NH_3 \rightleftharpoons [Ag(NH_3)_2]^+; \; K_1 = 1.7 \times 10^7$...(ii)

Add reaction (i) and (ii), we get

$AgCl + 2NH_3 \rightleftharpoons [Ag(NH_3)_2]^+ + Cl^-$

So, $K = K_1K_3$

$K = 1.7 \times 10^7 \times 1.85 \times 10^{-10} = 0.31 \times 10^{-2}$

59. XY_2 dissociates as

$XY_2\,(g) \rightleftharpoons XY\,(g) + Y\,(g)$

When the initial pressure of XY_2 is 600 mm Hg, the total equilibrium pressure is 800 mm Hg. Calculate K for the reaction assuming that the volume of the system remains unchanged.

(a) 50 (b) 100

(c) 166.6 (d) 400.0

UPTU/UPSEE-2014

Ans. (b) : The dissociates of XY_2 is–

$XY_2(g) \rightleftharpoons XY(g) + Y(g)$

Initial pressure of XY_2 is 600 mm Hg. The total pressure at equilibrium is 800 mm Hg. Let x mm Hg of XY_2 dissociates to reach equilibrium x mmHg of XY and x mm Hg of Y will be formed at equilibrium. (600 – x) mm Hg of XY_2 will be present at equilibrium.

Total pressure = (600 – x)+x+x=600+x mm Hg

But total pressure = 800 mm Hg

So, 600+x=800

x=200

Thus, the equilibrium pressures are:

P_{xy_2} = 600-x = 600-200=400 mm Hg

Pxy = x = 200 mm Hg

Py = x = 200 mm Hg

Assuming volume of system to remain constant, the value of

$$K_p = \frac{P_{xy}P_y}{P_{xy_2}}$$

$$K_p = \frac{200 \times 200}{400}$$

K_p = 100 mm Hg

60. Consider the following equilibria involving SO_2 (g) and their corresponding equilibrium constants:

$SO_2\,(g) + \frac{1}{2}O_2\,(g) \xrightleftharpoons{K_1} SO_3\,(g)$

$2SO_3\,(g) \xrightleftharpoons{K_2} 2SO_2\,(g) + O_2\,(g)$

Which one of the following is correct?

(a) $K_2 = K_1^2$ (b) $K_2^2 = K_1$

(c) $K_2 = K_1$ (d) $K_2K_1^2 = 1$

SCRA-2014

Ans. (d) : Given the reversible reaction are :

$$SO_2(g) + \frac{1}{2}O_2(g) \rightleftharpoons SO_3(g)$$

The equilibrium expression is :

$$K_1 = \frac{[SO_3(g)]}{[SO_2(g)][O_2(g)]^{1/2}} \quad \text{.....(i)}$$

And, $2SO_3(g) \rightleftharpoons 2SO_2(g) + O_2(g)$

The equilibrium expression is :

$$K_2 = \frac{[SO_2(g)]^2\,[O_2(g)]}{[SO_3(g)]^2} \quad \text{.....(ii)}$$

Taking square both side in equation (i) we get,

$$K_1^2 = \frac{[SO_3(g)]^2}{[SO_2(g)]^2\,[O_2(g)]} \quad \text{.....(iii)}$$

Multiply the equation (ii) and (iii), we get– $K_2K_1^2 = 1$

61. One mole of PCl_5 is heated in a closed 2 dm^3 vessel. At equilibrium 40% PCl_5 is dissociated. Calculate the equilibrium constant.

(a) 0.066 (b) 0.154

(c) 0.133 (d) 0.266

COMEDK-2014

Ans. (c) :

	PCl_5	$\rightleftharpoons$	PCl_3	$+ Cl_2$
Initial conc.	$\frac{1}{2} = 0.5$		0	0
Equi. conc.	$\frac{1-0.4}{2} = \frac{0.6}{2}$		$\frac{0.4}{2}$	$\frac{0.4}{2}$

$$K_c = \frac{[PCl_3][Cl_2]}{[PCl_5]} = \frac{\frac{0.4}{2} \times \frac{0.4}{2}}{\frac{0.6}{2}} = \frac{(0.4)^2}{2 \times 0.6} = 0.133$$

62. In the reaction at constant volume,

$C(s) + CO_2(g) \rightleftharpoons 2CO(g)$

argon gas is added which does not take part in the reaction; choose the correct statement.

(a) The equilibrium constant is unchanged.

(b) The equilibrium shifts in the forward direction.

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(c) The equilibrium shifts in the backward direction.
(d) The direction of equilibrium depends on the amount of argon added.

AMU-2014

Ans. (a) : Equilibrium constant depends only upon temperature, not on the concentration. Thus, it remains unchanged when an inert gas like Argon is added.
Further, Argon is added at the constant volume i.e. the relative molar concentration of the substance will not change. Hence, the equilibrium position of the reaction remain unaffected.

63. For the reaction at equilibrium $N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$, some inert gas is added at constant volume. In this situation, which of the following statements is correct?
(a) More of NH_3 gas is produced
(b) Less of NH_3 gas is produced
(c) K_p of the reaction is increased
(d) No effect on the production of NH_3

Assam CEE-2014

Ans. (d) : $N_2(g)+3H_2(g) \rightleftharpoons 2NH_3(g)$
According to Le-chatelier's principle for the given reaction.
When an inert gas is added to an equilibrium at constant volume there will be no effect on the equilibrium.
Hence, no effect on the production of NH_3.

64. The equilibrium constant for the aromatization reaction of acetylene is 8. The aromatization reaction is given below

$$3C_2H_2 \xrightarrow[\text{tube}]{\text{Red hot}} C_6H_6$$

If the equilibrium concentration of acetylene is found to be 0.5 then the equilibrium concentration of benzene (C_6H_6) is
(a) 0.5 mol L^{-1} (b) 1 mol L^{-1}
(c) 0.25 mol L^{-1} (d) 2 mol L^{-1}

UP CPMT-2014

Ans. (b) : For the given reaction, $K_c = \dfrac{[C_6H_6]}{[C_2H_2]^3}$

$$8 = \frac{[C_6H_6]}{(0.5)^3}$$

$$[C_6H_6] = 8 \times (0.5)^3 \simeq 1 \text{mol } L^{-1}$$

65. The equilibrium constant for the reaction

$$H_2(g)+I_2(g) \rightleftharpoons 2HI(g)$$

at a certain temperature is 49. What will be the equilibrium constant for the reaction

$$HI(g) \rightleftharpoons \frac{1}{2}H_2(g)+\frac{1}{2}I_2(g)$$

at the same temperature?
(a) 7 (b) $\dfrac{1}{7}$
(c) 24.5 (d) 98

Assam CEE-2014

Ans. (b) : $H_2(g)+I_2(g) \rightleftharpoons 2HI(g)$
Equilibrium constant for the given reaction K = 49.
Now, reaction is rivers and dividing by 2–

$$HI(g) \rightleftharpoons \frac{1}{2}H_2(g)+\frac{1}{2}I_2(g)$$

Then, the new equilibrium constant K' is $= \dfrac{1}{\sqrt{K}}$

Hence, $K' = \dfrac{1}{\sqrt{49}} = \dfrac{1}{7}$

66. K_c for the reaction, $[Ag(CN)_2]^- \rightleftharpoons Ag^+ + 2CN^-$, the equilibrium constant at 25^0C is 4.0×10^{-19}, then the silver ion concentration in a solution which was originally 0.1 molar in KCN and 0.03 molar in $AgNO_3$ is :
(a) 7.5×10^{18} (b) 7.5×10^{-19}
(c) 7.5×10^{19} (d) 7.5×10^{-18}

BITSAT-2014

Ans. (d) : Given that, $K_c = 4 \times 10^{-19}$

	2KCN	+ AgNO$_3$ ⇌	$[Ag(CN)_2]^-$	+ KNO$_3$	+ K^+
t = 0	0.1	0.03	0	0	0
t = equ.	(0.1 – 0.06)	(0)	(0.03)	(0.03)	(0.03)

∵	$[Ag(CN)_2]^-$ ⇌	Ag^+	+ $2CN^-$
	0.03	a	0.04 (Left from KCN)
	0.03 – a	a	0.049

Hence, $K_c = \dfrac{[Ag^+]\cdot[CN^-]^2}{[Ag(CN)_2]^-}$

$$4 \times 10^{-19} = \frac{[a]\cdot[0.04]^2}{[0.03]}$$

$a = 7.5 \times 10^{-18}$

67. The mixture of reactants and products in the equilibrium state is called
(a) chemical mixture
(b) equilibrium mixture
(c) chemical equilibrium
(d) dynamic equilibrium.

J & K CET-(2014)

Ans. (b) : The mixture of reactants and products in the equilibrium state is called equilibrium mixture.
This state of equilibrium is called chemical equilibrium and nature of this state is dynamic instead of static.

68. The thermodynamic equilibrium constant, K_a for the reaction:
$CuO(s) + H_2(g) \rightleftharpoons Cu(s) + H_2O(g)$ is given by

(a) $K = \dfrac{[Cu][H_2O]}{[CuO][H_2]}$ (b) $K = \dfrac{[Cu][H_2O]}{[H_2]}$

(c) $K = \dfrac{[H_2O]}{[CuO][H_2]}$ (d) $K = \dfrac{[H_2O]}{[H_2]}$

AMU-2013

Ans. (d) : $CuO(s)+H_2(g) \rightleftharpoons Cu(s)+H_2O(g)$

$$K_c = \frac{[H_2O]}{[H_2]}$$

As a general rule the concentration of pure solids and pure liquids are not included when writing on equilibrium equation.

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69. Steam reacts with iron at high temperature to give hydrogen gas and $Fe_3O_4(s)$. The correct expression for the equilibrium constant is

(a) $\frac{P^2_{H_2}}{P^2_{H_2O}}$ (b) $\frac{(P_{H_2})^4}{(P_{H_2O})^4}$

(c) $\frac{(P_{H_2})^4[Fe_3O_4]}{(P_{H_2O})^4[Fe]}$ (d) $\frac{[Fe_3O_4]}{[Fe]}$

AMU-(2013)

Ans. (b): The reaction that takes place is following :

$$3Fe(s)+4H_2O(steam) \rightleftharpoons Fe_3O_4(s)+4H_2(g)$$

$$K_p=\frac{(P_{H_2})^4}{(P_{H_2O})^4}$$

Note–Only gaseous products are reactants are considered.

70. Equilibrium constant for the reaction, $NH_4OH+H^+ \rightleftharpoons NH_4^+ + H_2O$ is 1.8×10^9. Hence, equilibrium constant for $NH_3(aq) + H_2O \rightleftharpoons NH_4^+ + OH^-$ is –

(a) 1.8×10^{-5} (b) 1.8×10^{5}

(c) 1.8×10^{-9} (d) 5.59×10^{-10}

BCECE-2013

Ans. (a) : $NH_2OH + H^+ \rightleftharpoons NH_4^+ + H_2O$

$$K=\frac{[NH_4^+][H_2O]}{[NH_4OH][H^+]}$$

$$\text{or } 1.8\times10^9=\frac{[NH_4^+][H_2O]}{[NH_4OH][H^+]} \quad ...(i)$$

$$NH_3 + H_2O \rightleftharpoons NH_4^+(aq) + OH^-(aq)$$

$$K'=\frac{[NH_4^+][OH^-]}{[NH_3][H_2O]}$$

$$K'=\frac{[NH_4^+][OH^-]}{[NH_4OH]} (\because NH_3 + H_2O \rightarrow NH_4OH) \text{ ... (ii)}$$

Eq^n. (ii) divided by eq^n. (i), we get–

$$\frac{K'}{K}=\frac{[NH_4^+][OH^-][NH_4OH][H^+]}{[NH_4OH][NH_4^+][H_2O]}\{H_2O \rightarrow \text{excess}\}$$

$$\frac{K'}{K}=[OH^-][H^+] \quad ...(iii)$$

We know that

$K_w = [H^+]\ [OH^-]$

$10^{-14} = [H^+]\ [OH^-]$

So, from eq^n. (iii), we get –

$$\frac{K'}{K}=10^{-14}$$

$K' = 10^{-14} \times 1.8 \times 10^9$

$K' = 1.8 \times 10^{-5}$

71. For the following reaction, $NO_2(g) + CO(g) \rightarrow NO(g) + CO_2(g)$, the rate law is Rate = $k[NO_2]^2$. If 0.1 mole of gaseous carbon monoxide is added at constant temperature to the reaction mixture which of the following statements is true ?

(a) Both k and the reaction rate remain the same

(b) Both k and the reaction rate increase

(c) Both k and the reaction rate decrease

(d) Only k increases, the reaction rate remain the same

(e) Only the reaction rate increases; k remains the same

Kerala-CEE-2013

Ans. (a) : $NO_2(g)+CO(g) \rightarrow NO(g)+CO(g)$

$\because$ Rate of reaction, $\left(\frac{dx}{dt}\right) = k[NO_2]^2$

$\therefore$ Rate is independent of CO

Hence on adding more CO to the reaction mixture both k and rate remain the same.

72. Two equilibria, $AB \rightleftharpoons A^+ + B^-$ and $AB + B^- \rightleftharpoons AB_2^-$ are simultaneously maintained in a solution with equilibrium constants, K_1 and K_2 respectively. The ratio of $[A^+]$ to $[AB_2^-]$ in the solution is

(a) directly proportional to $[B^-]$

(b) inversely proportional to $[B^-]$

(c) directly proportional to the square of $[B^-]$

(d) inversely proportional to the square of $[B^-]$

(e) independent $[B^-]$

Kerala-CEE-2013

Ans. (d) : $AB \xrightleftharpoons{K_1} A^+ + B^-$

$$\therefore K_1=\frac{[A^+][B^-]}{[AB]} \text{ ....(i)}$$

$$AB + B^- \xrightleftharpoons{K_2} AB_2^-$$

$$K_2=\frac{[AB_2^-]}{[AB][B^-]} \text{ ....(ii)}$$

On dividing eq^n. (i) and eq^n. (ii), we get–

$$\frac{[A^+][B^-]}{[AB]}\times\frac{[AB][B^-]}{[AB_2^-]}=\frac{K_1}{K_2}$$

$$\text{or } \frac{[A^+][B^-]^2}{[AB_2^-]}=K'$$

$$\text{Where } K'=\frac{K_1}{K_2}=\text{constant}$$

$$\text{or } \frac{[A^+]}{[AB_2^-]}=K' \times \frac{1}{[B^-]^2}$$

$$\text{or } \frac{[A^+]}{[AB_2^-]} \propto \frac{1}{[B^-]^2}$$

73. The equilibrium constants for the reaction, $Br_2 \rightleftharpoons 2Br$ at 500 K and 700 K are 1×10^{-10} and 1×10^{-5} respectively. The reaction is

(a) endothermic (b) exothermic

(c) fast (d) slow

UPTU/UPSEE-2013

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Ans. (a) : Given that:
The equilibrium constants for the reaction, $Br_2 \rightleftharpoons 2Br$ at 500K and 700K are 1×10^{-10} and 1×10^{-5} respectively. The reaction is endothermic.
An endothermic reaction is characterized by absorption of heat. When heat is added, the position of the equilibrium shifts to forward direction. With increase in temperature, the value of the equilibrium constant increase for an endothermic reaction and decrease for exothermic reaction.

74. For a gas in equilibrium with a liquid, the ratio of the concentration of the gas in the solution plase to that in the gaseous phase is constant at constant temperature, only if molecules undergo

(a) ionisation (b) dissociation
(c) isolation (d) reaction with solvent

UPTU/UPSEE-2012

Ans. (c) : According to Henry's law;

$$\frac{\text{Concentration of gas in solution}}{\text{Concentration of gas in the gaseous phase}} = \text{constant}$$

Only there is simple solvation (isolation then stablisation). Not possible in the case of ionisation or dissociation.

75. Reaction,

$$\mathbf{BaO_2(s) \rightleftharpoons BaO(s) + O_2(g); \Delta H = +ve.}$$

In equilibrium condition, pressure of O_2 depends on

(a) increased mass of BaO_2
(b) increased mass of BaO
(c) increased temperature of equilibrium
(d) increased mass of BaO_2 and BaO both

BCECE-2012

Ans. (c) : The given reaction is –

$$BaO_2(s) \rightleftharpoons BaO(s) + O_2(g); \quad \Delta H = +ve$$

Since ΔH is +ve for this reaction. So, it is endothermic in nature. On increasing the temperature, by applying Le Chatelier's principal, we can see that the reaction proceeds in a forward direction on increasing temperature. So, the pressure of O_2 will increase the temperature at equilibrium.

76. The correct order of equilibrium constants for the reaction is

$$H_2CO + H_2O \xrightleftharpoons{K_1} H_2C(OH)_2$$

$$CH_3CH_2CHO + H_2O \xrightleftharpoons{K_2} CH_3CH_2CH(OH)_2$$

$$CH_3COCH_3 + H_2O \xrightleftharpoons{K_3} CH_3C(OH)_2CH_3$$

(a) $K_1 > K_2 > K_3$ (b) $K_1 < K_2 < K_3$
(c) $K_1 > K_3 > K_2$ (d) $K_1 < K_3 < K_2$

AMU-2012

Ans. (a) : $H_2CO + H_2O \xrightleftharpoons{K_1} H_2(COH)_2$

$$CH_3CH_2CHO + H_2O \xrightleftharpoons{K_2} CH_3CH_2CH(OH)_2$$

$$CH_3COCH_3 + H_2O \xrightleftharpoons{K_3} CH_3C(OH)_2CH_3$$

Due to steric effect, the order of equilibrium constants will be

$$K_1 > K_2 > K_3$$

77. Given that the equilibrium constant for the reaction, $2SO_2(g) + O_2(g) \rightleftharpoons 2SO_3(g)$ has a value of 278 at a particular temperature. What is the value of the equilibrium constant for the following reaction at the same temperature ?

$$\mathbf{SO_3(g) \rightleftharpoons SO_2(g) + \frac{1}{2}O_2(g)}$$

(a) 1.8×10^{-3} (b) 3.6×10^{-3}
(c) 6.0×10^{-2} (d) 1.3×10^{-5}

NEET-Mains 2012

Ans. (c) : The given equilibrium equation–

$$2SO_2(g) + O_2(g) \rightleftharpoons 2SO_3(g), K = 278$$

Now for $SO_2 + \frac{1}{2}O_2 \rightleftharpoons SO_3$ will have $\sqrt{K}$

So, reverse the above reaction:

$SO_3(g) \rightleftharpoons SO_2(g) + \frac{1}{2}O_2(g)$ will have

$$= \frac{1}{\sqrt{K}} = \frac{1}{\sqrt{278}} = 6\times10^{-2}$$

78. The equilibrium constant for the reaction, $aA + bB \rightleftharpoons cC + dD$ is K, then the equilibrium constant for the reaction, $naA + nbB \rightleftharpoons ncC + ndD$

(a) K (b) K^n
(c) $\frac{1}{K^n}$ (d) $\frac{1}{K^{n-1}}$

UP CPMT-2012

Ans. (b) : $aA + bB \rightleftharpoons cC + dD$

$$\text{Equilibrium constant } K = \frac{[C]^c[D]^d}{[A]^a[B]^b}$$

$$naA + nbB \rightleftharpoons ncC + ndD$$

$$\text{Equilibrium constant, } K_1 = \frac{[C]^{nc}[D]^{nd}}{[A]^{na}[B]^{nb}}$$

$$= \left(\frac{[C]^c[D]^a}{[A]^a[B]^b}\right)^n = K^n$$

79. Phosphorus pentachloride dissociates as follows in a closed reaction vessel,

$$\mathbf{PCl_5(g) \rightleftharpoons PCl_3(g) + Cl_2(g)}$$

If total pressure at equilibrium of the reaction mixture is p and degree of dissociation of PCl_5 is x, the partial pressure of PCl_3 will be

(a) $\left(\frac{x}{x+1}\right)p$ (b) $\left(\frac{2x}{1-x}\right)p$
(c) $\left(\frac{x}{x-1}\right)p$ (d) $\left(\frac{x}{1-x}\right)p$

UP CPMT-2012

Ans. (a) :

$$\begin{array}{ccccc} PCl_5(g) & \rightleftharpoons & PCl_3(g) & + & Cl_2(g) \\ (1-x) & & x & & x \end{array}$$

Total number of moles at equilibrium

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$= (1–x) + x + x = 1 + x$

Therefore, $P_{PCl_3} = \left(\frac{x}{1+x}\right) \times p$

80. For the homogeneous reaction.

$$4NH_3 + 5O_2 \rightleftharpoons 4NO + 6H_2O$$

the equilibrium constant K_c has the units

(a) $conc.^{+10}$
(b) $conc.^{+1}$
(c) $conc.^{-1}$
(d) it is dimensionless

JIMPER-2012

Ans. (b) : The unit of the equilibrium constant K_c is $(mole/litre)^{\Delta n}$.

Where, Δn is the difference in the total number of gaseous reactants.

For the reaction–

$$4NH_3(g) + 5O_2(g) \rightleftharpoons 4NO(g) + 6H_2O(g)$$

$$\Delta n = 4 + 6 - (4 + 5) = 1$$

Hence, the unit of the equilibrium constant K_c will be $(mole/litre)^{\Delta n}$

$= (mole/litre)^1$

= conc.

81. The reaction, $SO_2 + Cl_2 \rightarrow SO_2Cl_2$ is exothermic and reversible. A mixture of $SO_2(g)$, $Cl_2(g)$ and $SO_2Cl_2(I)$ is at equilibrium in a closed container. Now a certain quantity of extra SO_2 is introduced into the container, the volume remaining the same. Which of the following is/are true?

(a) The pressure inside the container will not change
(b) The temperature will not change
(c) The temperature will increase
(d) The temperature will decrease

BITSAT-2012

Ans. (c) : $SO_2 + Cl_2 \rightleftharpoons SO_2Cl_2 + Heat$

For the above reaction, on adding SO_2 the equilibrium will shift in forward direction, i.e. more heat will be evolved. So temperature will increase.

82. For the reaction

$$N_2O_5 \longrightarrow 2NO_2 + \frac{1}{2}O_{2,}$$

$$\frac{-d[N_2O_5]}{dt} = k_1[N_2O_5]$$

$$\frac{d[NO_2]}{dt} = k_2[N_2O_5]$$

$$\frac{d[O_2]}{dt} = k_3[N_2O_5]$$

(a) $2k_1 = k_2 = 4k_3$
(b) $k_1 = k_2 = k_3$
(c) $2k_1 = 4k_2 = k_3$
(d) none of these

AMU-2011

Ans. (a) : The reaction is –

$$N_2O_5 \rightarrow 2NO_2 + \frac{1}{2}O_2 \qquad \text{... (i)}$$

$$\frac{-d[N_2O_5]}{dt} = k_1[N_2O_5] \qquad \text{... (ii)}$$

$$\frac{d[NO_2]}{dt} = k_2[N_2O_5] \qquad \text{...(iii)}$$

$$\frac{d[O_2]}{dt} = k_3[N_2O_5] \qquad \text{...(iv)}$$

From eq^n. (i), we get–

$$\frac{-d[N_2O_5]}{dt} = \frac{1}{2}\frac{d[NO_2]}{dt} = \frac{2d[O_2]}{dt}$$

From eq^n. (ii), (iii) and (iv), we get–

$$k_1[N_2O_5] = \frac{1}{2}k_2[N_2O_5] = 2k_3[N_2O_5] \qquad \text{.....(v)}$$

Multiplying by 2 in eq^n. (v), we get –

$2k_1[N_2O_5[= k_2 [N_2O_5] = 4k_3 [N_2O_5]$

Dividing by $[N_2O_5]$, we get–

$2k_1 = k_2 = 4k_3$

83. The equilibrium constants for the reactions

$$N_2 + 3H_2 \rightleftharpoons 2NH_3$$

and $\frac{1}{2}N_2 + \frac{3}{2}H_2 \rightleftharpoons NH_3$

are K_1 and K_2 respectively. Which one of the following is the correct relationship?

(a) $K_1 = 2K_2$
(b) $K_1 = \frac{1}{2}K_2$
(c) $K_2 = \sqrt{K_1}$
(d) $K_1 = K_2$

BCECE-2011

Ans. (c) : The reaction is –

$$N_2 + 3H_2 \rightleftharpoons 2NH_3$$

$$K_1 = \frac{[NH_3]^2}{[N_2][H_2]^3} \ldots\ldots\ldots\ldots\text{(i)}$$

$$\frac{1}{2}N_2 + \frac{3}{2}H_2 \rightleftharpoons NH_3$$

$$K_2 = \frac{[NH_3]}{[N_2]^{1/2}[H_2]^{3/2}}$$

Squaring on both sides –

$$K_2^2 = \frac{[NH_3]^2}{[N_2][H_2]^3} \qquad \text{... (ii)}$$

From (i) & (ii) we get

$$K_2^2 = K_1 \Rightarrow K_2 = \sqrt{K_1}$$

84. In the reaction,

$$N_2(g) + O_2(g) \rightleftharpoons 2NO(g) + 180.7\,kJ,$$

on increasing the temperature, the production of NO

(a) increases
(b) decreases
(c) remains same
(d) Cannot be predicted

BCECE-2011

Ans. (a) : The reaction is –

$$N_2(g) + O_2(g) \rightleftharpoons 2NO(g)\ 180.7kJ$$

Here, $\Delta H = 180.7$ kJ

ΔH is positive so the given reaction is endothermic reaction. And the case of endothermic reaction if we increase the temperature means we provided the heat to the system then equilibrium shift forward direction. So, the production of NO will be increase.

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85. Final pressure is higher than initial pressure of a container filled with an ideal gas at constant temperature. What will be the value of equilibrium constant?

(a) K = 1.0 (b) K = 10.0

(c) K > 1.0 (d) K < 1.0

GUJCET-2011

Ans. (d): Number of gaseous moles increases as pressure increase at equilibrium for the reaction.

$$P(g) \rightleftharpoons Q(g) + R(g)$$

$$1(1-\alpha) \qquad 0\alpha \qquad 0\alpha$$

$$\therefore\ K_p = \frac{\alpha^2 \times p_{eq}}{1-\alpha^2} = \frac{1 \times p_{eq}}{1/\alpha^2 - 1}$$

For $\alpha < 1$, $P_{eq} < 1$ [$\because P_{initial} < P_{final}$]

$K_p < 1.0$

Hence the option (d) is correct.

86. In the reversible reaction.

$$2NO_2 \underset{k_2}{\overset{k_1}{\rightleftharpoons}} N_2O_4$$

the rate of disappearance of NO_2 is equal to

(a) $\frac{2k_1}{k_2}[NO_2]^2$

(b) $2k_1[NO_2]^2 - 2k_2[N_2O_4]$

(c) $2k_1[NO_2]^2 - k_2[N_2O_4]$

(d) $(2k_1 - k_2)[NO_2]$

VITEEE- 2011

Ans. (c) : In the reversible reaction

$$2NO_2 \underset{k_2}{\overset{k_1}{\rightleftharpoons}} N_2O_4$$

The concentration of NO_2 is decrease in the forward reaction and increase in backward reaction.

The rate of disappearance of NO_2 in the forward reaction is $-\frac{1}{2}\frac{d[NO_2]}{dt} = k_1[NO_2]^2$

$$-\frac{d[NO_2]}{dt} = 2k_1[NO_2]^2$$

Rate of formation of NO_2 in the reversible reaction is $\frac{d[NO_2]}{dt} = k_2[N_2O_4]$

$\therefore$ rate of disappearance of

$$NO_2 = 2k_1[NO_2]^2 - k_2[N_2O_4]$$

87. The unit of equilibrium constant for the following reaction is

$$2NO_2(g) \rightleftharpoons N_2O_4(g)$$

(a) mol L^{-1}

(b) L mol^{-1}

(c) $mol^{-1}L^{-1}$

(d) equilibrium constant is unitless

UPTU/UPSEE-2011

Ans. (b) : $2NO_2(g) \rightleftharpoons N_2O_4(g)$

$$K_c = \frac{[N_2O_4]}{[NO_2]^2} = \frac{mol\,L^{-1}}{(mol\,L^{-1})^2} = L\,mol^{-1}$$

88. If the equilibrium constant for reaction (i) is 2, what is the equilibrium constant for reaction (ii)?

$$CO_2 \rightleftharpoons CO + \frac{1}{2}O_2 \text{ ---------(i)}$$

$$2CO + O_2 \rightleftharpoons 2CO_2 \text{ ---------(ii)}$$

(a) $\frac{1}{4}$ (b) $\frac{1}{2}$

(c) 1 (d) 2

UPTU/UPSEE-2011

Ans. (a) : $CO_2 \rightleftharpoons CO + \frac{1}{2}O_2$

The equilibrium constant for the reaction–

$$K_c = \frac{[CO][O_2]^{1/2}}{[CO_2]}$$

$$CO_2 \rightleftharpoons CO + \frac{1}{2}O_2$$

The equilibrium constant for the reaction–

$$K_c = \frac{[CO_2]^2}{[CO]^2[O_2]} = \left(\frac{1}{K_c}\right)^2 = \frac{1}{2^2} = \frac{1}{4}$$

89. One mole of pure ethyl alcohol is mixed with one mole of acetic acid at room temperature and it is found that at equilibrium two-third mole of ester and two-third mole of water are present in the reaction mixture. What is the equilibrium constant for the reaction?

(a) 1 (b) 2

(c) 4 (d) 6

SCRA-2010

Ans. (c) $C_2H_5OH(l) + CH_3COOH(l) \rightleftharpoons CH_3COOC_2H_5(l) + H_2O$

Initially	1	1	0	0
At equil.	1 – 2/3	1 – 2/3	2/3	2/3

$$\therefore\quad K_{eq} = \frac{[CH_3COOC_2H_5][H_2O]}{[C_2H_5OH][CH_3COOH]}$$

$$K_{eq} = \frac{2/3 \times 2/3}{1/3 \times 1/3} = 4$$

90. In the reaction of a A + 2B → C + 2D, the initial rate, $-\frac{d[A]}{dt}$ at t=0 was found to be $2.6 \times 10^{-2}\,Ms^{-1}$. What is the value of $-\frac{d[B]}{dt}$ at $t = 0$ in Ms^{-1}?

(a) 2.6×10^{-2} (b) 5.2×10^{-2}

(c) 1.0×10^{-1} (d) 6.5×10^{-3}

CG PET- 2010

Ans. (b) : $A + 2B \rightarrow C + 2D$

$$-\frac{d[A]}{dt} = -\frac{1}{2}\frac{d[B]}{dt}$$

or $$-\frac{d[B]}{dt} = 2 \times -\frac{d[A]}{dt}$$

$$= 2 \times 2.6 \times 10^{-2}\,Ms^{-1}$$

$$= 5.2 \times 10^{-2}\,Ms^{-1}$$

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91. For the reversible reaction.

$$A(s)+B(g) \rightleftharpoons C(g)+D(g);\ \Delta G^{\circ}=-350\text{kJ}$$

Which one of the following statements is true?

(a) The entropy change is negative
(b) Equilibrium constant is greater than one
(c) The reaction should be instantaneous
(d) The reaction is thermodynamically not feasible

Karnataka-CET, 2010

Ans. (b) : In the reversible reaction,

$$A(s)+B(g) \rightleftharpoons C(g)+D(g);\qquad \Delta G^{\circ}=-350\text{kJ}$$

Since, the randomness increases (because solid is changing into gas), entropy will increase and thus, ΔS is positive. Reversible reaction never undergo to completion (i.e. never be instantaneous)

$\because$ For the given reaction, $\Delta G^{\circ}=-350\text{kJ}$

We know that, $\Delta G^{\circ}=-RT\log K$

$-350=-RT\log K$

i.e., K (equilibrium constant) is greater than one. Moreover, the reaction is thermodynamically feasible.

92. Consider the following reactions in which all the reactants and the products are in gaseous state.

$$\mathbf{2PQ \rightleftharpoons P_2+Q_2; K_1=2.5\times10^5}$$

$$\mathbf{PQ+\frac{1}{2}R_2 \rightleftharpoons PQR;\ K_2=5\times10^{-3}}$$

The value of K_3 for the equilibrium

$$\mathbf{\frac{1}{2}P_2+\frac{1}{2}Q_2+\frac{1}{2}R_2 \rightleftharpoons PQR, is}$$

(a) 2.5×10^{-3}
(b) 2.5×10^{3}
(c) 1.0×10^{-5}
(d) 5×10^{-3}
(e) 5×10^{-3}

Kerala-CEE-2010

Ans. (c) : Given the reaction are:

$2PQ \rightleftharpoons P_2+Q_2;\ K_1=2.5\times10^5$ ....(i)

$PQ+\frac{1}{2}R_2 \rightleftharpoons PQR : K_2=5\times10^{-3}$.......(ii)

Reverse first reaction:

$P_2+Q_2 \rightleftharpoons 2PQ$

$K_3=\frac{1}{K_1}=\frac{1}{2.5\times10^5}=0.000004$ ....(iii)

Divide above reaction with 2

$\frac{1}{2}P_2+\frac{1}{2}Q_2 \rightleftharpoons PQ$

$K_4=\sqrt{K_3}=\sqrt{0.000004}=0.002$ ....(iv)

Add reaction (ii) & (iv)

$\frac{1}{2}P_2+\frac{1}{2}Q_2+\frac{1}{2}R_2 \rightleftharpoons PQR$ ....(v)

$K_5=0.002\times5\times10^{-3}=1.0\times10^{-5}$

93. For a reversible chemical reaction where the forward process is exothermic. Which of the following statements is correct?

(a) The backward reaction has higher activation energy than the forward reaction
(b) The backward and the forward processes have the same activation energy
(c) The backward reaction has lower activation energy
(d) No activation energy is required at all since energy is liberated in the process.

WB-JEE-2010

Ans. (a) : If forward reaction is exothermic it means that higher energy is released during forward reaction which implies than it is easy to bring reaction forward. So, forward reaction has lower activation energy than backward reaction.

94. $\mathbf{A+B \rightleftharpoons C+B}$

Initially moles of A and B are equal. At equilibrium, moles of C are three times that of A. The equilibrium constant of the reaction will be

(a) 1
(b) 3
(c) 4
(d) 9

CG PET -2009

Ans. (d) : Given the reaction–

$$\begin{array}{llllllll} & A & + & B & \rightleftharpoons & C & + & D \\ \text{at } t=0 & 1 & & 1 & & 0 & & 0 \\ t=\text{eq}^{n}. & (1-\alpha) & & (1-\alpha) & & \alpha & & \alpha \end{array}$$

Now, $[C]=3[A]$

$\alpha=3(1-\alpha)$

$\alpha=\frac{3}{4}$

Hence, the equilibrium constant–

$$\therefore\quad K_c=\frac{\alpha^2}{(1-\alpha)^2}$$

$$=\frac{\left(\frac{3}{4}\right)^2}{\left(\frac{1}{4}\right)^2}$$

$=K_c=9$

95. If for $\mathbf{N_2+3H_2 \rightleftharpoons 2NH_3, K_{eq}=1.6\times10^{-5}}$, then the value of $\mathbf{K'_{eq}}$ for the reaction

$$\mathbf{NH_3 \rightleftharpoons \frac{1}{2}N_2+\frac{3}{2}H_2 \text{ will be}}$$

(a) 6.25
(b) 25
(c) 250
(d) 500

CG PET -2009

Ans. (c) : For reaction –

$N_2+3H_2 \rightleftharpoons 2NH_3$

$K_{eq}=\frac{[NH_3]^2}{[N_2][H_2]^3}=1.6\times10^{-5}$ ....(i)

And

$NH_3 \rightleftharpoons \frac{1}{2}N_2+\frac{3}{2}H_2$

$K'_{eq}=\frac{[N_2]^{\frac{1}{2}}[H_2]^{\frac{3}{2}}}{[NH_3]}$ ....(ii)

Squaring on both sides

@apna_pdf

$$(K'_{eq}) = \left[\frac{[N_2]^{1/2}[H_2]^{3/2}}{[NH_3]}\right]^2$$

$$(K'_{eq})^2 = \frac{[N_2][H_2]^3}{[NH_3]^2}$$

On multiply equation (i) and (ii)

$$\left[K_{eq} \times (K'_{eq})^2\right] = \frac{[NH_3]^2}{[N_2][H_2]^3} \times \frac{[N_2][H_2]^3}{[NH_3]^2}$$

$$K_{eq} \times (K'_{eq})^2 = 1$$

$$(K'_{eq})^2 = \frac{1}{K_{eq}}$$

$$(K'_{eq})^2 = \frac{1}{1.6\times10^{-5}}$$

$$K'_{eq} = \sqrt{\frac{1}{1.6\times10^{-5}}}$$

$$K'_{eq} = \sqrt{\frac{10^5\times10}{1.6\times10}}$$

$$K'_{eq} = \sqrt{\frac{10^6}{16}}$$

$$K'_{eq} = \frac{10^3}{4}$$

$$K'_{eq} = \frac{1000}{4}$$

$$K'_{eq} = 250$$

96. In a reversible reaction, at equilibrium, the net heat change of the reaction is

(a) positive (b) negative
(c) zero (d) cannot be predicted

AP-EAMCET(MEDICAL)-2009

Ans. (c) : In a reversible reaction, at equilibrium, the free energy will be zero. Thus, the net heat change will be also zero.

97. The equilibrium constant for the given reaction is 100.

$$\mathbf{N_2(g) + 2O_2(g) \rightleftharpoons 2NO_2(g)}$$

What is the equilibrium constant for the reaction given below?

$$\mathbf{NO_2(g) \rightleftharpoons \frac{1}{2}N_2(g) + O_2(g)}$$

(a) 10 (b) 1
(c) 0.1 (d) 0.01

VITEEE-2009

Ans. (c) : The equilibrium reaction is–

$$N_2(g) + 2O_2(g) \rightleftharpoons 2NO_2(g)$$

$$\therefore \quad K_1 = \frac{[NO_2]^2}{[N_2][O_2]^2}$$

$$\text{or} \quad 100 = \frac{[NO_2]^2}{[N_2][O_2]^2} \qquad \ldots.(i)$$

And, $NO_2(g) \rightleftharpoons \frac{1}{2}N_2(g) + O_2(g)$

$$\therefore \quad K_2 = \frac{[N_2]^{1/2}[O_2]}{[NO_2]}$$

$$\text{or } K_2^2 = \frac{[N_2][O_2]^2}{[NO_2]^2} \qquad \ldots.(ii)$$

Multiplying equations (i) and (ii), we get–

$$100 \times K_2^2 = 1$$

$$\Rightarrow K_2^2 = \frac{1}{100} \text{ or } K_2 = \frac{1}{10} = 0.1$$

98. What is the equation for the equilibrium constant (K_c) for the following reaction?

$$\mathbf{\frac{1}{2}A(g) + \frac{1}{3}B(g) \underset{}{\overset{T(K)}{\rightleftharpoons}} \frac{2}{3}C(g)}$$

(a) $K_c = \frac{[A]^{1/2}[B]^{1/3}}{[C]^{3/2}}$ (b) $K_c = \frac{[C]^{3/2}}{[A]^2[B]^3}$

(c) $K_c = \frac{[C]^{2/3}}{[A]^{1/2}[B]^{1/3}}$ (d) $K_c = \frac{[C]^{2/3}}{[A]^{1/2}+[B]^{1/3}}$

JIMPER-2009

Ans. (c) : Equilibrium constant is $\frac{[\text{Product}]}{[\text{Reactants}]}$

For the reaction

$$\frac{1}{2}A + \frac{1}{3}B \rightleftharpoons \frac{2}{3}C$$

Equilibrium constant will be = $\frac{[C]^{2/3}}{[A]^{1/2}[B]^{1/3}}$

99. The equilibrium for the reaction is 100.

$$\mathbf{N_2(g) + 2O_2(g) \rightleftharpoons 2NO_2(g)}$$

What is the equilibrium constant for the reaction given below?

$$NO_2(g) \rightleftharpoons \frac{1}{2}N_2(g) + O_2(g)$$

(a) 10 (b) 1
(c) 0.1 (d) 0.01

AP EAMCET (Engg.)-2009

Ans. (c): Given reaction is -

$$N_2(g) + 2O_2(g) \rightleftharpoons 2NO_2(g)$$

$$\therefore \quad K_1 = 100 = \frac{[NO_2]^2}{[N_2][O_2]^2} \qquad \ldots..(i)$$

and, $NO_2(g) \rightleftharpoons \frac{1}{2}N_2(g) + O_2(g)$

$$K_2 = \frac{[N_2]^{1/2}[O_2]}{[NO_2]}$$

$$K_2^2 = \frac{[N_2][O_2]^2}{[NO_2]^2} \qquad \ldots.. (ii)$$

On multiplying Eqs. (i) and (ii), we get –

$$100 \times K_2^2 = 1$$

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$$K_2^2 = \frac{1}{100}$$

$$K_2 = \sqrt{\frac{1}{100}}$$

$$K_2 = \frac{1}{10}$$

$K_2 = 0.1$

100. $2HI(g) \rightleftharpoons H_2(g) + I_2(g)$

The equilibrium constant of the above reaction is 6.4 at 300 K. If 0.25 mole each of H_2 and I_2 are added to the system, the equilibrium constant will be

(a) 6.4 (b) 0.8
(c) 3.2 (d) 1.6

Karnataka-CET, 2009

Ans. (a) :

$$\underset{\substack{t=0\\ t=t_{eq}\ 2x}}{2HI(g)} = \underset{\substack{0.25\\ (0.25-x)}}{H_2(g)} + \underset{\substack{0.25\\ (0.25-x)}}{I_2(g)} \qquad K_{eq} = \frac{[H_2][I_2]}{[HI]} = 6.4$$

$$K_{eq} = 6.4 = \frac{(0.25-x)(0.25-x)}{(2x)^2}$$

$$\Rightarrow \quad 6.4 = \frac{(0.25-x)^2}{(2x)^2} = \left(\frac{0.25-x}{2x}\right)^2$$

$$\Rightarrow \quad \frac{0.25-x}{2x} = 2.53 \qquad [\sqrt{6.4} = 2.53]$$

$$\Rightarrow \quad 0.25 - x = 5.06x$$

$0.25 = 5.06x + x$

$0.25 = 6.06x$

$$x = \frac{0.25}{6.06} = 0.041$$

$[H_2] = [I_2] = 0.25 - x$

$[H_2] = [I_2] = 0.25 - 0.041$

$[H_2] = [I_2] = 0.209$ mol

$HI = 2x$

$[HI] = 2 \times 0.041 = 0.081$ mol

And, equilibrium constant will be same, as temperature is not changing $K_{eq} = 6.4$.

101. The dissociation constant for acetic acid and HCN at 25ºC are 1.5×10^{-5} and 4.5×10^{-10} respectively. The equilibrium constant for the equilibrium,

$CN^- + CH_3COOH \rightleftharpoons HCN + CH_3COO^-$

would be

(a) 3.0×10^{-3} (b) 3.0×10^{-4}
(c) 3.0×10^{4} (d) 3.0×10^{5}

NEET-2009

Ans. (c) : $CN^- + CH_3COOH = HCN + CH_3COO^-$

$K_1 = 1.5 \times 10^{-5}$ .....(i)

$HCN = H^+ + CN^-$

$K_2 = 4.5 \times 10^{-10}$ .....(ii)

$CN^- + CH_3COOH = HCN + CH_3COO^-$

K = ?

On subtracting equation (ii) from eq. (i) we get:

$$K = \frac{K_1}{K_2} = \frac{1.5 \times 10^{-5}}{4.5 \times 10^{-10}} = \frac{15}{45} \times 10^{-5}$$

$$K = \frac{1}{3} \times 10^5$$

$K = 0.3 \times 10^5$

$K = 3.0 \times 10^4$

102. For the reaction

$2HI(g) \rightleftharpoons H_2(g) + I_2(g) - Q$ kJ,

the equilibrium constant depends upon

(a) temperature (b) pressure
(c) catalyst (d) volume

Karnataka-CET, 2008

Ans. (a) : $2HI(g) \rightleftharpoons H_2(g) + I_2(g) - Q\,kJ$

$$\Delta n_g = n_p - n_R = 2 - 2 = 0$$

As the number of moles of products and reactant are equal, so equilibrium constant is not affected by any change in pressure and volume. Catalyst also does not affect the equilibrium constant. It is an endothermic reaction, hence equilibrium constant depends only upon the temperature.

103. On doubling p and V with constant temperature, the equilibrium constant will–

(a) remain constant (b) become double
(c) become one-fourth (d) None of the above

BCECE-2008

Ans. (a) : On doubling P and volume (V) with constant temperature, the equilibrium constant (K) will remain constant.

104. In which of the following reactions, the concentration of the product is higher than the concentration of the reactant at equilibrium ? (K = equilibrium constant)

(a) $A \rightleftharpoons B; K = 0.001$ (b) $M \rightleftharpoons N; K = 10$
(c) $X \rightleftharpoons Y; K = 0.005$ (d) $R \rightleftharpoons P; K = 0.01$

AIIMS-2008

Ans. (b): We know that,

$$K = \frac{[Product]}{[Reactant]}$$

Hence, [Product] = K [Reactant]

∴ [Product] > Reactant, when K > 1

Hence, option b is the only correct answer as K = 10 > 1

105. Consider the reaction .

$CO(g) + H_2O(g) \rightleftharpoons CO_2(g) + H_2(g)$

the equilibrium amount of $CO_2(g)$ can be increased at a given temperature by

(a) adding a suitable catalyst
(b) decreasing the volume of the container
(c) adding an inert gas
(d) increasing the amount of CO(g).

AMU-2008

Ans. (d) : If an additional amount of any reactant is added the rate of forward reaction increases. In general, in a chemical equilibrium, increasing the concentration of the reactants results in shifting the equilibrium in favour of products.

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106. The rate law for a reaction between the substances A and B is given by rate = K$[A]^n[B]^m$. On doubling the concentration of A and having the concentration of B, the ratio of the new rate to the earlier rate of the reaction will be as

(a) $\frac{1}{2^{m+n}}$ (b) (m+n)

(c) (n-m) (d) $2^{(n-m)}$

JCECE - 2008

Ans. (d) : rate = K $[A]^n$ $[B]^m$

On doubling the concentration of A and making the volume of B half, the new rate becomes

$2^n \times \left(\frac{1}{2}\right)^m = 2^{n-m}$ times the earlier rate.

So, ration is 2^{n-m}

107. A 20 litre container at 400 K contains $CO_2(g)$ at pressure 0.4 atm and an excess of SrO (neglect the volume of solid SrO). The volume of the container is now deceased by moving the movable piston fitted in the container. The maximum volume of the container, when pressure of CO_2 attains its maximum value, will be

(Given that : $SrCO_3(s) \rightleftharpoons SrO(s) + CO_2(g)$ K_p = 1.6 atm)

(a) 10 Litre (b) 4 Litre

(c) 2 Litre (d) 5 Litre

(NEET-2007

Ans. (d) : Given that,

$$SrCO_3(s) \rightleftharpoons SrO(s) + CO_2(g)$$

Kp = 1.6 atm.

The initial pressure Pco_2 = 0.4 atm

The final pressure $P'co_2$ = Kp = 1.6 atm

The initial volume v = 20L

The final volume $V' = \frac{PV}{P'}$

$$= \frac{0.4 \text{ atm} \times 20L}{1.6 \text{ atm}}$$

= 5L

Hence, the maximum volume the container when the pressure of CO_2 attains its max. volume will be 5 liters.

108. The equilibrium constant of the following reaction aA + bB $\rightleftharpoons$ cC + dD is K

the equilibrium constant of the reaction, ncC + ndD $\rightleftharpoons$ naA + nbB, will be

(a) K^n (b) $\frac{n}{K}$

(c) n.K (d) $\frac{1}{K^n}$

AMU-2007

Ans. (d) : For reaction–

aA + bB $\rightleftharpoons$ cC + dD

$$K = \frac{[C]^c[D]^d}{[A]^a[B]^b} \quad .....(i)$$

And, ncC + ndD $\rightleftharpoons$ naA + nbB

$$K' = \frac{[A]^{na}[B]^{nb}}{[C]^{nc}[D]^{nd}}$$

$$\frac{1}{K'} = \frac{[C]^{nc}[D]^{nd}}{[A]^{na}[B]^{nb}}$$

$$\frac{1}{K'} = \left[\frac{[C]^c[D]^d}{[A]^a[B]^b}\right]^n \quad .....(ii)$$

On putting value of K in equation (ii)–

$$\frac{1}{K'} = K^n$$

$$K' = \frac{1}{K^n}$$

109. The equilibrium constant for the reaction,

$$SO_2(g) + \frac{1}{2}O_2(g) \rightleftharpoons SO_3(g)$$

is 5 × 10^{-2} atm. The equilibrium constant of the reaction, $2SO_3(g) \rightleftharpoons 2SO_2(g) + O_2(g)$

(a) 100 atm (b) 200 atm

(c) 4 × 10^2 atm (d) 6.25 × 10^4 atm

AP-EAMCET-2007

Ans. (c) : Given that, $K_1 = 5 \times 10^{-2}$ atm.

For the reaction–

$$SO_2(g) + \frac{1}{2}O_2(g) \overset{K_1}{\rightleftharpoons} SO_3(g)$$

$$\therefore \quad K_1 = \frac{[SO_3]}{[SO_2][O_2]^{1/2}} \quad .....(i)$$

And, $2SO_3(g) \overset{K_2}{\rightleftharpoons} 2SO_2(g) + O_2(g)$

$$K_2 = \frac{[SO_2]^2[O_2]}{[SO_3]^2} \quad .....(ii)$$

From equation (i) and (ii), we get

$$K_2 = \frac{1}{K_1^2} \quad .....(iii)$$

Putting the value of K_1 in equation (iii) we get,

$$K_2 = \frac{1}{(5 \times 10^{-2})^2} = \frac{1}{25 \times 10^{-4}}$$

$$K_2 = \frac{10000}{25} = 4 \times 10^2 \text{ atm}$$

110. Which of the following reactions is an example of reversible reaction?

(a) $Pb(NO_3)_2(aq) + 2NaI(aq) \rightarrow PbI_2(s) + 2NaNO_3(aq)$

(b) $2Na(s) + 2H_2O(l) \rightarrow 2NaOH(aq) + H_2(g)$

(c) $AgNO_3(aq) + HCl(aq) \rightarrow AgCl(s) + HNO_3(aq)$

(d) $KNO_3(aq) + NaCl(aq) \rightarrow KCl(aq) + NaNO_3(aq)$

SRMJEEE – 2007

Ans. (d) : A reaction in which reactant and product in equilibrium with each other is known as reversible reaction.

$$KNO_3(aq) + NaCl(aq) \longrightarrow KCl(aq) + NaNO_3(aq)$$

All are in aqueous state that's why follow the properties of reversible reaction.

@apna_pdf

111. At T(K), 100 L of dry oxygen is present in a sealed container. It is subjected to silent electrical discharge, till the volumes of oxygen and ozone become equal. What is the volume (in L) of ozone formed at T (K)?

(a) 50 (b) 60
(c) 30 (d) 40

AP-EAMCET-2006

Ans. (d) : Initially when T = 0

$$\underset{3x}{3O_2} \rightleftharpoons \underset{2x}{2O_3}$$

At T K, total volume of O_2 and O_3 is 100L hence after time T when the reaction is completed total volume of oxygen and ozone will be–

$$3x + 2x = 100$$

$$x = \frac{100}{5} = 20 \text{ mL}$$

$\therefore$ Volume of ozone formed = 2x = 2 × 20 = 40 mL

112. Equation $\log\frac{K_2}{K_1} = \frac{\Delta H}{2.303R}\left(\frac{T_2 - T_1}{T_1T_2}\right)$, n is

(a) Van der Waals' equation
(b) Kirchoff's equation
(c) Gas equation
(d) Van't Hoff equation

CG PET -2006

Ans. (b) : $\log\frac{K_2}{K_1} = \frac{\Delta H}{2.303R}\left(\frac{T_2 - T_1}{T_1T_2}\right)$

The above equation is Van't Hoff equation.

113. $A(g) + 3B(g) \rightleftharpoons 4C(g)$.

Initially concentration of A is equal to that of B. The equilibrium concentration of A and C are equal. K_c is :

(a) 0.08 (b) 0.8
(c) 8 (d) 80
(e) $\frac{1}{8}$

Kerala-CEE-2005

Ans. (c) : The reaction is:

$$A(g) + 3B(g) \rightleftharpoons 4C(g)$$

t = 0 1 1 0
teq. 1–x 1–3x 4x

According to question–

$$1 - x = 4x$$
$$1 = 4x + x$$
$$1 = 5x$$
$$x = \frac{1}{5}$$

For above reaction–

$$K_c = \frac{[C]^4}{[A][B]^3}$$

$$K_c = \frac{(4x)^4}{(1-x)(1-3x)^3}$$

$$K_c = \frac{\left(\frac{4}{5}\right)^4}{\left(\frac{4}{5}\right)\left(1-\frac{3}{5}\right)^3}$$

$$K_c = \frac{\left(\frac{4}{5}\right)^4}{\left(\frac{4}{5}\right)\left(\frac{2}{5}\right)^3}$$

$K_c = 8$

114. In Haber process, 30 litre of dihydrogen and 30 liters of dinitrogen were taken for reactions which yielded only 50% of the expected product. What will be the composition of gaseous mixture under the above said condition in the end ?

(a) 20 litre ammonia, 20 litre nitrogen, 15 litre hydrogen
(b) 10 litre ammonia, 25 litre nitrogen, 15 litre hydrogen
(c) 20 litre ammonia, 10 litre nitrogen, 30 litre hydrogen
(d) 20 litre ammonia, 25 litre nitrogen, 15 litre hydrogen

NEET-2005

$$N_2 + 3H_2 \Leftrightarrow 2NH_3$$

Ans. (b) : 30 30 0
30-x 30-3x 2x

But, 2x = 50%, of the expected (20Lt) product = 10 lit

x = 5

$\therefore$ Vol. of N_2 at eq. = 30-5 = 25 lit
Vol. of H_2 at eq. = 30-3×5=15 lit
Vol. of NH_3 at eq. = 2×5 = 10 lit

115. The equilibrium $P_4(g) + 6Cl_2(g) \rightleftharpoons 4PCl_3(g)$ is attained by mixing equal moles of P_4 and Cl_2 in an evacuated vessel. Then, at equilibrium

(a) $[Cl_2] > [PCl_3]$ (b) $[Cl_2] > [P_4]$
(c) $[P_4] > [Cl_2]$ (d) $[Cl_3] > [P_4]$

J & K CET-(2004)

Ans. (c) : The reaction is –

$$P_4(g) + 6Cl_2(g) \rightleftharpoons 4PCl_3(g)$$

t = 0 1 1 0
$t = t_{equi.}$ 1 − α 1 − 6α 4α

It attained by mixing equal moles (take 1 moles of each) of P_4 and Cl_2 in an evacuated vessel.

Then at equilibrium,

$$[P_4] = \frac{1-\alpha}{V} \text{ and } [Cl_2] = \frac{1-6\alpha}{V}$$

$\therefore$ $[P_4] > [Cl_2]$

From the reaction stoichiometry, we observe that 1 mole of P_4 will react with 6 moles of Cl_2. So more number of moles of Cl_2 are consumed than those of P_4 to reach equilibrium.

116. In which of the following reactions, the concentration of product at equilibrium : (K = equilibrium constant)

(a) $A \rightleftharpoons B;\ K = 0.01$ (b) $R \rightleftharpoons P;\ K = 1$
(c) $X \rightleftharpoons Y;\ K = 10$ (d) $L \rightleftharpoons J;\ K = 0.025$

AP-EAMCET (Engg.)-2004

@apna_pdf

Ans. (b) : In the reversible reaction, the concentration of reactant will be equal to concentration of product only when the value of rate constant is unity. For the reaction –

$$R \rightleftharpoons P$$

$$\therefore \quad K = \frac{[P]}{[R]}$$

Given, $K = 1$

$$\therefore \quad [P] = [R]$$

117. The term- (dc/dt) in a rate equation refers to the

(a) concentration of the reactant
(b) decreases in concentration of the reactant with time
(c) increase in concentration of the reactant with time
(d) velocity constant of the reaction

CG PET -2004

Ans. (b) : The term $-\left(\frac{dc}{dt}\right)$ in rate expression indicates the decrease in concentration of the reactant with time. It is negative sign with is used to show the decrease in concentration of the reactant.

118. If the rate expression for a chemical reaction is given by rate = $k[A]^m[B]^n$

(a) the order of the reaction is m
(b) the order of the reaction is n
(c) the order of the reaction is m + n
(d) the order of the reaction is m – n

CG PET -2004

Ans. (c) : Order is the sum of power of the concentration of the reactants present in rate law expression.

$$\text{Rate} = k[A]^n.[B]^m$$

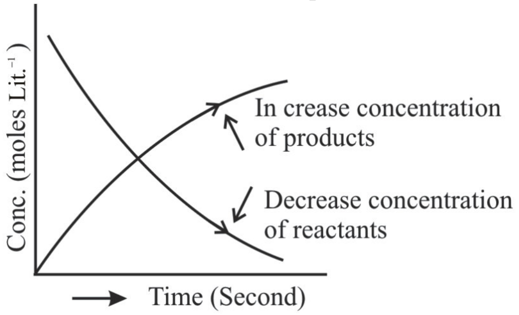
Hence, the order of reaction is = n + m or m + n

119. The rate of a chemical reaction :

(a) increase as the reaction proceeds
(b) decrease as the reaction proceeds
(c) may increase or decrease during reaction
(d) remain constant as the reaction

BCECE-2003

Ans. (b) : The rate of chemical reaction is directly proportional to the concentration of the reactants i.e. rate of reaction decreases with decrease of concentration and increases with increase in concentration. As the reaction progresses the reactant is converted into the product and thus the concentration of reactants decreases while that of product increases.



120. Consider the following reaction equilibrium?
$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$

Initially, 1 mole of N_2 and 3 moles of H_2 are taken in a 2 L flask. At equilibrium state, if the number of moles of N_2 is 0.6, what is the total number of moles of all gases present in the flask?

(a) 0.8 (b) 1.6
(c) 3.2 (d) 6.4

AP-EAMCET-2003

Ans. (c) : For the equilibrium reaction–

	$N_2(g)$	$+ 3H_2(g)$	$\rightleftharpoons 2NH_3(g)$
Initial mole	1	3	0
At equilibrium	0.6 = (1–x)	(3–3x)	2x

$\therefore$ Number of moles of $N_2 \Rightarrow (1 - x) = 0.6$

$$1 - x = 0.6$$
$$x = 1 - 0.6 = 0.4$$

$\therefore$ Total number of moles at equilibrium–

$$= (1 - x) + (3 - 3x) + 2x$$
$$= 4 - 2x$$
$$= 4 - 2 \times 0.4$$
$$= 3.2 \text{ moles}$$

121. In the reaction

$PCl_5(g) \rightleftharpoons PCl_3(g) + Cl_2(g)$,

The equilibrium concentrations of PCl_5 and PCl_3 are 0.4 and 0.2 mol/L respectively. If the value of K_c is 0.5, what is the concentration of Cl_2 in mol/L?

(a) 2.0 (b) 1.5
(c) 1.0 (d) 0.5

AP-EAMCET (Medical), 2003

Ans. (c) : Given that,

$[PCl_5] = 0.4\text{mol/L}, [PCl_3] = 0.2 \text{ mol/L}$
$K_c = 0.5, [Cl_2] = ?$

Give the reaction–

$$PCl_5(g) \rightleftharpoons PCl_3(g) + Cl_2(g)$$

Now, $K_c = \frac{[PCl_3][Cl_2]}{[PCl_5]}$

or $[Cl_2] = \frac{K_c[PCl_5]}{[PCl_3]}$

or $[Cl_2] = \frac{0.5 \times 0.4}{0.2}$

or $[Cl_2] = 1.0 \text{ mol/L}$

122. One mole of A(g) is heated to 300°C in a closed one liter vessel till the following equilibrium is reached : $A(g) \rightleftharpoons B(g)$

The equilibrium constant of this reaction at 300°C is 4. What is the concentration of B (in mol L^{-1}) at equilibrium?

(a) 0.2 (b) 0.6
(c) 0.8 (d) 0.1

AP-EAMCET (Medical), 2002

Ans. (c) : Given that, $K_c = 4$

For the given reaction–

$$A(g) \rightleftharpoons B(g)$$

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Initial conc. 1 0

At equi. $(1 - x)$ x

$$\therefore \quad K_c = \frac{[B]}{[A]}$$

or $$4 = \frac{x}{1 - x}$$

or $$4 - 4x = x$$

or $$x = \frac{4}{5}$$

or $$x = 0.8$$

123. $A + 2B \rightleftharpoons 2C + D$, initial concentration of B was 1.5 times that of A, but the equilibrium concentration of A and B are found to be equal. The equilibrium constant for the reaction is :

(a) 4 (b) 8

(c) 12 (d) 16

IIT-JEE-2000

Ans. (a): $A + 2B \rightleftharpoons 2C + D$

	A	2B	2C	D
Initial	1	1.5	0	0
Equi.	1– x	1.5 – 2x	2x	x

At equilibrium [A] = [B]

$$1 - x = 1.5 - 2x$$

$$x = 0.5$$

$$\therefore \quad K_c = \frac{[C]^2[D]}{[A][B]^2}$$

$$K_c = \frac{(2x)^2(x)}{(1-x)(1.5-2x)^2}$$

$$K_c = \frac{1 \times 1 \times 0.5}{0.5 \times 0.5 \times 0.5}$$

$$K_c = 4$$

124. One mole of CH_3COOH and one mole of C_2H_5OH reacts to produce $\frac{2}{3}$ mole of $CH_3COOC_2H_5$. The equilibrium constant is:

(a) 2 (b) +2

(c) –4 (d) +4

JEE-Main-2013

Ans. (d):

$$CH_3COOH + C_2H_5OH \rightarrow CH_3COOC_2H_5 + H_2O$$

	CH_3COOH	C_2H_5OH	$CH_3COOC_2H_5$	H_2O
At t=0	1	1	0	0
At equi.	$1-\frac{2}{3}$	$1-\frac{2}{3}$	$\frac{2}{3}$	$\frac{2}{3}$

Let, the volume = V L

$$\therefore \quad [CH_3COOH] = \frac{1}{3} V \text{ mol/L}$$

$$[C_2H_5OH] = \frac{1}{3} V \text{ mol/L}$$

$$[CH_3COOC_2H_5] = \frac{2}{3} V \text{ mol/L}$$

$$[H_2O] = \frac{2}{3} V \text{ mol/L}$$

$$K = \frac{[CH_3COOC_2H_5][H_2O]}{[CH_3COOH][C_2H_5OH]}$$

$$\therefore \quad K = \frac{\frac{2}{3}V \times \frac{2}{3}V}{\frac{1}{3}V \times \frac{1}{3}V} = 4$$

125. If K_1 and K_2 are the equilibrium constants of the equilibriums A and B respectively, what is the relationship between the two constants?

(1) $SO_2(g) + \frac{1}{2}O_2(g) \rightleftharpoons SO_3(g); K_1$

(2) $2SO_3(g) \rightleftharpoons 2SO_2(g) + O_2(g); K_2$

(a) $K_1 = K_2$ (b) $K_1 = \frac{1}{K_2}$

(c) $K_2 = K_1^2$ (d) $K_1^2 = \frac{1}{K_2}$

AP EAMCET (Medical)-1998

Ans. (d): The equilibrium reaction are :

$$SO_2(g) + \frac{1}{2}O_2(g) \xrightleftharpoons{K_1} SO_3(g)$$

And, $$2SO_3(g) \xrightleftharpoons{K_2} 2SO_2(g) + O_2(g)$$

For the first equilibrium reaction –

$$K_1 = \frac{[SO_3]}{[SO_2][O_2]^{1/2}} \quad \text{.....(1)}$$

Similarly, for second –

$$K_2 = \frac{[SO_2]^2[O_2]}{[SO_3]^2}$$

Taking square root both side –we get

$$K_2^2 = \frac{[SO_2][O_2]^{1/2}}{[SO_3]}$$

or $$\frac{1}{\sqrt{K_2}} = \frac{[SO_3]}{[SO_2][O_2]^{1/2}} \quad \text{.....(2)}$$

Equating equation (1) and (2) we get

$$K_1 = \frac{1}{\sqrt{K_2}}$$

or $$K_1^2 = \frac{1}{K_2}$$

126. The equilibrium for the following reaction will be: $3A + 2B \rightarrow C$

(a) $\frac{[3A][2B]}{[C]}$ (b) $\frac{[C]}{[3A][2B]}$

(c) $\frac{[C]}{[A]^2[B]^2}$ (d) $\frac{[C]}{[A]^3[B]^2}$

NEET-1999

Ans. (d): The reaction is –

$$3A + 2B \rightarrow C$$

The expression for the equilibrium constant will be

$$K_c = \frac{[C]}{[A]^3[B]^2}$$

@apna_pdf

127. The equilibrium constant of a reaction is 300. If the volume of a reaction flask is tripled, the equilibrium constant will be

(a) 300 (b) 100
(c) 600 (d) 150

AIIMS-1996

Ans. (a): As we know that, equilibrium constant depends only upon temperature and here temperature is constant.
So, the equilibrium constant will remain unaffected and will not change with change in the volume (pressure or conc.).
So, equilibrium constant will be 300.

128. The equilibrium constant for the reaction $N_2 + 3H_2 \rightleftharpoons 2NH_3$ is K, then the equilibrium constant for the equilibrium $2NH_3 \rightleftharpoons N_2 + 3H_2$ is,

(a) $\sqrt{K}$ (b) $\sqrt{\frac{1}{K}}$
(c) $\frac{1}{K}$ (d) $\frac{1}{K^2}$

NEET-1996

Ans. (c) : The reaction is :

$$N_2 + 3H_2 \rightleftharpoons 2NH_3$$

$$K = \frac{[NH_3]^2}{[N_2][H_2]^3} \quad .....(i)$$

And, $2NH_3 \rightleftharpoons N_2 + 3H_2$

$$K' = \frac{[N_2][H_2]^3}{[NH_3]^2} \quad .....(ii)$$

On solving eq^n. (i) & (ii), we get–

$$K' = \frac{1}{K}$$

129. The law of equilibrium was first given by

(a) Boyle (b) Goldberg
(c) Waage (d) both (b) and (c)

AIIMS-1994

Ans. (d) : According to Guldberg and Waage, the rate at which substance reacts is directly proportional to its active mass (i.e. molar concentration)

$$aA + bB \rightleftharpoons xX + yY$$

$$K_C = \frac{[x]^x[y]^y}{[A]^a[B]^b}$$

K_C = equilibrium constant.

130. K_1 and K_2 are equilibrium constant for reaction (i) and (ii) respectively,

$N_2(g) + O_2(g) \rightleftharpoons 2NO(g)$ .... (i)

$NO(g) \rightleftharpoons \frac{1}{2}N_2(g) + \frac{1}{2}O_2(g)$ .... (ii)

(a) $K_1 = \left(\frac{1}{K_2}\right)^2$ (b) $K_1 = K_2^2$
(c) $K_1 = \frac{1}{K_2}$ (d) $K_1 = (K_2)^0$

NEET-1989

Ans. (a) : The reaction is:

$$N_2(g) + O_2(g) \rightleftharpoons 2NO(g)$$

$$K_1 = \frac{[NO]^2}{[N_2][O_2]} \quad .....(i)$$

$$NO(g) \rightleftharpoons \frac{1}{2}N_2(g) + \frac{1}{2}O_2(g)$$

$$K_2 = \frac{[N_2]^{1/2}[O_2]^{1/2}}{[NO]}$$

Squaring on both sides

$$(K_2)^2 = \frac{[N_2][O_2]}{[NO]^2} \quad .....(ii)$$

On solving eq^n. (i) & (ii), we get–

$$(K_2)^2 = \frac{1}{K_1}$$

$$K_1 = \left(\frac{1}{K_2}\right)^2$$

131. Given that the equilibrium constant for the reaction $2SO_2(g) + O_2(g) \rightleftharpoons 2SO_3(g)$ has a value of 278 at a particular temperature. What is the value of the equilibrium constant for the following reaction at the same temperature?

$$SO_3(g) \rightleftharpoons SO_2(g) + \frac{1}{2}O_2(g)$$

(a) 1.8×10^{-3} (b) 3.6×10^{-3}
(c) 6.0×10^{-2} (d) 1.3×10^{-5}

VITEEE-2018

Ans. (c) : The given reaction is –

$$2SO_2(g) + O_2(g) \rightleftharpoons 2SO_3(g)$$

$$\therefore \quad K = \frac{[SO_3]^2}{[SO_2]^2[O_2]} \quad ....(1)$$

Given, K = 278

And, $SO_3(g) \rightleftharpoons SO_2(g) + \frac{1}{2}O_2(g)$

K' = ?

Where, K' = equilibrium constant.

$$K' = \frac{[SO_2][O_2]^{1/2}}{[SO_3]}$$

Taking square both side – we get

$$K'^2 = \frac{[SO_2]^2[O_2]}{[SO_3]^2} \quad .....(2)$$

Substituting the values from equation (1), we get–

$$K'^2 = \frac{1}{K}$$

or $$K' = \sqrt{\frac{1}{278}} = \sqrt{35.97 \times 10^{-4}}$$

$$K' = 6 \times 10^{-2}$$

132. For which one of the following systems at equilibrium, at constant temperature will the doubling of the volume cause a shift to the right?

@apna_pdf

(a) $H_2(g)+Cl_2(g)\rightleftharpoons 2HCl(g)$

(b) $2CO(g)+O_2(g)\rightleftharpoons 2CO_2(g)$

(c) $N_2(g)+3H_2(g)\rightleftharpoons 2NH_3(g)$

(d) $PCl_5(g)\rightleftharpoons PCl_3(g)+Cl_2(g)$

VITEEE-2018

Ans. (d) : For the reaction, $PCl_5(g) \rightleftharpoons PCl_3(g) + Cl_2(g)$ is at equilibrium as well as constant temperature, doubling the volume will cause a shift to the right.

The number of moles of gaseous products is more than the no. of moles of gaseous reactant. Doubling the volume will reduce the pressure to one half. The equilibrium will shift to right to increase the pressure.

133. The rate constant for forward reaction and backward reaction of hydrolysis of ester are 1.1 × 10^{-2} and 1.5 × 10^{-3} per minute respectively. Equilibrium constant for the reaction is

$CH_3COOC_2H_5+H_2O\rightleftharpoons CH_3COOH+C_2H_5OH$

(a) 33.7 (b) 7.33

(c) 5.33 (d) 33.3

VITEEE-2014

Ans. (b) : Given data,

$k_f = 1.1 \times 10^{-2}$

$k_b = 1.5 \times 10^{-3}$

$K_{eq} = ?$

$CH_3COOC_2H_5 + H_2O \rightleftharpoons CH_3COOH + C_2H_5OH$

The equilibrium constant for the reaction is–

$$K_{eq} = \frac{k_f}{k_b} = \frac{1.1\times10^{-2}}{1.5\times10^{-3}} = 7.33.$$

134. For the following three reactions I, II and III, equilibrium constants are given

(I) $CO(g) + H_2O(g) \rightleftharpoons CO_2(g) + H_2(g); K_1$

(II) $CH_4(g) + H_2O(g) \rightleftharpoons CO(g) + 3H_2(g); K_2$

(III) $CH_4(g)+2H_2O(g) \rightleftharpoons CO_2(g)+4H_2(g);K_3$

Which of the following relations is correct?

(a) $K_1 \sqrt{K_2} = K_3$ (b) $K_2 \sqrt{K_3} = K_1$

(c) $K_3 = K_1 K_2$ (d) $K_3K_2^3 = K_1^2$

UPSEEE/UPTU-2019

Ans. (c) : $CO(g) + H_2O(g) \rightleftharpoons CO_2(g) + H_2(g);$ K_1

$CH_4(g) + H_2O(g) \rightleftharpoons CO(g) + 3H_2(g);$ K_2

Adding both equations, we get –

$CH_4(g) + 2H_2O(g) \rightleftharpoons CO_2(g) + 4H_2(g)$

$K_3 = K_1K_2$

Hence, option (c) is correct.

135. The equilibrium constant (K_c) for the reaction $N_2(g) + O_2(g) \rightarrow 2NO(g)$ at temperature T is 4 × 10^{-4}. The value of K_c for the reaction $NO(g)\rightarrow\frac{1}{2}N_2(g)+\frac{1}{2}O_2(g)$ at the same temperature is

(a) 0.02 (b) 2.5 × 10^2

(c) 4 × 10^{-4} (d) 50.0

AIEEE-2012

Ans. (d) : Given equations are –

$N_2(g) + O_2(g) \rightleftharpoons 2NO(g)$

$$K_c = \frac{[NO]^2}{[N_2][O_2]}$$

or $$4\times10^{-4} = \frac{[NO]^2}{[N_2][O_2]} \quad .....(i)$$

And, $$NO \rightleftharpoons \frac{1}{2}N_2 + \frac{1}{2}O_2$$

$$K' = \frac{[N_2]^{1/2}[O_2]^{1/2}}{[NO]}$$

On squaring on both sides –

$$(K')^2 = \frac{[N_2][O_2]}{[NO]^2} \quad .....(ii)$$

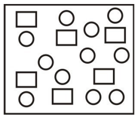
On substituting value of eq^n (i), we get–

$$(K')^2 = \frac{1}{K}$$

$$K' = \frac{1}{\sqrt{K}} = \frac{1}{\sqrt{4\times10^{-4}}} = \frac{1}{2\times10^{-2}}$$

$K' = 50$

136. In the figure shown below, reactant A (represented by square) is in equilibrium with product B (represented by circle). The equilibrium constant is



(a) 4 (b) 2

(c) 8 (d) 1

JEE-Main-2020

Ans. (b) : In the above image

$$\text{Equilibrium constant} = \frac{[\text{Product}]}{[\text{Reactant}]} = \frac{11}{6} \approx 2$$

137. For the following reactions, equilibrium constants are given:

$S(s)+O_2(g)\rightleftharpoons SO_2(g);K_1=10^{52}$

$2S(s)+3O_2(g)\rightleftharpoons 2SO_3(g);\ K_2=10^{129}$

The equilibrium constant for the reaction, $2SO(g)+O_2(g)\rightleftharpoons 2SO_3(g)$ is

(a) 10^{25} (b) 10^{77}

(c) 10^{154} (d) 10^{181}

JEE-Main-2019

Ans. (a) $S(s) + O_2(g) \rightleftharpoons SO_2(g);\ K_1 = 10^{52}$ ...(i)

$2S(s) + 3O_2(g) \rightleftharpoons 2SO_3(g); K_2 = 10^{129}$ ...(ii)

Multiplying equation (i) by (ii) and reversing if–

$$2SO_2(g) \rightleftharpoons 2S(s) + 2O_2(g);\ K_1' = \frac{1}{K_1^2} \quad .....(iii)$$

Adding equation (ii) and equation (iii), we get–

$2SO_2(g) + O_2(g) \rightleftharpoons 2SO_3(g);\ K_3 = K_2 \times K_1'$

$$K_3 = K_2 \times \frac{1}{K_1^2} = 10^{129} \times \frac{1}{(10^{52})^2} = 10^{25}$$

@apna_pdf

138. An open beaker of water in equilibrium with water vapour is in a sealed container. When few grams of glucose are added to the beaker of water, the rate at which water molecules

(a) leaves the solution decreases
(b) leaves the solution increases
(c) leaves the vapour increases
(d) leaves the vapour decreases

JEE-Main-02.09.2020, Shift-I

Ans. (c) : The vapour pressure of solution will be less than vapour pressure of pure solvent, so some vapour molecules will get condensed to maintain new equilibrium. So, leaves the vapour increases is correct answer.

139. The equilibrium constant for the reaction $A(s) \rightleftharpoons M(s)+\frac{1}{2}O_2(g)$ is $K_p = 4$. At equilibrium, the partial pressure of O_2 is.......atm.
(Round off to the nearest integer)

JEE-Main-2021

Ans. 16 : For the reaction –

$$A(s) \rightleftharpoons M(s)+\frac{1}{2}O_2(g) \qquad K_p = 4$$

$K_p = (Po_2)^{1/2}$
$4 = (Po_2)^{1/2}$
$(4)^2 = Po_2$
$Po_2 = 16$

140. $2SO_2(g)+O_2(g) \longrightarrow 2SO_3(g)$ The above reaction is carried out in a vessel starting with partial pressure Pso_2 = 250m bar, Po_2 = 750m bar and Pso_3 = 0. When the reaction is complete, the total pressure in the reaction vessel is .... m bar. (Round off of the nearest integer).

JEE-Main-2021

Ans. 875 : $2SO_2(g)+O_2(g) \longrightarrow 2SO_3(g)$

Initial	250 m bar	750m bar	0
Final adding	–250m bar	–125m bar	250m bar
	0	625	250

Final total = 625 + 250 = 875m bar.

141. The equilibrium constant K_c at 298 K for the reaction $A+B \rightleftharpoons C+D$ is 100. Starting with an equimolar solution with concentration of A,B,C and D all equal to 1M, the equilibrium concentration of D is ....×10^{-2} M. (Nearest integer)

JEE-Main-2016

Ans. 182 :

	A	+ B	⇌ C	+ D
Initially	1	1	1	1
at equilibrium	1 – x	1 – x	1 + x	1 + x

Equilibrium constant–

$$K_c = \frac{(1+x)^2}{(1-x)^2}$$

$$100 = \left(\frac{1+x}{1-x}\right)^2$$

$$10 = \frac{1+x}{1-x}$$

$$x = \frac{9}{11}$$

So, equilibrium concentration of

$$D = 1+x = 1+\frac{9}{11} = \frac{20}{11} = 1.818$$
$$= 181.8 \times 10^{-2}$$
$$= 182 \times 10^{-2}$$

2. Law of Mass Action

142. What is the equilibrium expression for the reaction,

$P_4(s) + 5O_2(g) \rightleftharpoons P_4O_{10}(s)$?

(a) $K_c = \frac{[P_4O_{10}]}{[P_4][O_2]^5}$ (b) $K_c = \frac{[P_4O_{10}]}{5[P_4][O_2]}$

(c) $K_c = [O_2]^5$ (d) $K_c = \frac{1}{[O_2]^5}$

JCECE - 2008, UPTU/UPSEE-2007

Ans. (d) : The reaction is

$$P_4(s)+5O_2(g) \rightleftharpoons P_4O_{10}(s)$$

$$K_c = \frac{[P_4O_{10}]}{[P_4][O_2]^5}$$

We know that the concentration of solids is unity.

So, $K_c = \frac{1}{[O_2]^5}$

143. The rate, at which a substance reacts, depends upon its

(a) equivalent mass (b) molecular mass
(c) active mass (d) atomic mass

AMU-2001, AIIMS-1996

Ans. (c): The rate at which a substance reacts depends upon its active mass as the rate of reaction is directly proportional to concentration of each reactant and product.

144. Which of the following statements is true when equilibrium is established in the reaction ?
$A + B \rightleftharpoons C + D$, K_C =10

(a) [C][D] = [A] [B]
(b) [C] = [A]and [B] = [D]
(c) [A][B] = 0.1 [C][D]
(d) [A] = [B] = [C] = [D] = 10M

AP-EAPCET 24.08.2021 Shift-II

Ans. (c) : Given reaction is –

$A + B \rightleftharpoons C + D$, $K_c = 10$

Rate law of reaction at equilibrium.

$$K_c = \frac{[C]\,[D]}{[A]\,[B]} = 10 = \frac{[C][D]}{[A][B]}$$

10 [A][B] = [C][D]

@apna_pdf

$$[A][B] = \frac{1}{10}[C][D]$$

$$[A][B] = 0.1\ [C][D]$$

145. For a reaction taking place in three steps, the rate constants are k_1, k_2 and k_3 and overall rate constant is $k = \frac{k_1k_3}{k_2}$. If the energies of activation E_1, E_2 and E_3 are 60, 30 and 10 kJ mol^{-1} respectively, then the overall energy of activation is

(a) 30 kJ mol^{-1} (b) 40 kJ mol^{-1}

(c) 60 kJ mol^{-1} (d) 100 kJ mol^{-1}

AMU-2014

Ans. (b) : Given,

$$K = \frac{K_1K_2}{K_3}$$

On taking log both sides:

$$\log K = \log K_1 + \log K_2 - \log K_3 \qquad .....(i)$$

We know that:

$$\log k = \log A - \frac{Ea}{2.303\ RT}$$

So, from (i)

$$\log A - \frac{Ea}{2.303RT} = \log A - \frac{Ea_1}{2.303RT} + \frac{Ea_2}{2.303RT} - \frac{Ea_3}{2.303RT}$$

$Ea = Ea_1 + Ea_3 - Ea_2$

$= 60 + 10 - 30$

$= 70 - 30 = 40$ kJ mol^{-1}

146. The K_p value for the reaction,

$$H_2 + I_2 \rightleftharpoons 2HI$$

at 460 °C is 49. If the initial pressure of H_2 and I_2 is 0.5 atm respectively, what will be the partial pressure of H_2 at equilibrium?

(a) 0.111 atm (b) 0.123 atm

(c) 0.133 atm (d) 0.222 atm

AMU-2014

Ans. (a) :	H_2	+	I_2	$\rightleftharpoons$	2HI
initially	0.5atm		0.5atm		0
at eq.	(0.5-x) atm		(0.5-x) atm		2x atm

$$Kp = \frac{(P_{HI})^2}{P_{H_2}.P_{I_2}}$$

$$49 = \frac{(2x)^2}{(0.5-x)(0.5-x)}$$

$$49 = \frac{(2x)^2}{(0.5-x)^2}$$

$$7 = \frac{2x}{0.5-x}$$

$2x = 3.5 - 7x$

$9x = 3.5$

$$x = \frac{3.5}{9} = 0.388$$

$\therefore \quad PH_2 = 0.5 - 0.388 = 0.111$ atm

147. The values of K_{sp} of $CaCO_3$ and CaC_2O_4 are 4.7×10^{-9} and 1.3×10^{-9} respectively at 25°C. If the mixture of these two is washed with water, what is the concentration of Ca^{2+} ions in water?

(a) 5.831×10^{-5} M (b) 6.856×10^{-5} M

(c) 3.606×10^{-5} M (d) 7.746×10^{-5} M

Karnataka-NEET-2013

Ans. (d) : $CaCO_3 \longrightarrow \underset{x}{Ca^{2+}} + \underset{x}{CO_3^{2-}}$

$$CaC_2O_4 \longrightarrow \underset{y}{Ca^{2+}} + \underset{y}{C_2O_4^{2-}}$$

Now, $[Ca^{2+}] = x+y$

And, $x(x+y) = 4.7\times10^{-9}$

$y(x+y) = 1.3\times10^{-9}$

Dividing equation (i) and (ii) we get,

$$\frac{x}{y} = 3.6 \Rightarrow x = 3.6y$$

Putting this value in equation (ii) we get,

$y(3.6y+y) = 1.3\times10^{-9}$

On solving, we get $y = 1.68\times10^{-5}$

And, $x = 3.6\times1.68\times10^{-5} = 6.048\times10^{-5}$

$\therefore \quad [Ca^{2+}] = (x+y) = (6.048\times10^{-5}) + (1.68\times10^{-5})$

$\therefore \quad [Ca^{2+}] = 7.728\times10^{-5}M$

148. If 1.0 mole of I_2 is introduced into 1.0 litre flask at 1000 K, at equilibrium ($K_c = 10^{-6}$), which one is correct?

(a) $[I_2(g)] > [I^-(g)]$ (b) $[I_2(g)] < [I^-(g)]$

(c) $[I_2(g)] = [I^-(g)]$ (d) $[I_2(g)] = \frac{1}{2}[I^-(g)]$

BITSAT-2013

Ans. (a) : $\underset{1-x}{I_2} \rightleftharpoons \underset{2x}{2I^-}$

$$K_c = \frac{(2x)^2}{(1-x)} = 10^{-6}$$

It shows that $(1-x) > 2x \Rightarrow \boxed{I_2 > I^-}$

149. 630 mg of oxalic acid is equivalent to

(a) 100 mL of 0.2 N $KMnO_4$

(b) 100 mL of 0.05 N $KMnO_4$

(c) 100 mL of 0.01 N $KMnO_4$

(d) 100 mL of 0.1 N $KMnO_4$

COMEDK-2011

Ans. (d) : At equivalence point:

No. of gram equivalents of oxalic acid = No. of gram equivalents of oxalic acid

$$= \frac{w}{Eq.wt.} = \frac{630\times10^{-3}}{63} = 1\times10^{-2} = 0.01$$

Now, no. of gram equivalents in

(a) 100 mL of 0.2 N $KMnO_4$ = $0.2\times\frac{100}{1000} = 0.02$

(b) 100 mL of 0.05 N $KMnO_4$ = $0.05\times\frac{100}{1000} = 0.005$

(c) 100 mL of 0.01 N $KMnO_4$ = $0.01\times\frac{100}{1000} = 0.001$

(d) 100 mL of 0.1 N $KMnO_4$ = $0.1\times\frac{100}{1000} = 0.01$

@apna_pdf

150. For the reaction $A+3B \longrightarrow 2C+D$, which one of the following is not correct?

(a) Rate of disappearance of A = Rate of formation of D

(b) Rate of formation of $C=\frac{2}{3}\times$Rate of disappearance of B

(c) Rate of formation of $D=\frac{1}{3}\times$Rate of disappearance of B

(d) Rate of disappearance of A = 2 × Rate of formation of C

AP- EAMCET(Medical) -2010

Ans. (d): For the reaction-

$$A+3B \longrightarrow 2C+D$$

We can write the rate of formation and deformation of reactant and product for the above reaction-

$$\frac{-d[A]}{dt}=-\frac{1}{3}\frac{d[B]}{dt}=+\frac{1}{2}\frac{d[C]}{dt}=+1\frac{d[D]}{dt}$$

We get the following conclusion–

(1) rate of disappearance of A = rate of formation of D.

(2) rate of formation of $C=\frac{2}{3}\times$ rate of disappearance of B.

(3) rate of formation of $D=\frac{1}{3}\times$rate of disappearance of B.

(4) rate of disappearance of $A=\frac{1}{2}\times$rate of formation of C.

151. According to Ellingham diagram, the oxidation reaction of carbon to carbon monoxide may be used to reduce which one of the following oxides at the lowest temperature?

(a) Al_2O_3 (b) Cu_2O

(c) MgO (d) ZnO

(e) FeO

Kerala-CEE-2010

Ans. (b) : Cu_2O is least stable among all so the oxidation reaction of carbon to carbon monoxide may be used to reduce this at the lowest temperature.

152. By applying law of mass action, the equilibrium constant K for the reaction
$HA + H_2O \rightleftharpoons H_3O^+ + A^-$

(a) $K=\frac{[HA][H_2O]}{[H_3O^+][A^-]}$ (b) $K=\frac{[H_3O^+][A^-]}{[HA][H_2O]}$

(c) $K=\frac{[H_3O^+][H_2O]}{[A^-][HA]}$ (d) $K=\frac{[HA][A^-]}{[H_2O][H_3O^+]}$

J & K CET-(2007)

Ans. (b) : The reaction is :

$$HA+H_2O \rightleftharpoons H_3O^+ + A^-$$

The equilibrium constant $K=\frac{[\text{Product}]}{[\text{Reactant}]}$

So, $K=\frac{[H_3O^+][A^-]}{[HA][H_2O]}$

153. Which of the following is not a characteristic property of chemical equilibrium?

(a) Rate of forward reaction is equal to rate of backward reaction at equilibrium

(b) After reaching the chemical equilibrium, the concentrations of reactants and products remain unchanged with time

(c) For $A(g) \rightleftharpoons B(g)$, K_c is 10^{-2}, If this reaction is carried out in the presence of catalyst, that value of K_c decreases

(d) After reaching the equilibrium, both forward and backward reactions continue to take place

AP-EAMCET-2006

Ans. (c) : For $A(g) \rightleftharpoons B(g)$, $K_c = 10^{-2}$
If this reaction is carried out in the presence of catalyst, the value of K_C (equilibrium constant) not effect.

154. The equilibrium constant for the reaction $H_2O(g)+CO(g) \rightleftharpoons H_2(g)+CO_2(g)$ is 64. The rate constant for the forward reaction is 160, the rate constant for the backward reaction is:

(a) 0.4 (b) 2.5

(c) 6.2 (d) 10.24×10^3

AP-EAMCET (Med.)-1999

Ans. (b) : Given values:- $K_c = 64$, $K_f = 160$, $K_b = ?$
For the equilibrium reaction-

$$H_2O + CO \rightleftharpoons H_2 + CO_2$$

At equilibrium-

$$K_c=\frac{k_f}{k_b}$$

Where- K_c = Equilibrium constant
k_f = Rate of forward reaction
k_b = Rate of backward reaction

$$k_b=\frac{160}{64}$$

or $k_b = 2.5$

155. The equilibrium constant (K_c) for the reaction $HA+B \rightleftharpoons BH^+ + A^-$ is 100. If the rate constant for the forward reaction is 10^5, rate constant for the reverse reaction is

(a) 10^{-3} (b) 10^{-5}

(c) 10^7 (d) 10^3

AP-EAMCET-1994

Ans. (d) : Given that, $K_c = 100$, $k_f = 10^5$, $k_b = ?$

$$HA+B \rightleftharpoons C(g)+D(g)$$

At equilibrium-

$$K_c=\frac{k_f}{k_b}$$

or $k_b=\frac{k_f}{K_c}$

Putting the value, we get-

$$k_b=\frac{10^5}{100}=10^3$$

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3. Activation Energy, Standard Free Energy

156. Hydrolysis of sucrose is given by the following reaction. Sucrose + H_2O $\rightleftharpoons$ Glucose + Fructose. If the equilibrium (K_c) is 2 × 10^{13} at 300 K, the value of ΔG^o at the same temperature will be

(a) – 8.314 J $mol^{-1}K^{-1}$ × 300 K × ln (2 × 10^{13})
(b) 8.314 J $mol^{-1}K^{-1}$ × 300 K × ln (2 × 10^{13})
(c) 8.314 J $mol^{-1}K^{-1}$ × 300 K × ln (3 × 10^{13})
(d) – 8.314 J $mol^{-1}K^{-1}$ × 300 K × ln (4 × 10^{13})

NEET-2020

Ans. (a) : Given data: $K_c = 2\times10^{13}$, T = 300 K, ΔG^o = ?
The relation between standard Gibbs energy and equilibrium constant is givens by -

$\Delta G^o = -RT \ln K_c$
$= -8.314\ Jmol^{-1}K^{-1} \times 300K \times \ln (2 \times 10^{13})$.

157. Assertion: At equilibrium, $\Delta G = 0$.
Reason: At equilibrium, $\Delta G^o = RT \log K_c$.

(a) If both Assertion and Reason are correct and Reason is the correct explanation of Assertion.
(b) If both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.
(c) If Assertion is correct but Reason is incorrect.
(d) If both the Assertion and Reason are incorrect.

AIIMS 25 May 2019 (Morning)

Ans. (c) : When ΔG is 0, reaction has achieved equilibrium. A mathematical expression of this thermodynamic view of equilibrium can be described by the following equation.

$\Delta G = \Delta G^o = RT \ln K_c$.

158. The value of $\log_{10}K$ for the reaction A $\rightleftharpoons$ B is

(Given : $\Delta_f H^o(298K) = -54.07 kJmol^{-1}$
$\Delta_r S^o = 10JK^{-1}mol^{-1}$
$R = 8.314 JK^{-1}mol^{-1}$)

(a) 5
(b) 10
(c) 95
(d) 100

BCECE-2018

Ans. (b) : Given: $\Delta H = -54.07$ kJ mol^{-1}
$\Delta S = 10\ JK^{-1}\ mol^{-1}$

We know that,

$\Delta G^\circ = \Delta H^\circ_{298} - T\Delta S^\circ_{298}$
$= -54.07 \times 1000 - 298\times10$
$= -54070 - 2980$
$= -57050$ J

And, $\Delta G^\circ = -2.303RT \log_{10}K$
$-57050 = -2.303 \times 8.314 \times 298 \times \log_{10}K$
$-57050 = -5705.8 \times \log_{10}K$
$\frac{57050}{5705.8} = \log_{10} K$
$\log_{10}K = 10$

159. The dissociation energy of CH_4 and C_6H_6 to convert them into gaseous atom are 360 and 620 kcal/mol respectively. The bond energy of C–C bond is

(a) 260 kcal mol^{-1}
(b) 180 kcal mol^{-1}
(c) 130 kcal mol^{-1}
(d) 80 kcal mol^{-1}

BCECE-2018

Ans. (d) : Given,
Dissociation energy of CH_4 = 360 kcal mol^{-1}
Dissociation energy of C_6H_6 = 620 kcal mol^{-1}

$\therefore$ Bond energy of C─H bond $= \frac{360}{4} = 90$ kJ

Bond energy of ethane:
(C–C) + 6 (C–H) = 620 kJ/mol
(C–C) + 6 × 90 = 620
(C–C) + 540 = 620
(C–C) = 620-540
(C–C) = 80
So, bond energy of (C–C) is 80 k calmol^{-1}

160. One mole of ethanol is produced reacting graphite, H_2 and O_2 together. The standard enthalpy of formation is –277.7 kJ mol^{-1}. Calculate the standard enthalpy of the reaction when 4 moles of graphite is involved

(a) –277.7
(b) –555.4
(c) –138.85
(d) –69.42
(e) –1110.8

Kerala-CEE-2018

Ans. (b) : When graphite reacted with H_2 and O_2 then one mole of ethanol is formed. The chemical reaction is given below-

$$2C(s) + 3H_2(g) + \frac{1}{2}O_2(g) \rightarrow C_2H_5OH(l)$$

$\Delta H_f = -277.7$ kJ/mol

If 2 moles of graphite is involved, the standard enthalpy of reaction is –277.7 kJ/mol. When 4 moles of graphite is involved then standard enthalpy of reaction will be 2×(–277.7 kJ/mol) = – 555.4 kJ/mol

161. $\Delta_r G^\circ$ for the conversion of O_2 to ozone,

$\frac{3}{2}O_2(g) \longrightarrow O_3(g)$ at 298 K is

(K_p for this conversion is 1×10^{-29})

(a) 16.54 kJ mol^{-1}
(b) 165.4 kJ mol^{-1}
(c) 1654 kJ mol^{-1}
(d) 1.654 kJ mol^{-1}

COMEDK-2015

Ans. (b) : Given, $K_p = 1 \times 10^{-29}$, T = 298 K, $\Delta_r G^o$ = ?
The conversion reaction of ozone is -

$$\frac{3}{2}O_2(g) \longrightarrow O_3(g)$$

The relation between standard Gibb's free energy and equilibrium constant is -

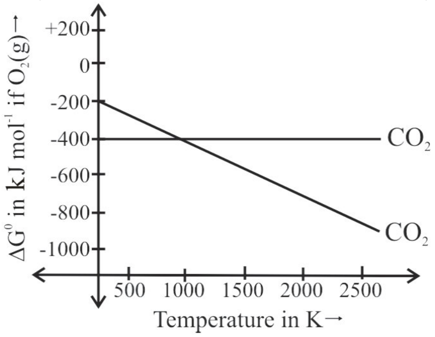
$\Delta_r G^o = -RT \ln K_p$
or $\Delta_r G^\circ = -2.303 RT \log K_p$
$= -2.303 \times 8.314 \times 298 \times \log (1\times10^{-29})$
$= 165469.6$ J mol^{-1} = 165.47 kJ mol^{-1}

@apna_pdf

162. From the Ellingham graphs on carbon, which of the following statements is false?
(a) CO reduces Fe_2O_3 to Fe at less than 983 K
(b) CO is less stable than CO_2 at more than 983 K
(c) CO reduces Fe_2O_3 to Fe in the reduction zone of blast furnace
(d) CO_2 is more stable than CO at less then 983 K

Karnataka-CET-2012

Ans. (b) : CO_2 is less stable than CO at more than 983K. At these temperature, the ΔG value of formation of CO is more negative than the ΔG value of formation of CO_2. More negative, the value of ΔG, the greater is the tendency of the element to combine with oxygen.



163. If the activation energy for the forward reaction is 150 kJ mol^{-1} and that of the reverse reaction is 260 kJ mol^{-1}. What is the enthalpy change for the reaction?
(a) 410 kJ mol^{-1} (b) 110 kJ mol^{-1}
(c) –110 kJ mol^{-1} (d) –410 kJ mol^{-1}
(e) 90 kJ mol^{-1}

Kerala-CEE-2010

Ans. (c) : Given,
Activation energy of forward reaction (E_f) = 150 kJ mol^{-1}
Activation energy of backward reaction (E_b) = 260 kJ mol^{-1}
Enthalpy change for a reversible reaction is -
$\Delta H = E_f$ (forward) – E_b (backward)
$\Delta H = 150 - 260$
$= -110$ kJ mol^{-1}

164. Calculate the standard enthalpy change (in kJ mol^{-1}) for the reaction

$$H_2(g) + O_2(g) \longrightarrow H_2O_2\,(g)$$

Given that bond enthalpies of H—H, O═O, O—H and O—O (in kJ mol^{-1}) are respectively 438, 498, 464 and 138.
(a) –130 (b) –65
(c) +130 (d) – 334
(e) +334

Kerala-CEE-2010

Ans. (a) : Given,
Bond enthalpy of H–H = 438 kJ mol^{-1}
Bond enthalpy of O = O = 498 kJ mol^{-1}
Bond enthalpy of O–H = 464 kJ mol^{-1}
Bond enthalpy of O–O = 138 kJ mol^{-1}
For the reaction-

$$H_2(g) + O_2(g) \rightarrow H_2O_2(g)$$

$\therefore$ ΔH^o = [Bond Energy]$_{Reactant}$ – [Bond Energy]$_{Product}$
ΔH^o = [(Bond energy of H–H) + (Bond energy of O–O)] –[2 (Bond energy of O–H) + (Bond energy of O–O)]
= [438+498] –[2×464+138]
= 936 – 1066
= –130 kJ mol^{-1}

165. The first $(\Delta_i H_1)$ and second $(\Delta_i H_2)$ ionisation enthalpies (in kJ mol^{-1}) and the $(\Delta_{eg}H^o)$ electron gain enthalpy (in kJ mol^{-1}) of the elements I, II, III, IV and are given below

Element	$\Delta_i H_1$	$\Delta_i H_2$	$\Delta_{eg}H^o$
I	520	7300	– 60
II	419	3051	– 48
III	1681	3374	– 328
IV	1008	1846	– 295
V	2372	5251	+ 48

The most reactive metal and the least reactive non-metal of these are respectively
(a) I and V (b) V and II
(c) II and V (d) IV and V
(e) V and III

Kerala-CEE-2010

Ans. (c)
(a) The metal I can form a stable MX halide.
(b) The metal II is the most reactive metal. It has very low value of first ionization energy.
(c) The element III is the most reactive non-metal. Its electron gain enthalpy is most negative.
(d) The element IV is the least reactive non-metal as it has least negative electron gain enthalpy among the non-metals.
(e) The element V is the least reactive element as it has highest value of first ionization energy and positive election gain enthalpy.

166. $N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$ + 22 kcal. The activation energy for the forward reaction is 50 kcal. What is the activation energy for the backward reaction ?
(a) – 72 kcal (b) – 28 kcal
(c) + 28 kcal (d) + 72 kcal

AP - EAMCET (Medical) - 2007

Ans. (d) : Given,
enthalpy change of the reaction = 22 kcal
activation energy of forward reaction (E_f) = 50 kcal
activation energy of backward reaction (E_b) = ?
For the reaction–

$$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g) \quad \Delta H = -22\text{kcal}$$

As we know that formation of ammonia is a exothermic reaction. The activation energy for the forward reaction (E_f) is 50 kcal.
$\therefore$ $\Delta H = E_f - E_b$
or $E_b = E_f - \Delta H$
or E_b = 50 kcal – (–22 kcal)
or E_b = 72 kcal.

@apna_pdf

167. The reactions with low activation energy are always

(a) adiabatic (b) slow
(c) non-spontaneous (d) fast

VITEEE- 2006

Ans. (d) : The reactions with low activation energies are always fast where as the reactions with high activation energy are always slow.

168. A chemical reaction is catalysed by 'X' therefore, 'X'

(a) increases the activation energy
(b) does not affect the equilibrium constant of the reaction
(c) decreases the enthalpy of the reaction
(d) decreases the velocity constant of the reaction

CG PET -2006

Ans. (b) : A catalyst increases the rate of the chemical reaction by making available a new low energy pathway for the conversion of reactants to products. It increases the rate of forward and reverse reactions that pass through the same transition state and does not affect equilibrium. Catalyst lowers the activation energy for the forward and reverse reactions by exactly the same amount.

4. Degree of Dissociation

169. For a reaction at equilibrium

$$A(g) \rightleftharpoons B(g) + \frac{1}{2}C(g)$$

The relation between dissociation constant (K), degree of dissociation (α) and equilibrium pressure (p) is given by:

(a) $K = \dfrac{\alpha^{\frac{1}{2}}p^{\frac{3}{2}}}{\left(1+\frac{3}{2}\alpha\right)^{\frac{1}{2}}(1-\alpha)}$

(b) $K = \dfrac{\alpha^{\frac{3}{2}}p^{\frac{1}{2}}}{(2+\alpha)^{\frac{1}{2}}(1-\alpha)}$

(c) $K = \dfrac{(\alpha p)^{\frac{3}{2}}}{\left(1+\frac{3}{2}\alpha\right)^{\frac{1}{2}}(1-\alpha)}$

(d) $K = \dfrac{(\alpha p)^{\frac{3}{2}}}{(1+\alpha)(1-\alpha)^{\frac{1}{2}}}$

JEE Main-24.06.2022, Shift-I

Ans. (b) : For a given reaction at equilibrium-

$$A(g) \rightleftharpoons B(g) + \frac{1}{2}C(g)$$

	$A(g)$	$B(g)$	$\frac{1}{2}C(g)$
Initially	1	0	0
At equi.	(1–α)	α	$\frac{\alpha}{2}$

$$\therefore\ n_{(total)} = 1 - \alpha + \alpha + \frac{\alpha}{2} = 1 + \frac{\alpha}{2}$$

$$\text{So, } K_p = \frac{\left(\frac{\alpha}{1+\frac{\alpha}{2}}\times p\right)\left(\frac{\alpha/2}{1+\frac{\alpha}{2}}p\right)^{1/2}}{\left(\frac{1-\alpha}{1+\frac{\alpha}{2}}p\right)}$$

$$K_p = \frac{\alpha\left(\frac{\alpha}{2}\right)^{1/2}p^{1/2}}{(1-\alpha)^{1/2}\left(1+\frac{\alpha}{2}\right)^{1/2}}$$

$$K_p = \frac{\alpha^{3/2}p^{1/2}}{(2+\alpha)^{1/2}(1-\alpha)}$$

170. The overall complex dissociation equilibrium constant for $[Cr(H_2O)_6]^{3+}$ ion is 5×10^{-12} the overall stability constant of the complex is

(a) 2×10^{-11} (b) 5×10^{11}
(c) 5×10^{10} (d) 2×10^{11}
(e) 0.2×10^{11}

Kerala CEE -03.07.2022

Ans. (d) : Given, that–

Complex dissociation equilibrium constant $K = 5\times10^{-12}$

We know,

Dissociation constant is the reciprocal of the stability constant $\left(\beta = \frac{1}{K}\right)$

So, overall stability constant $\beta = \left(\frac{1}{5\times10^{-12}}\right)$

$= 0.2 \times 10^{12}$

$= 2 \times 10^{11}$

171. The value of Van't Hoff factor for 0.1 M $Ba(NO_3)_2$ solution is 2.74. The degree of dissociation is–

(a) 100% (b) 92%
(c) 87% (d) 74%

MHT CET-02.05.2019, SHIFT-III
JIMPER-2018
BCECE-2016
J & K CET-(2003)

Ans. (c) : $Ba(NO_3)_2 \rightleftharpoons Ba^{2+} + 2NO_3^-$

$i = 1+2\alpha$

$\therefore\ 2.74 = 1+2\alpha$

$\alpha = \frac{1.74}{2} = 0.87 = 87\%$

The Van't Hoff's factor for 0.1 M $Ba(NO_3)_2$ solution is 2.74. The degree of dissociation is 87%.

172. Van't Hoff factor of $Ca(NO_3)_2$ is

(a) One (b) Two
(c) Three (d) Four

J & K CET-(2013)
BCECE-2008
UP CPMT-2006

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Ans. (c) : $Ca(NO_3)_2 \rightleftharpoons Ca^{2+} + 2NO_3^-$

It furnishes 3 ions per formula unit. So, its Van't Hoff factor is 3.

173. Precipitation takes place when the product of concentration of ions is

(a) more than solubility product
(b) negligible
(c) less than the solubility product
(d) equal to the solubility product

J & K CET-2005, 2001

Ans. (a) : Precipitation takes place when ionic product of concentration of ions is greater that solubility product.

174. The degree of dissociation (α) of a weak electrolyte, A_xB_y is related to van't Hoff factor (i) by the expression

(a) $\alpha = \frac{i-1}{(x+y-1)}$
(b) $\alpha = \frac{i-1}{x+y-1}$
(c) $\alpha = \frac{x+y-1}{i-1}$
(d) $\alpha = \frac{x+y+1}{i-1}$

Tripura JEE-2022
[AIEEE 2011]

Ans. (a) : Van't Hoff factor

$$\underset{1-\alpha}{AxBy} \rightleftharpoons \underset{\alpha x}{xA^{y+}} + \underset{\alpha y}{yB^{x-}}$$

Total amount of species = 1+(x+y–1)α

Van't Hoff factor $i = \frac{1+(x+y-1)\alpha}{1}$

$$\alpha = \frac{i-1}{(x+y-1)}$$

175. The Van't Hoff factor i for an electrolyte which undergoes dissociation and association in solvents are respectively

(a) greater than 1 and greater than 1
(b) less than 1 and greater than 1
(c) less than 1 and less than 1
(d) greater than 1 and less than 1

BITSAT – 2012
NEET-2011

Ans. (d) : When an electrolyte dissociates Van't Hoff factor *i* is greater than 1 and when it associated the *i* is less than 1.

176. The degree of dissociated of $PCl_5(\alpha)$ obeying the equilibrium;

$$PCl_5 \rightleftharpoons PCl_3 + Cl_2$$

is related to the pressure (p) at equilibrium by

(a) $\alpha \propto p$
(b) $\alpha \propto \frac{1}{\sqrt{p}}$
(c) $\alpha \propto \frac{1}{p^2}$
(d) $\alpha \propto \frac{1}{p^4}$

BITSAT 2016, UP CPMT-2013

Ans. (b) : $PCl_5(g) \rightleftharpoons PCl_3(g) + Cl_2(g)$

Before reaction 1 0 0
At equilibrium 1 – α α α
Total number of moles at equilibrium
= (1 – α) + α + α = (1 + α)
If p is the total pressure at equilibrium, then

$$P_{PCl_5} = \frac{(1-\alpha)}{(1+\alpha)} \times p$$

$$P_{PCl_3} = \frac{\alpha}{(1+\alpha)} \times p$$

$$P_{Cl_2} = \frac{\alpha}{(1+\alpha)} \times p$$

$$K_p = \frac{P_{PCl_3} \times P_{Cl_2}}{P_{PCl_5}}$$

$$= \frac{[\alpha p/(1+\alpha)][\alpha p/(1+\alpha)]}{(1-\alpha)p/(1+\alpha)}$$

$$= \frac{\alpha^2}{(1+\alpha)(1-\alpha)} \times p = \frac{\alpha^2}{1-\alpha^2} \times p$$

or $\alpha^2 = \frac{K_p}{p}$

or $\alpha = \sqrt{\frac{K_p}{p}}$ $(1 - \alpha^2 = 1)$

or $\alpha \propto \frac{1}{\sqrt{p}}$

177. Which one of the following electrolytes has the same value of Van't Hoff factor (i) as that of $K_4[Fe(CN)_6]$?

(a) $Al_2(SO_4)_3$
(b) K_2SO_4
(c) $K_3[Fe(CN)_6]$
(d) $Al(NO_3)_3$

JIMPER-2018
NEET-1994

Ans. (a) : For $K_4[Fe(CN)_6]$

$$K_4[Fe(CN)_6] \longrightarrow \underbrace{4K^+ + [Fe(CN)_6]^{4-}}_{n=5}$$

Since, n for strong electrolytes so i = 5
For, $Al_2(SO_4)_3$

$$Al_2(SO_4)_3 \longrightarrow \underbrace{2Al^{3+} + 3SO_4^{2-}}_{n=5}$$

Hence, $K_4[Fe(CN)_6]$ and $Al_2(SO_4)_3$ has same Van"t Hoff factor (i)

178. Which of the following acids has the smallest dissociation constant?

(a) $CH_3CHFCOOH$
(b) FCH_2CH_2COOH
(c) $BrCH_2CH_2COOH$
(d) $CH_3CHBrCOOH$

JCECE - 2011
WB JEE-2008

Ans. (c) : Lower the acidic character, smaller is the value of dissociation constant.

Acidity ∝ dissociation constant.

–I (inductive effect) of F is more than Br, so $CH_3CHFCOOH$ is a stronger acid as compared to $CH_3CHBrCOOH$.

As the distance between electron withdrawing group and —COOH group increases, acidity decreases.

Thus, the order of acidity and thus, of dissociation constant is

$$\underset{\text{(smallest } K_a)}{BrCH_2CH_2COOH} < FCH_2CH_2COOH$$

$$< CH_3CHBrCOOH < CH_3CHFCOOH$$

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179. For a concentrated solution of a weak electrolyte A_xB_y, the degree of dissociation is given as

(a) $\alpha = \sqrt{K_{eq}/C(x+y)}$

(b) $\alpha = \sqrt{K_{eq}C/(xy)}$

(c) $\alpha = (K_{eq}/C^{x+y-1}x^xy^y)^{1/(x+y)}$

(d) $\alpha = \sqrt{K_{eq}/xyC}$

Kerala-CEE-2008
AMU-2011

Ans. (c) : Dissociation of weak electrolyte AxBy as

$$\begin{array}{lccc} & A_xB_y & \rightleftharpoons xA^{y+} & + yB^{x-} \\ \text{At } t=0 & C & 0 & 0 \\ \text{At equi.} & C(1\text{-}\alpha) & xC\alpha & yC\alpha \end{array}$$

Applying law of mass action–

$$K_{eq.} = \frac{[xC\alpha]^x[yC\alpha]^y}{[C(1-\alpha)]}$$

For weak electrolytes $\alpha <<< 1$,

$\because \quad 1-\alpha = 1$

$\therefore \quad K_{eq}C = x^xy^y[C\alpha]^{x+y}$

$$\frac{K_{eq.}}{C^{x+y-1}} = x^xy^y(\alpha)^{x+y}$$

$$\alpha = \left(\frac{K_{eq}.}{(C^{x+y-1})x^xy^y}\right)^{\frac{1}{x+y}}$$

180. The dissociation equilibrium of gas AB_2 can be represented as

$$2AB_2(g) \rightleftharpoons 2AB(g) + B_2(g)$$

The degree of dissociation 'x' and is small compared to 1.The expression relating the degree of dissociation(x) with equilibrium constant K_p and total pressure p is

(a) $(2K_p/p)$
(b) $(2K_p/p)^{1/3}$
(c) $(2Kp/p)^{1/2}$
(d) (K_p/p)

JIMPER-2014
NEET-2008

Ans. (b) : The reaction is -

$$\begin{array}{ccc} 2AB_2(g) & \rightleftharpoons 2AB(g) & + B_2(g) \\ 2(1-x) & 2x & x \end{array}$$

Moles at equilibrium = 2 (1 – x) + 2x +x
= x + 2

$$K_p = \frac{[P_{AB}]^2[P_{B_2}]}{[P_{AB_2}]^2} = \frac{\left(\frac{2x}{x+2}\times p\right)^2\left(\frac{x}{2+x}\times p\right)}{\left(\frac{2(1-x)}{x+2}\times p\right)^2}$$

$$K_p = \frac{\frac{4x^3}{x+2}\times p}{4(1-x)^2} = \frac{4x^2\times p}{2}\times\frac{1}{4}$$

$$x = \left(\frac{2K_p}{p}\right)^{1/3} \quad (\text{as } 1-x \approx 1, 2+x \approx 2)$$

181. The degree of dissociation for a 0.1M $Al_2(SO_4)_3$ solution having Van't Hoff factor value of 4.2 will be

(a) 80%
(b) 90%
(c) 75%
(d) 85%

Assam CEE-2021

Ans. (a) : $Al_2(SO_4)_3 \rightarrow 2Al^{3+} + 3SO_4^{2-}$

$$\begin{array}{lccc} t=0 & 1 & 0 & 0 \\ t=\text{time} & 1-\alpha & 2\alpha & 3\alpha \end{array}$$

$$i = \frac{1-\alpha+2\alpha+3\alpha}{1} = 4\cdot2$$

$= 1 + 4\alpha = 4.2$

$4\alpha = 3.2$

$\alpha = 0.8$

= 80%

182. At a fixed concentration, the molar conductance of aqueous sodium hydroxide at 298 K is found to be 10 ohm^{-1} cm^2, mol^{-1}. At infinite dilution nd 298 K, its molar conductance is found to be 242 ohm^{-1}, cm^2, mol^{-1}. Find the degree of ionization of sodium hydroxide at the same concentration and temperature.

(a) 2.06%
(b) 4.13%
(c) 0.04%
(d) 10%

AP- EAPCET- 07-09-2021, Shift-I

Ans. (b) Degree of dissociation (α) =

$$= \frac{\text{molar conductivity at conc.}(\Lambda_m^c)}{\text{molar conductivity at infinite dilution}(\Lambda_m^\infty)}$$

$$(\alpha) = \frac{10\,\Omega^{-1}\,cm^2\,mol^{-1}}{242\,\Omega^{-1}\,cm^2\,mol^{-1}}$$

$= 0.0413$

$= 4.13\%$

183. 0.01 moles of a weak acid HA (Ka = 2.0×10^{-6}) is dissolved in 1.0 L of 0.1 M HCI solution. The degree of dissociation of HA s........$\times10^{-5}$ (Round off the nearest integer).
[Neglect volume change on adding HA. Assume degree of dissociation<<]

[JEE Mains 2021, 17 March Shift-I]

Ans. (2) : (x = 2)

$$\underset{0.1}{HCL} \longrightarrow \underset{0.1}{H^+} + \underset{0.1}{Cl^-}$$

$$\begin{array}{lccc} & HA(aq) & \rightleftharpoons H^+(aq) & + A^-(aq) \\ \text{Initially} & 10^{-2} & 0 & 0 \\ \text{At eq.} & (1\text{–}\alpha)10^{-2} & 0.01\alpha+0.1 & 0.01\alpha \\ & \approx 10^{-2} & \approx 0.1 & \approx 10^{-2}\alpha \end{array}$$

Now, $\quad K_a = \dfrac{[H^+][A^-]}{[HA]}$

$$2\times10^{-6} = \frac{(0.1)(10^{-2}\alpha)}{10^{-2}}$$

$\alpha = 2\times10^{-5}$

184. At 298K, the ratio of dissociated water to that of undissociated water is [Assume pure water]

(a) 1×10^{-7}
(b) 1.8×10^{-9}
(c) 1×10^{-3}
(d) 1,000

TS-EAMCET 09.08.2021, Shift-I

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Ans. (b) : Assuming pure water (c) = 55.55

$$\begin{array}{lccccc} & H_2O & \rightleftharpoons & H^+ & + & OH^- \\ \text{Initial con.} & c & & 0 & & 0 \\ \text{after diss.} & c-\alpha & & \alpha & & \alpha \\ & (55.55-10^{-7}) & & (10^{-7}) & & (10^{-7}) \end{array}$$

Undissociated water = 55.55 – 10^{-7} $(\because\ 10^{-7} \approx 0)$

= 55.55

Dissociated water = 10^{-7}

$\therefore$ The ratio of dissociated water to that of undissociated water $= \dfrac{\text{Dissociated water}}{\text{Undissociated water}}$

$$= \frac{10^{-7}}{55.55} = 1.8\times10^{-9}$$

185. In a solvent 50% of an acid HA dimerises and the rest dissociates. The Van't Hoff factor of the acid is .... × 10^{-2}.
(Round off to the nearest integer)
[JEE Mains 2021, 27 July Shift-II]

Ans. (125) : The reaction is

$$\begin{array}{lcccccc} & 2HA \rightleftharpoons & H_2A_2, & HA \rightleftharpoons & H^+ & + & A^- \\ \text{Initial moles} & a\times\dfrac{50}{100} & 0 & a\times\dfrac{50}{100} & 0 & & 0 \\ \text{Final moles} & 0 & 0.25a & 0 & 0.5a & & 0.5a \end{array}$$

Now, $i = \dfrac{\text{final moles}}{\text{initial moles}}$

$$i = \frac{0.25a + 0.5a + 0.5a}{0.5a + 0.5a}$$

$i = 1.25$

$i = 125 \times 10^{-2}$

186. A 1 molal $K_4Fe(CN)_6$ solution has a degree of dissociation of 0.4. Its boiling point is equal to that of another solution which contains 18.1 weight percent of a non-electrolytic solute A. The molar mass of A is........u. (Round off to the nearest integer).
[Density of water = 1.0 g cm^{-3}]
[JEE Mains 2021, 17 March Shift-II]

Ans. (85) : Since boiling point is the same, elevation in boiling point is also the same for both solutions.

$(\Delta T_B)K_4\,[Fe\,(CN)_6] = (\Delta T_B)_A$

$(i\,K_Bm)\ K_4[Fe(CN)_6] = (i\,K_Bm)_A$

$$(1+4\alpha)\times1 = \frac{1\times\dfrac{18.1}{M}\times1000}{100-18.1}$$

$$2.6 = \frac{18.1}{M}\times\frac{1000}{18.9}$$

M = 85

187. The successive equilibrium constant for the stepwise dissociation of a tribasic acid are K_1, K_2, and K_3, respectively. The equilibrium constant for the overall dissociation is

(a) $(K_1 + K_2 + K_3)$
(b) $\sqrt[3]{(K_1 + K_2 + K_3)}$
(c) $(K_1 \times K_2 \times K_3)^3$
(d) $K_1 \times K_2 \times K_3$

TS-EAMCET (Engg.), 06.08.2021

Ans. (d): The equilibrium constant at first dissociation constant–

Since, $H_3A \overset{K_1}{\rightleftharpoons} H_2A^- + H^+$

$$K_1 = \frac{[H_2A^-][H^+]}{[H_3A]} \qquad .....(i)$$

$$H_2A^- \overset{K_2}{\rightleftharpoons} HA^{2-} + H^+$$

$$K_2 = \frac{[HA^{2-}][H^+]}{[H_3A^-]} \qquad .....(ii)$$

$$HA^{2-} \overset{K_3}{\rightleftharpoons} A^{3-} + H^+$$

$$K_3 = \frac{[A^{3-}][H^+]}{[HA^{2-}]} \qquad .....(iii)$$

Thus, $H_3A \overset{K_a}{\rightleftharpoons} A^{3-} + 3H^+$

$$K_a = \frac{[A^{-3}][H^+]^3}{[H_3A]}$$

Thus, equilibrium constant for the over all dissociation.

$$\boxed{K_a = K_1 \times K_2 \times K_3}$$

188. Match the following

List-I **Acid**	**List-II** **K_a (ionization constant)**
(a) HCN	(I) 6.8 × 10^{-4}
(b) $H_2C_2O_4$	(II) 8.9 × 10^{-8}
(c) H_2S	(III) 4.9 × 10^{-10}
(d) Niacin	(IV) 5.6 × 10^{-2}
	(V) 1.5 × 10^{-5}

The correct match is
Options :

	A	**B**	**C**	**D**
(a)	I	III	IV	V
(b)	V	II	III	IV
(c)	II	III	IV	V
(d)	III	IV	II	V

TS EAMCET 04.08.2021, Shift-I

Ans. (d) : Ionization constant is a constant that depends upon the equilibrium between ions and molecules that are not ionized in a solution or liquid.

	Acid	**K_a (Ionization constant)**
(A)	HCN	4.9 × 10^{-10}
(B)	$H_2C_2O_4$	5.6 × 10^{-2}
(C)	H_2S	8.9 × 10^{-8}
(D)	Niacin	1.5 × 10^{-5}

189. The stepwise formation of $[Cu(NH_3)_4]^{2+}$ is below:

$$Cu^{2+} + NH_3 \overset{K_1}{\rightleftharpoons} \left[Cu\left(NH_3\right)\right]^{2+}$$

$$\left[Cu\left(NH_3\right)\right]^{2+} + NH_3 \overset{K_2}{\rightleftharpoons} \left[Cu\left(NH_3\right)_2\right]^{2+}$$

$$\left[Cu\left(NH_3\right)_2\right]^{2+} + NH_3 \overset{K_3}{\rightleftharpoons} \left[Cu\left(NH_3\right)_3\right]^{2+}$$

$$\left[Cu\left(NH_3\right)_3\right]^{2+} + NH_3 \overset{K_4}{\rightleftharpoons} \left[Cu\left(NH_3\right)_4\right]^{2+}$$

The value of stability constants K_1, K_2, K_3 and K_4 are 10^4, 1.58×10^3, 5×10^2 and 10^2 respectively. The overall equilibrium constants for dissociation of

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$[Cu(NH_3)_4]^{2+}$ is $x\times10^{-12}$. The value of x is______. (Rounded off to the nearest integer)

JEE Mains 24.02.2021, Shift-I

Ans. (1) : $Cu^{2+}+NH_3 \xrightleftharpoons{K_1} [Cu(NH_3)]^{2+}$

$[Cu(NH_3)]^{2+}+NH_3 \xrightleftharpoons{K_2} [Cu(NH_3)_2]^{2+}$

$[Cu(NH_3)_2]^{2+}+NH_3 \xrightleftharpoons{K_3} [Cu(NH_3)_3]^{2+}$

$[Cu(NH_3)_3]^{2+}+NH_3 \xrightleftharpoons{K_4} [Cu(NH_3)_4]^{2+}$

So, $K = K_1 \times K_2 \times K_3 \times K_4$

$= 10^4 \times 1.58 \times 10^3 \times 5 \times 10^2 \times 10^2$

$K = 7.9 \times 10^{11}$

Where, K = Equilibrium constant for formation of $[Cu(NH_3)_4]^{2+}$ is $\frac{1}{K}$

$$K' = \frac{1}{K}$$

$$K' = \frac{1}{7.9\times10^{11}}$$

$= 1.26 \times 10^{-12} = (x \times 10^{-12})$

So, the value of x = 1.26.

190. When 9.45 g of $ClCH_2COOH$ is added to 500 mL of water, its freezing point drops by 0.5°C. The dissociation constant of $ClCH_2COOH$ is $x \times10^{-3}$. The value of x is ____. (rounded off to the nearest integer)
$[K_f(_{H_2O}) = 1.86\ K\ kg\ mol^{-1}]$

JEE Mains 24.02.2021, Shift-I

Ans. : Given– $\Delta T_p = 0.5°C$, $K_p = 1.86\ Kkg\ mol^{-1}$

The dissociation of $ClCH_2COOCH$ is :

$$ClCH_2COOH \rightleftharpoons ClCH_2COO^- + H^+$$

$i = 1 + (2 - 1)\alpha$

$i = 1 + \alpha$

Now, $\Delta T_p = iK_pm$

$$0.5 = (1+\alpha)\times1.86\times\frac{9.45\times1000}{94.5\times500}$$

or $1+\alpha = \frac{2.5}{1.86} \quad \Rightarrow \alpha = \frac{32}{93}$.

Now, $ClCH_2COOH \rightleftharpoons ClCH_2COO^- + H^+$

$C - C\alpha \qquad C\alpha \qquad C\alpha$

$$\therefore\ K_a = \frac{C\alpha\times C\alpha}{(C-C\alpha)} = \frac{C\alpha^2}{(1-\alpha)} \quad \left(\because C = \frac{0.1\times1000}{500} = 0.2\right)$$

or $$K_a = \frac{0.2\times(32)^2}{\left(1-\frac{32}{93}\right)(93)^2}$$

or $$K_a = \frac{0.2}{61}\times93\times\frac{(32)^2}{(93)^2}$$

or $K_a = 36\times10^{-3}$ (Given ; $K_a = x \times10^{-3}$)

$\therefore$ $x\times10^{-3} = 36\times10^{-3}$

or $x = 36$

191. A 1 molal $K_4[Fe(CN)_6]$ solution has a degree of dissociation of 0.4. Its boiling point is equal to that of another solution which contains 18.1 weight percent of a non electrolytic solute A. The molar mass of A is ________ u. (Round off to the Nearest Integer).
[Density of water =1.0 g cm^{-3}]

JEE Mains 17.03.2021, Shift-II

Ans. (85) :

Given that, degree of dissociation (α) = 0.4

The dissociation of potassium ferrocyanide is:

$$K_4[Fe(CN)_6] \rightleftharpoons 4K^+ + [Fe(CN)_6]^{4-}$$

Initial conc.	1m	0	0
Final conc.	(1–α)m	4α	α
∴	= 0.6 m	=1.6m	0.4

Effective molality = 0.6+1.6+0.4=2.6m

For same boiling point, the molatity of another solution should also be 2.6 m. Now, 18.1 weight percent solution means 18.1 g solute is present in 100g solution and here , (100–18.1) = 81.9 g water

Now, $2.6 = \frac{18.1/M}{81.9/1000}$

or $M = 85$

192. If in the reaction, $N_2O_4 \rightleftharpoons 2NO_2$; α is the degree of dissociation of N_2O_4, then total number of moles at equilibrium is :

(a) (1 – α)
(b) (1 + α)
(c) $(1 - \alpha)^2$
(d) $(1 + \alpha)^2$

Manipal-2020

Ans. (b) :

$$N_2O_4 \rightleftharpoons 2NO_2$$

t = 0	1	0
t = teq	1– α	2x

∴ Total moles = 1–α + 2α

= (1 + α)

193. The K_{sp} for the following dissociation is 1.6×10^{-5}

$$PbCl_2(s) \rightleftharpoons Pb^{2+}(aq) + 2Cl^-(aq)$$

Which of the following choices is correct for a mixture of 300 mL 0.134 M $Pb(NO_3)_2$ and 100 mL 0.4 M NaCl?

(a) $Q < K_{sp}$
(b) $Q > K_{sp}$
(c) $Q = K_{sp}$
(d) Not enough data provided

[JEE Mains 2020, 9 Jan Shift-I]

Ans. (b) : $PbCl_2(s) \rightleftharpoons Pb^{2+}_{(aq.)} + 2Cl^-_{(aq.)}$

$$[Pb^{2+}] = \frac{300\times0.134}{400} = 1.005\times10^{-1}M$$

$$[Cl^-] = \frac{100\times0.4}{400} = 10^{-1}M$$

Reaction quotient, $Q = [Pb^{2+}][Cl^-]^2$

$$= \frac{300\times0.134}{400}\times\left[\frac{100\times0.4}{400}\right]^2$$

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$$=1.005\times10^{-1}\times(10^{-1})^2$$
$$=1.005\times10^{-3}$$
$$Q > K_{sp}$$

194. When 0.05 M dimethyl amine is dissolve in 0.1 M NaOH solution then the percentage dissociation of dimethyl amine is: $(K_b)_{(CH_3)_2NH} = 5\times10^{-4}$

(a) 5×10^{-5} (b) 5×10^{-3}
(c) 5×10^{-1} (d) 5×10^{-2}

AIIMS 26 May 2019 (Morning)

Ans. (c): Given that: Concentration of dimethyl amine = 0.05 M, $K_b = 5 \times 10^{-4}$

$(OH^-) = 0.1+0.05\,\alpha \approx 0.1$

$$K_b = \frac{(C\alpha)(OH^-)}{(C-C\alpha)}$$

$$5\times10^{-4} = \frac{\alpha\times0.1}{1-\alpha}$$

$\alpha = 5 \times 10^{-1}\%$

195. K_2HgI_4 is 40% ionised in aqueous solution. The value of its Van't Hoff factor (i) is

(a) 1.6 (b) 1.8
(c) 2.2 (d) 2.0

[JEE Mains 2019, 11 Jan Shift-II]

Ans. (b) : The ionisation of K_2HgI_4 is given as–

$$K_2HgI_4 \longrightarrow 2K^+ + HgI_4^{2-}$$

$i = 1+(n-1)\alpha$

$\alpha = 0.4,\ n = 3$

So, $i = 1+2 \times 0.4 = 1.8$

196. Calculate Van't Hoff factor (i) for an aqueous solution of $K_3[Fe(CN)_6]$ having a degree of dissociation (α) equal to 0.778.

(a) 4.334 (b) 3.334
(c) 0.222 (d) 2.334

GUJCET-2019

Ans. (b) : The reaction is :

$$K_3[Fe(CN)_6] \rightarrow 3K^+ + [Fe(CN)_6]^{3-}$$

Here there are 4 ions form So:

$i = 1+(n-1)\alpha$

$i = 1+(4-1)0.778$

$i = 3.334$

197. Relationship between Van't Hoff's factor (i) and degree of dissociation (α) is

(a) $i = \dfrac{\alpha-1}{n'-1}$ (b) $i = \dfrac{\alpha-1}{1-n'}$

(c) $\alpha = \dfrac{1-i}{n'-1}$ (d) $\alpha = \dfrac{i-1}{n'-1}$

MHT CET-02.05.2019, SHIFT-II

Ans. (d) : Relationship between Van't Hoff factor (i) and degree of dissociation (α) is given by

$$\alpha = \frac{1-i}{n'-1}$$

The relationship can be obtained as follows-

For the reaction

$$\begin{array}{lccc} & A & \rightleftharpoons & n'B \\ \text{Initially} & 1\,\text{mole} & & 0 \\ \text{After diss.} & 1-\alpha & & n'\alpha \end{array}$$

Total no. of moles present in the solution

$= (1-\alpha) + n'\alpha$

$= 1 + (n'-1)\alpha$

Van't Hoff factor (i) = $1 + (n' - \alpha)$, $\alpha > 1$ if $n' \geq 2$

So, $\alpha = \dfrac{i-1}{n'-1}$

198. Degree of dissociation of an acid HCl is 95%. 0.192 g of the acid is present in 0.5 L of solution. The pH of the solution is :

(a) 2 (b) 1
(c) 3 (d) 4

Manipal-2018

Ans. (a) : Given, Amount of acid = 0.192g

$$\therefore \text{ No. of moles of acid} = \frac{0.192}{36.5} = 0.0053$$

Volume = 0.5 L

$$\text{Molarity of HCl} = \frac{0.0053}{0.5} = 1.06\times10^{-2}\,M$$

$[H^+]$ in HCl solution–

$= 1.06 \times 10^{-2} \times \dfrac{95}{100}$

$= 100.7 \times 10^{-4}$

$= 1 \times 10^{-2}$

Thus pH = $-\log[H]^+$

$= -\log(1 \times 10^{-2})$

$= 2$

199. For the following equilibrium $N_2O_4 \rightleftharpoons 2NO_2$ in gaseous phase, NO_2 is 50% of the total volume, when equilibrium is set up. Hence, percent dissociation of N_2O_4 is :

(a) 50% (b) 25%
(c) 66.66% (d) 33.33%

BCECE-2017

Ans. (d) : The dissociation of N_2O_4 is–

$$N_2O_4 \rightleftharpoons 2NO_2$$

Initial 1 0

At equilibrium $1-x$ $2x$

Total numbers of moles = $1-x+2x = 1+x$

$$\therefore \%\text{ of } NO_2 \text{ by Volume} = \frac{2x}{1+x}\times100 = 50$$

$$x = \frac{1}{3}$$

Hence, % dissociation = 33.33%

200. The Van't Hoff's factor 'i' accounts for

(a) extent of solubility of solute
(b) extent of mobility of solute
(c) extent of dissolution of solute
(d) extent of dissociation of solute

Karnataka-CET-2017

Ans. (d) : The Van't Hoff's factor (i) accounts for the extent of dissociation of solute.

@apna_pdf

201. For which among the following equimolar aqueous solutions Van't Hoff factor has the lowest value?

(a) Aluminium chloride (b) Potassium sulphate
(c) Ammonium chloride (d) Urea

MHT CET-2017

Ans. (d) : For the aqueous solution of urea, Van't Hoff factor has the lowest value.

Urea is non-electrolyte and does not dissociate in aqueous solution. Hence, Vant Hoff factor is 1.

For Aluminium chloride $AlCl_3$–

$$AlCl_3 \rightarrow Al^{3+} + 3Cl^-$$
$$i = 4$$

For potassium sulphate K_2SO_4

$$K_2SO_4 \rightarrow 2K^+ + SO_4^{2-}$$
$$i = 3$$

202. When an electrolyte is dissociated in solution, the van't Hoff's factor (i) is

(a) > 1 (b) < 1
(c) = 0 (d) = 1

Karnataka-CET-2016

Ans. (a) : When an electrolyte is dissolved in the solution, it breaks into ions and hence the Van't Hoff factor will be greater than 1 (i > 1).

203. When PCl_5 is heated it gasifies and dissociates into PCl_3 and Cl_2. The density of the gas mixture at 200°C is 70.2. What is the degree of dissociation of PCl_5 at 200°C?

(a) 0.485 (b) 0.242
(c) 0.845 (d) 0.542

AMU-2016

Ans. (a) : The dissociation of PCl_5 is–

$$PCl_5(g) \rightarrow PCl_3(g) + Cl_2(g)$$

The initial vapour density will be same, it would be $M_{PCl_5}/2$.

$\therefore$ Initial vapour density = (31+5×35.5)/2=104.25

Vapour density at equilibrium at 200°C= 70.2

$\therefore$ Total moles at equilibrium

$$(1+\alpha) = \frac{\text{Vapour density initial}}{\text{Vapour density at equilibrium}}$$

$$(1+\alpha) = \frac{104.25}{70.2} = 1.485$$

$$1+\alpha = 1.485$$
$$\alpha = 0.485$$

204. The percentage hydrolysis of 0.15 solution of ammonium acetate, K_a for CH_3COOH is 1.8×10^{-5} and K_b for NH_3 is 1.8×10^{-5}

(a) 0.556 (b) 4.72
(c) 9.38 (d) 5.56

BITSAT-2016

Ans. (a) : Given that, K_a for $CH_3COOH = 1.8 \times 10^{-5}$

K_b for $NH_3 = 1.8\times10^{-5}$

The degree of hydrolysis:

$$h = \sqrt{\frac{K_w}{K_a \times K_b}} = \sqrt{\frac{1\times10^{-14}}{1.8\times10^{-5}\times1.8\times10^{-5}}}$$

$$h = 0.556$$

205. 0.6 mL of acetic acid is dissolved in 1 litre of water. The value of Van't Hoff factor is 1.04. What will be the degree of dissociation of the acetic acid?

(a) 0.01 (b) 0.02
(c) 0.03 (d) 0.04

AMU-2015

Ans. (d) : Given, Van't Hoff factor (*i*) = 1.04

The dissociation reaction of CH_3COOH is–

	$CH_3COOH \rightleftharpoons$	$CH_3COO^- +$	H^+
Before diss.	1	0	0
After diss.	$(1-\alpha)$	α	α

Van't Hoff factor (*i*) = $(1 - \alpha) + \alpha + \alpha$

$$1.04 = 1 + \alpha$$

or $\alpha = 0.04$

206. Which of the following compounds have the same value of Van't Hoff's factor (*i*) as that of $Al_2(SO_4)_3$?

(a) $K_4[Fe(CN)_6]$ (b) NaCl
(c) $Al(NO_3)_3$ (d) Na_2SO_4

COMEDK-2015

Ans. (a) : (a) The dissociation of $K_4[Fe(CN)_6]$ is–

$$K_4[Fe(CN)_6] \Rightarrow 4K^+ + [Fe(CN)_6]^{4-}$$

Here, Van't Hoff factor (*i*) = 4 + 1 = 5

(b) $NaCl \rightarrow Na^+ + Cl^-$

$i = 2$

(c) $Al(NO_3)_3 \rightarrow Al^{3+} + 3NO_3^-$

$i = 4$

(d) $Na_2SO_4 \rightarrow 2Na^+ + 5O_4^{2-}$

$i = 3$

Hence, option (a) have value of vant Hoff's factor (i) same as that of $Al_2(SO_4)_3$.

207. Which of the following compound possesses the C—H bond with the lowest bond dissociation energy?

(a) Toluene (b) Benzene
(c) n-pentane (d) 2, 2-dimethyl propane

Karnataka-CET-2015

Ans. (a) : Toluene has the lowest C – H bond dissociation energy compare to other three The C – H bond of the methyl group is in hyper conjugation with benzene nucleus. Hence it is easy to break.

208. Van't Hoff factor of centimolal solution of $K_3[Fe(CN)_6]$ is 3.333. Calculate the per cent dissociation of $K_3[Fe(CN)_6]$.

(a) 33.33 (b) 0.78
(c) 78 (d) 23.33

MHT CET-2015

Ans. (c) : Given, Van't Hoff's factor = 3.333, %α = ?

The dissociation of $K_3[Fe(CN)_6]$ is–

$$K_3[Fe(CN)_6] \rightarrow 3K^+ + [Fe(CN)_6]^{3-}$$
$$i = 1 + (n-1)\alpha$$

Here, $n = 4$

$\therefore$ $i = 1 + (4-1)\alpha$

So, $3.333 = 1 + (4-1)\alpha$

$3.333 - 1 = 3\alpha$

or $3\alpha = 2.333$

@apna_pdf

$$\alpha = \frac{2.333}{3}$$

$$\alpha = 0.777$$

Percent dissociation = 0.777 × 100

≈ 78%

209. Van't Hoff's factors of equimolal solutions of sodium chloride, barium chloride and glucose in water are

(a) 2, 3, 0 respectively
(b) 2, 3, 6 respectively
(c) 2, 3, 4 respectively
(d) 2, 3, 1 respectively

COMEDK-2014

Ans. (d) : Van't Hoff factor (*i*) gives the extent of association or dissociation of the solute particles in the solution.

$$NaCl(aq) \rightarrow Na^+ + Cl^-$$

van't Hoff's factor (*i*) = 2

And, $BaCl_2 \rightarrow Ba^{2+} + 2Cl^-$

van't Hoff's factor (*i*) = 3

Glucose does not undergoes dissociation or association (*i*) = 1.

Hence, option (d) is correct.

210. What will be the degree of ionisation of 0.05 M acetic acid if its pK_a value is 4.74?

(a) 0.019%
(b) 1.9%
(c) 3.0%
(d) 4.74%

JCECE - 2014

Ans. (b) : Given, Concentration = 0.05 M, pK_a = 4.74

The ionisation of acetic acid is–

$$\begin{array}{lccc} & CH_3COOH & \rightleftharpoons CH_3COO^- & + H^+ \\ \text{Initially} & 1 & 0 & 0 \\ \text{At equilibrium} & 1-\alpha & \alpha & \alpha \end{array}$$

$pK_a = -\log K_a = 4.74$

∴ K_a = antilog (4.74)

$K_a = 1.82 \times 10^{-5}$

From, $K_a = \frac{C\alpha^2}{(1-\alpha)} = C\alpha^2$ $(1 - \alpha \approx 1)$

$$\alpha = \sqrt{\frac{K_a}{C}} = \sqrt{\frac{1.82\times10^{-5}}{0.05}} = 0.019 \text{ or } 1.9\%$$

211. The value of vant Hoff's factor for $Hg_2(NO_3)_2$ is

(a) 1
(b) 2
(c) 3
(d) 4

UP CPMT-2014

Ans. (c) : $Hg_2(NO_3)_2$ ionizes as –

$$Hg_2(NO_3)_2 \longrightarrow Hg_2^{2+} + 2NO_3^-$$

So, van't Hoff's factor, i = 3

212. On adding 0.1 M solution each of $[Ag^+]$, $[Ba^{2+}]$, $[Ca^{2+}]$ in Na_2SO_4 solution, species first precipitated is
[$K_{sp}BaSO_4 = 10^{-11}$, $K_{sp}CaSO_4 = 10^{-6}$ and $K_{sp}Ag_2SO_4 = 10^{-5}$]

(a) Ag_2SO_4
(b) $BaSO_4$
(c) $CaSO_4$
(d) All of these

JCECE - 2013

Ans. (b) : Solubility of $BaSO_4$, (X) = $\sqrt{K_{sp}} = \sqrt{10^{-11}}$

$= 3.16 \times 10^{-6}$ $molL^{-1}$

Solubility of Ag_2SO_4, $4x^3 = K_{sp}$

$$x = \sqrt[3]{\frac{10^{-5}}{4}} = 1\times10^{-2}\,mol\,L^{-1}$$

Least solubility is of $BaSO_4$, hence it will precipitate first.

213. Accumulation of Lactic acid ($HC_3H_5O_3$), a monobasic acid in tissues leads to pain and a feeling to fatigue. In a 0.10 M aqueous solution, Lactic acid is 3.7% dissociates. The value of dissociation constant, K_a, for this acid will be

(a) 1.4×10^{-5}
(b) 1.4×10^{-4}
(c) 3.7×10^{-4}
(d) 2.8×10^{-4}

Karnataka NEET 2013

Ans. (b) :

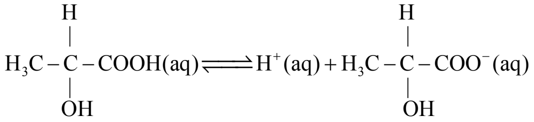
Degree of dissociation $(\alpha) = 3.7\% = \frac{3.7}{100} = 0.037$

According to Ostwald's formula,

$K_a = \alpha^2 C$

$K_a = (0.037)^2 \times 0.10 = 1.369\times10^{-4} = 1.4\times10^{-4}$

214. The degree of ionization of 0.10 M lactic acid is 4.0%



$$H_3C-\underset{OH}{\overset{H}{C}}-COOH(aq) \rightleftharpoons H^+(aq) + H_3C-\underset{OH}{\overset{H}{C}}-COO^-(aq)$$

The value of K_c is

(a) 1.66×10^{-5}
(b) 1.66×10^{-4}
(c) 1.66×10^{-3}
(d) 1.66×10^{-2}

AP-EAMCET (Engg.) 2013

Ans. (b) : Given that, Degree of ionisation $(\alpha) = 4\%$

$$\alpha = \frac{4}{100} = 0.04$$

The ionisation of lactic acid is–

$$\begin{array}{lccc} & CH_3CH(OH)COOH & \rightleftharpoons CH_3CH(OH)COO^- & + H^+ \\ \text{Initial concentration} & C & 0 & 0 \\ \text{At equilibrium} & C(1-\alpha) & C\alpha & C\alpha \end{array}$$

∴ At equilibrium $(K_c) = \frac{C\alpha \cdot C\alpha}{C(1-\alpha)} = \frac{C\alpha^2}{(1-\alpha)}$

$$K_c = \frac{0.1\times0.04\times0.04}{(1-0.04)}$$

$$K_c = 1.66\times10^{-4}$$

215. What will be the % of the N_2H_4 that has reacted with water in solution, when 0.32 g of N_2H_4 are dissolved in water and the total volume was made 4 L (given, K_b for $N_2H_4 = 6 \times 10^{-8}$ M)

(a) 3%
(b) 3.6%
(c) 2%
(d) 0.489%

UP CPMT-2013

Ans. (d) : Given, Amount of N_2H_4 = 0.32g

Total volume = 4L

Concentration or molarity of hydrazine solution

$= \frac{0.32}{32}\times\frac{1}{4}M = 0.25 \times 10^{-2}$ M

Ionisation of hydrazine–

$$\begin{array}{lccc} & NH_2NH_2 + H_2O & \rightleftharpoons NH_2NH_3^{\oplus} & + OH^- \\ \text{Initial conc.} & C & 0 & 0 \\ \text{Equi.conc.} & C(1-\alpha) & C\alpha & C\alpha \end{array}$$

@apna_pdf

$$\therefore \quad K_b = \frac{[NH_2NH_3^{\oplus}][OH^-]}{[NH_2NH_2]}$$

$$K_b = \frac{C\alpha \times C\alpha}{C(1-\alpha)} \qquad (\alpha <<< 1)$$

$$\text{or} \quad K_b = C\alpha^2$$

$$\text{or} \quad \alpha = \sqrt{\frac{K_b}{C}}$$

$$= \sqrt{\frac{6\times10^{-8}}{0.25\times10^{-2}}}$$

$$= 0.489 \times 10^{-2}$$

Degree of ionisation = 0.489×10^{-2}

% of N_2H_4 that has reacted with water (% ionisation)

$= (0.489 \times 10^{-2}) \times 100$

$= 0.489\%$

216. At 25ºC, the dissociation constant of a base, BOH, is 1.0 × 10^{-12}. The concentration of hydroxyl ions in 0.01 M aqueous solution of the base would be

(a) 2.0×10^{-6} mol L^{-1}
(b) 1.0×10^{-5} mol L^{-1}
(c) 1.0×10^{-6} mol L^{-1}
(d) 1.0×10^{-7} mol L^{-1}

JCECE - 2012

Ans. (d) : Given that, $K_b = 1.0 \times 10^{-12}$

$[BOH] = 0.01$ M

Base (BOH) is dissociated as follows–

$$BOH \rightleftharpoons B^+ + OH^-$$

So, the dissociation constant of base BOH–

$$K_b = \frac{[B^+][OH^-]}{[BOH]} \qquad \ldots(i)$$

At equilibrium,

$$[B^+] = [OH^-]$$

$$\therefore \quad K_b = \frac{[OH^-]^2}{[BOH]}$$

$$\text{Thus,} \quad 1.0 \times 10^{-12} = \frac{[OH^-]^2}{0.01}$$

$$[OH^-]^2 = 1 \times 10^{-14}$$

$$[OH^-] = 1.0 \times 10^{-7} \text{ mol L}^{-1}$$

217. The degree of ionization of 0.4 M acetic acid will be ($K_a = 1.8\times10^{-5}$)

(a) 6.71×10^{-3}
(b) 1.6×10^{-3}
(c) $0.4\times1.8\times10^{-5}$
(d) 1.8×10^{-5}

MHT CET-2012

Ans. (a) : Given, Concentration (C) = 0.4 M

$K_a = 1.8\times10^{-5}$

The ionisation of acetic acid is–

$$CH_3COOH \rightleftharpoons CH_3COO^- + H^+$$

$$\therefore \quad K_a = C\alpha^2$$

$$1.8 \times 10^{-5} = 0.4 \times \alpha^2$$

$$\alpha = \sqrt{\frac{1.8\times10^{-5}}{0.4}}$$

$$\alpha = 6.71 \times 10^{-3}$$

218. An acid HA ionises as $HA \rightleftharpoons H^+ + A^-$ The pH of 1.0 M solution is 5. Its dissociation constant would be

(a) 1×10^{-10}
(b) 5
(c) 5×10^{-8}
(d) 1×10^{-5}

[AIEEE 2011]

Ans. (a) : Given, pH = 5, concentration = 1 M, K_a = ?

The acid HA ionises as:

$$HA \rightleftharpoons H^+ + A^-$$

Also, 1 M solution means [HA] = 1

$$\text{So,} \quad K_a = \frac{[H^+][A^-]}{HA} = \frac{(10^{-5})(10^{-5})}{1}$$

$$K_a = 1 \times 10^{-10}$$

219. The van't Hoff factor (*i*) for a dilute aqueous solution of sucrose is

(a) zero
(b) 1.0
(c) 1.5
(d) 2.0

J & K CET-(2011)

Ans. (b) : The dilute aqueous solution of sucrose cannot associated or dissociated.

Hence, van't Hoff factor '*i*' is one

i = 1(No. of association or dissociation)

i > 1 (for dissociation)

i < 1 (for association)

220. Which of the following compounds corresponds to Van't Hoff factor (*i*) to be equal to 2 for dilute solution?

(a) K_2SO_4
(b) $NaHSO_4$
(c) Sugar
(d) $MgSO_4$

JCECE - 2011

Ans. (d) : *i* = 2 means two ions are present in the solution.

$$K_2SO_4 \longrightarrow \underbrace{2K^+ + SO_4^{2-}}_{3\text{ ions}}$$

$$NaHSO_4 \longrightarrow \underbrace{Na^+ + H^+ + SO_4^{2-}}_{3\text{ ions}}$$

$$\text{Sugar} \longrightarrow \text{No ions}$$

$$MgSO_4 \longrightarrow \underbrace{Mg^{2+} + SO_4^{2-}}_{2\text{ ions}}$$

Thus, van't Hoff factor is 2 for dilute solution of $MgSO_4$.

221. The degree of dissociation of PCl_5 at 1 atm and 298 K is 0.2. The value of K_p is

(a) 0.42 atm
(b) 0.24 atm
(c) 0.48 atm
(d) 0.042 atm

SRMJEEE – 2010

Ans. (d) : The dissociation of PCl_5 is :

$$PCl_5 \rightleftharpoons PCl_3 + Cl_2$$

$$\begin{array}{llll} \text{Initially} & 1 & 0 & 0 \\ \text{At equi.} & 1-\alpha & \alpha & \alpha \end{array}$$

Total mole (Δn_g) = 1 + 1 – 1 = 1

Given – α = 0.2 at 1 atm pressure

$$K_p = \frac{n_{PCl_5} \times n_{Cl_2}}{n_{PCl_5}} \times \left[\frac{P}{\Sigma_n}\right]^{\Delta n_g}$$

@apna_pdf

$$K_p = \frac{\alpha \times \alpha}{(1-\alpha)}\left[\frac{P}{1+\alpha}\right]^1$$
$$K_p = \frac{\alpha^2 \times P}{1-\alpha^2}$$
$$K_p = \frac{(0.2)^2 \times 1}{1-(0.2)^2}$$
$$K_p = \frac{0.2 \times 0.2}{0.96}$$
$$K_p = 0.0416$$
$$K_p \approx 0.042$$

222. If $BaCl_2$ ionizes to an extent of 80% in aqueous solution, the value of van't Hoff factor is

(a) 2.6　　(b) 0.4
(c) 0.8　　(d) 2.4

AP-EAMCET- (Engg.) - 2010

Ans. (a) : Ionisation of $BaCl_2$ is–

$$BaCl_2(s) \xrightarrow{H_2O} Ba^{2+} + 2Cl^-$$

Initial　1　0　0
at 80% aqueous sol. (1–0.8)　0.8　2×0.8=1.6

$$\text{van't Hoff factor (i)} = \frac{\text{No. of moles after reaction}}{\text{Initial no. of moles}}$$
$$i = \frac{(1-0.8)+0.8+1.6}{1}$$
$$i = 2.6$$

223. Approximate relationship between dissociation constant of water (K) and ionic product of water (K_w) is

(a) $K_w = K$　　(b) $K_w = 55.6 \times K$
(c) $K_w = 18 \times K$　　(d) $K_w = 14 \times K$

A.M.U. – 2009

Ans. (b) : Dissociation constant–

$$H_2O \rightleftharpoons H^+ + OH^-$$
$$K = \frac{[H^+][OH^-]}{[H_2O]}$$
$$K = \frac{10^{-14}}{55.6}$$

$\because$　$K_w = 1 \times 10^{-14}$

Hence,　$K_w = 55.6 \times K$

224. Van't Hoff factor of aq K_2SO_4 at infinite dilution has value equal to

(a) 1　　(b) 2
(c) 3　　(d) between 2 and 3

AMU-2009

Ans. (c) : At infinite dilution, complete dissociation will take place. So,

$$K_2SO_4 \rightarrow 2K^+ + SO_4^{2-}$$

van't Hoff factor = 2 + 1 =3

225. The degree of dissociation of $Ca(NO_3)_2$ in dilute aq. solution containing 7.0 g of salt per 100 g of water at 100°C is 70%. If vapour pressure of water at 100°C is 760 mm Hg. The vapour pressure of solution is

(a) 735　　(b) 730
(c) 760　　(d) 746

[BITSAT – 2009]

Ans. (d) : The molar mass of calcium nitrate is 164 g/mol.

7 g of calcium nitrate $\frac{7}{164} = 0.0427$ moles

The molar mass of water is 18 g/mol.

100 g of water $\frac{100}{18} = 5.56$ moles

The mole fraction of calcium nitrate $= \frac{0.0427}{0.0424+5.56}$
$= 0.00762$

The degree of dissociation α = 70% = 0.7

The van't Hoff factor = [1+(n–1)α]
i = [1+(3–1)0.7]
i = 2.4

The relative lowering of the vapour pressure

$$\frac{P^\circ - P}{P^\circ} = ix$$
$$\frac{760-P}{760} = 2.4 \times 0.00762 = 0.018$$

760–P=13.9
P = 746.10mm

226. At a certain temperature, the dissociation constants of formic acid and acetic acid are 1.8×10^{-4} and 1.8×10^{-5} respectively. The concentration of acetic acid solution in which the hydrogen ion has the same concentration as in 0.001 M formic acid solution is equal to

(a) 0.01 M　　(b) 0.001 M
(c) 0.1 M　　(d) 0.0001 M
(e) 0.1010 M

Kerala-CEE-2009

Ans. (a) : Given that,

Dissociation constant of formic acid $(K_{a_1}) = 1.8 \times 10^{-4}$

Dissociation constant of acetic acid $(K_{a_2}) = 1.8 \times 10^{-5}$

Concentration of acetic acid $(C_1) = 0.001$ M

$\therefore$　$H^+ = \sqrt{K_a \cdot C}$

So,　$K_{a_1} \cdot C_1 = K_{a_2} \cdot C_2$

$$1.8 \times 10^{-4} \times 0.001 = 1.8 \times 10^{-5} \times C_2$$
$$C_2 = \frac{1.8\times10^{-7}}{1.8\times10^{-5}}$$
$$C_2 = 10^{-2}$$
$$C_2 = 0.01 \text{ M}$$

227. 0.1 M solution of which of the following has almost unity degree of dissociation ?

(a) Ammonium chloride　　(b) Potassium chloride
(c) Sodium acetate　　(d) All of the above

MHT CET-2009

Ans. (b) : Among the given only potassium chloride (KCl) is a strong electrolyte, so its degree of dissociation is almost unity.

228. The degree of dissociation of a 0.01 M weak acid is 10^{-3}. Its pOH is

(a) 5　　(b) 3
(c) 9　　(d) 11

MHT CET-2009

@apna_pdf

Ans. (c) : Given, Concentration = 0.01 M

Degree of dissociation (α) = 10^{-3}

pOH = ?

$$\therefore \quad [H^+] = K_a C$$
$$= \alpha^2 \times C^2 \qquad [\because\ K_a = \alpha^2 C]$$
$$= (10^{-3})^2 . (0.01)^2$$
$$= 10^{-5}$$
$$pH = -\log [H^+] = -\log 10^{-5} = 5$$
$$pOH = 14 - 5 = 9$$

229. In a 500 mL flask, the degree of dissociation of PCl_5 at equilibrium is 40% and the initial amount is 5 moles. The value of equilibrium constant in mol L^{-1} for the decomposition of PCl_5 is

(a) 2.33
(b) 2.66
(c) 5.32
(d) 4.66

AP-EAMCET-2008

Ans. (b) :

$$\begin{array}{llll} & PCl_5 \rightleftharpoons & PCl_3 + & Cl_2 \\ \text{Initial} & 5 & 0 & 0 \\ \text{Conc. at Equilibrium} & \dfrac{5(1-\alpha)}{0.5} & \dfrac{5\alpha}{0.5} & \dfrac{5\alpha}{0.5} \end{array}$$

Given that,

Degree of dissociation of PCl_5 at equilibrium (α)=40%
= 0.4

$$\therefore \quad K_c = \frac{[PCl_3][Cl_2]}{[PCl_5]}$$
$$= \frac{\left(\frac{5\times0.4}{0.5}\right)\left(\frac{5\times0.4}{0.5}\right)}{\left(\frac{5\times0.6}{0.5}\right)} = \frac{16}{6} = 2.66\ \text{mol/L}$$

230. Assertion (A) The aqueous solution of CH_3COONa is alkaline in nature.

Reason (R) : Acetate ion undergoes anionic hydrolysis.

The correct answer is

(a) Both (A) and (R) are true and (R) is the correct explanation of (A)
(b) Both (A) and (R) are true and (R) is not correct explanation of (A)
(c) (A) is true but (R) is not true
(d) (A) is not true but (R) is true

AP-EAMCET-2008

Ans. (a) : The aqueous solution of CH_3COONa is alkaline in nature.

$$CH_3COONa \underset{}{\overset{\text{Ionisation}}{\rightleftharpoons}} CH_3COO^- + \underset{\text{Strong base}}{Na^+}$$
$$CH_3COO^- + H_2O \rightarrow CH_3COOH + OH^-$$

Acetate ion undergoes anionic hydrolysis due to excess of OH^- ions.

231. The equilibrium constants K_{p_1} and K_{p_2} for the reactions $X \rightleftharpoons 2Y$ and $Z \rightleftharpoons P + O$, respectively are in the ratio of 1:9. If the degree of dissociation of X and Z be equal, then the ratio of total pressure at these equilibria is

(a) 1:36
(b) 1:1
(c) 1:3
(d) 1:9

NEET-2008

Ans. (a) : The reaction is–

$$\begin{array}{lcc} & X \rightleftharpoons & 2Y \\ \text{Initially} & 1 & 0 \\ \text{At equilibrium} & (1-x) & 2x \end{array}$$

Total moles = 1 – x + 2x = 1 + x

$$p_Y = \frac{2x}{1+x} \cdot P_1, \quad p_X = \frac{1-x}{1+x} \cdot P_1$$
$$\therefore \quad K_{p_1} = \frac{p_Y^2}{p_X}$$
$$K_{p_1} = \frac{(2x)^2}{(1+x)^2} \times \frac{(1+x)}{(1-x)} \times P_1$$
$$K_{P_1} = \frac{(2x)^2}{(1-x)}\left(\frac{P_1}{1+x}\right)$$
$$\begin{array}{lcc} Z \rightleftharpoons & P + & Q \\ 1 & 0 & 0 \\ (1-x) & x & x \end{array}$$

Similarly,

$$K_{P_2} = \frac{(x)^2}{(1-x)}\left(\frac{P_2}{1+x}\right)$$

Given that :

$$\frac{K_{p_1}}{K_{p_2}} = \frac{1}{9}$$
$$\frac{\frac{4x^2}{(1-x)}\left(\frac{P_2}{1+x}\right)}{\frac{x^2}{(1-x)}\left(\frac{P_1}{1+x}\right)} = \frac{1}{9}$$
$$\frac{4\times P_1}{P_2} = \frac{1}{9}$$
$$\frac{P_1}{P_2} = \frac{1}{36}$$
$$P_1 : P_2 = 1:36$$

232. An acid solution of 0.005M has a pH of 5. The degree of ionization of acid is

(a) 0.1×10^{-2}
(b) 0.2×10^{-2}
(c) 0.5×10^{-4}
(d) 0.6×10^{-6}

BCECE-2007

Ans. (b) : Given, Concentration = 0.005 M, pH = 5

Degree of ionization = ?

$$\because \quad pH = -\log[H^+]$$
$$\text{or} \quad 5 = -\log[H^+]$$
$$\text{or} \quad [H^+] = 10^{-5}$$
$$\text{Now,} \quad \alpha = \frac{\text{actual ionisation}}{\text{molar concentration}}$$
$$\alpha = \frac{10^{-5}}{0.005} = 0.2\times10^{-2}$$

233. A monoprotic acid in 1.00 M solution is 0.01% ionised. The dissociation constant of this acid is

(a) 1×10^{-8}
(b) 1×10^{-4}
(c) 1×10^{-6}
(d) 1×10^{-5}

BCECE-2006

Ans. (a) : Given, C = 1.00 M, K_a = ?

We use the Ostwald's dilution law for weak electrolytes–

@apna_pdf

$$\alpha = \sqrt{K_a V}$$

Here, $\alpha = 0.001\% \; = 0.0001 = 1\times10^{-4}$

$$V = \frac{1}{C} = \frac{1}{1-0} = 1L$$

$$\therefore \quad K_a = \frac{\alpha^2}{V} = \frac{(1\times10^{-4})^2}{1}$$

$$= 1\times10^{-8}$$

234. A 2.1 aqueous solution of a weak acid is 2% ionised. If the ionic product of water is 1 × 10^{-14} The [OH^-] is;

(a) 5×10^{-12} M (b) 2×10^{-3} M

(c) 1×10^{-14} M (d) None of the above

AP-EAMCET (Medical), 2006

Ans. (a) : Degree of dissociation of weak acid (α) = $\frac{2}{100} = 0.02$

Concentration of H^+ = $C.\alpha = 0.1\times0.02 = 2\times10^{-3}$

Given:- ionic product of water (K_w) = 1×10^{-14}

$\therefore$ [H^+] [OH^-] = K_w

$$[OH^-] = \frac{1\times10^{-14}}{2\times10^{-3}}$$

[OH^-] = 5×10^{-12} M

235. HA is a weak acid. The pH of 0.1M HA solution is 2. What is the degree of dissociation (α) of HA?

(a) 0.5 (b) 0.2

(c) 0.1 (d) 0.301

J & K CET-(2006)

Ans. (c) : Given that- pH = 2

$\therefore \quad [H^+] = 10^{-2}$

For weak acid-

$[H^+] = C\alpha = 0.1 \times \alpha$

$10^{-2} = 0.1 \; \alpha$

$$\alpha = \frac{10^{-2}}{0.1} = 0.1$$

236. Degree of dissociation of 0.1 N CH_3COOH is ($K_{acid} = 1 \times 10^5$)

(a) 10^{-5} (b) 10^{-4}

(c) 10^{-3} (d) 10^{-2}

UP CPMT-2006

Ans. (d) : Given, C = 0.1 N, $K_a = 1 \times 10^5$

Relation between degree of dissociation and dissociation constant–

$$\therefore \quad \alpha = \sqrt{\frac{K_a}{C}} = \sqrt{\frac{1.0\times10^{-5}}{0.1}}$$

$$= \sqrt{1.0\times10^{-4}} = 1.0\times10^{-2}$$

237. If α is the degree of dissociation of Na_2SO_4 , the van't Hoff factor (*i*) used for calculating the molecular mass is

(a) $1-2\alpha$ (b) $1+2\alpha$

(c) $1-\alpha$ (d) $1+\alpha$

AIEEE-2005

Ans. (b) : The dissociation of Na_2SO_4 is given as–

$$Na_2SO_4 \longrightarrow \underbrace{2Na^+ + SO_4^{-2}}_{n=2}$$

$\therefore \quad i = 1 + (n–1)\alpha$

$i = 1 + 2\alpha$

238. The van't Hoff factor of $BaCl_2$ at 0.01M concentration is 1.98. The percentage of dissociation of $BaCl_2$ at this concentration is :

(a) 49 (b) 69

(c) 89 (d) 98

(e) 100

Kerala-CEE-2005

Ans. (a) : Given, i = 1.98, Concentration = 0.01 M

The dissociation of $BaCl_2$ is–

$$BaCl_2 \rightleftharpoons Ba^{2+} + 2Cl^-$$

We know that–

$$\alpha = \frac{i-1}{n-1}$$

Where, i = van't Hoff factor

n = number of dissociated ion

$$\therefore \quad \alpha = \frac{1.98-1}{3-1}$$

$$\alpha = \frac{0.98}{2}$$

$\alpha = 0.49$

$\therefore$ % dissociation = α = 100 = 49%

239. When NH_4Cl is added to NH_4OH solution, the dissociation of ammonium hydroxide is reduced. it is due to

(a) common ion effect (b) hydrolysis

(c) oxidation (d) reduction

CG PET-2004

Ans. (a) : When NH_4Cl is added to NH_4OH solution, concentration of NH_4^+ ions increases so the equilibrium shift towards left.

So, the dissociation of NH_4OH is reduced it is due to common ion effect.

240. At 90°C, pure water has [H_3O^+]= 10^{-6} moles/litre. The value of K_w at 90°C is

(a) 10^{-6} (b) 10^{-8}

(c) 10^{-12} (d) 10^{-14}

J & K CET-(2004)

Ans. (c) : Given,

$[H_3O^+] = 10^{-6}$ mol/L

Ionization reaction of H_2O is-

$$H_2O \rightleftharpoons H^+ + OH^-$$

$$K = \frac{[H^+][OH^-]}{H_2O}$$

$K \times [H_2O] = [H^+] \; [OH^-]$

$\therefore \quad K_w = [H^+] \; [OH^-]$

$[H^+] = [OH^-] = 10^{-6}$ mol/litre

$\therefore$ Mentioned that it is pure water

$K_w = [H^+] \; [OH^-]$

$K_w = 10^{-6} \times 10^{-6}$

$K_w = 10^{-12}$

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241. The K_a of an acid is 3.2×10^{-5}. The degree of dissociation of the acid at concentration of 0.2 M is

(a) 6.0×10^{-2} (b) 1.26×10^{-2}
(c) 40×10^{-4} (d) 0.04×10^{-3}

JIMPER-2004

Ans. (b) : Given, K_a of an acid = 3.2×10^{-5}
Concentration = 0.2 M
From Ostwald's dilution law –

$$\alpha = \sqrt{\frac{K_a}{C}}$$

$$\alpha = \sqrt{\frac{3.2\times10^{-2}}{0.2}}$$

$$\alpha = 1.26\times10^{-2}$$

242. The degree of hydrolysis in hydrolytic equilibrium $A^- + H_2O \rightleftharpoons HA + OH^-$ at salt concentration of 0.001 M is: ($K_a = 1 \times 10^{-5}$)

(a) 1×10^{-3} (b) 1×10^{-4}
(c) 5×10^{-4} (d) 1×10^{-6}

UPTU/UPSEE-2004

Ans. (a) : We have,
$K_a = 1 \times 10^{-5}$, C = 0.001 M
Degree of hydorolysis is –

$$h = \sqrt{\frac{K_w}{K_a \times C}} = \sqrt{\frac{10^{-14}}{10^{-5}\times0.001}} = \sqrt{10^{-14+5+3}}$$

$$h = 10^{-3}$$

243. The degree of hydrolysis of 0.01 M NH_4Cl is: ($K_h = 2.5\times10^{-9}$)

(a) 5×10^{-5} (b) 5×10^{-4}
(c) 5×10^{-3} (d) 5×10^{-7}

JCECE-2003

Ans. (b): Given, Hydrolysis constant (K_h) = 2.5×10^{-9}
Degree of hydrolysis = ?, Concentration (C) = 0.01 M

$$h = \sqrt{\frac{K_h}{C}}$$

$$h = \sqrt{\frac{2.5\times10^{-9}}{0.01}}$$

$$h = \sqrt{\frac{2.5\times10^{-9}}{10^{-2}}}$$

$$h = \sqrt{\frac{2.5\times10\times10^{-9}}{10^{-2}\times10}}$$

$$h = \sqrt{\frac{25\times10^{-9}}{10^{-1}}}$$

$$h = \sqrt{25\times10^{-8}}$$

$$h = 5 \times 10^{-4}$$

244. Which of the following salt has value of the van't Hoff factor equal to that of $K_3[Fe(CN)_6]$?

(a) $Al_2(SO_4)_3$ (b) NaCl
(c) $Al(NO_3)_3$ (d) Na_2SO_2

J & K CET-(2002)

Ans. (c) : $K_3[Fe(CN)_6]$ on ionisation gives 4 species ($3K^+$ and 1 $[Fe(CN)_6]^{-3}$).

And, $Al(NO_3)_3$ also gives 4 species ($1\ Al^{3+}$ and $3\ NO_3^-$).
∴ van't Hoff factor for $K_3[Fe(CN)_6]$ = 4
And, van't Hoff factor for $Al(NO_3)_3$ = 4

245. The dissociation constant of two acids HA_1 and HA_2 are 3.0×10^{-4} and 1.8×10^{-5} respectively. The relative strengths of the acids is

(a) 1 :16 (b) 1 :4
(c) 4 :1 (d) 16 :1

UP CPMT-2002

Ans. (c) : Given, $K_{a_1} = 3\times10^{-4}$, $K_{a_2} = 1.8\times10^{-5}$
The dissociation of acids are–

$$HA_1 \rightleftharpoons H^+ + A_1$$

$$HA_2 \rightleftharpoons H^+ + A_2$$

Dissociation constant (K_a) = $\frac{c\alpha^2}{1-\alpha}$

∴ Relative acidic strength ⇒ $\frac{HA_1}{HA_2} = \sqrt{\frac{K_{a_1}}{K_{a_2}}}$

$$\frac{HA_1}{HA_2} = \sqrt{\frac{3.0\times10^{-4}}{1.8\times10^{-5}}}$$

or $\frac{HA_1}{HA_2} = \frac{4}{1}$

∴ Relative strength are acids will be 4:1

246. The pH of a 0.1 M aqueous solution of a weak acid (HA) is 3. What is its degree of dissociation?

(a) 1% (b) 10%
(c) 50% (d) 25%

AP-EAMCET (Medical), 2001

Ans. (a) : Given, pH = 3, Concentration (c)=0.1 M
Now, pH = $-\log[H^+]$
or $[H^+] = 10^{-3}$
The dissociation of weak acid is-

$$HA \rightleftharpoons H^+ + A^-$$

We know that,
$[H^+] = C \times \alpha$
Where, C = Concentration
α = Degree of dissociation

or $\alpha = \frac{10^{-3}}{0.1}$
or $\alpha = 0.01$
∴ Percentage of dissociation = $10^{-2} \times 100$ = 1%.

247. Δx = (hydration energy) – (lattice energy), for a salt Δx is found to be –500 kcal mol^{-1}. Then, on increasing the temperature, its solubility in water

(a) increases
(b) decreases
(c) remains same
(d) increases initially and then decreases

AP-EAMCET-1998

Ans. (b) : In this reaction, heat is evolved during the dissolution, so solubility decreases with rise in temperature.

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248. The hydrogen ion concentration in mol/dm^3, in a 0.2 m solution of a weak acid, HA (K_a= 2 × 10^{-5}) is close to

(a) 2×10^{-5}
(b) 2×10^{-4}
(c) 2×10^{-3}
(d) 2×10^{-2}

J & K CET-(1998)

Ans. (c) : Given, Concentration (C)=0.2 m, K_a=2×10^{-5}
The dissociation of weak acid is –

$$HA \rightleftharpoons H^+ + A^-$$

$$\begin{array}{llll} t=0 & C & 0 & 0 \\ t=t' & C(1-\alpha) & C\alpha & C\alpha \end{array}$$

$$\therefore \quad K_a = \frac{[H^+][A^-]}{[HA]}$$

$$K_a = \frac{C\alpha\cdot C\alpha}{C(1-\alpha)}$$

$$K_a = \frac{C\alpha^2}{(1-\alpha)} \quad (\because \text{ for weak acid } \alpha <<< 1)$$

$$K_a = C\alpha^2 \quad (\because [H^+] = C\alpha)$$

$$\text{or} \quad [H^+] = \sqrt{K_a \times C}$$

$$[H^+] = \sqrt{2\times10^{-5}\times0.2}$$

$$[H^+] = \sqrt{0.4\times10^{-5}}$$

$$[H^+] = 2 \times 10^{-3}$$

249. The degree of dissociation of an acid HA in 0.1 M solution is 0.1%. Its dissociation constant is

(a) 1 × 10^{-3}
(b) 1 × 10^{-7}
(c) 1 × 10^{-10}
(d) 1 × 10^{-14}

AP-EAMCET-1992

Ans. (b) : Given that, degree of dissociation (α) = 0.1% = 10^{-3}

$C = 0.1\text{ M} = 10^{-1}\text{ M}$

According to ostwald dilution law, the dissociation constant (K_a) is equal to the product of molar concentration (C) and the square of the degree of dissociation (α^2).

$\therefore$ Dissociation constant (K) = α^2.C

$= (10^{-3})^2 \times 10^{-1}$

$= 10^{-7}$

250. 100 mL of a solution contains 2g of acetic acid and 3g of sodium acetate providing K_a=1.8×10^{-5}, then choose the correct option

(a) The solution is basic in nature
(b) The solution is acidic in nature
(c) The solution is amphoteric in nature
(d) The solution is neutral in nature

JIMPER-2016

Ans. (b) : According to Henderson's equation–

$$pH = -\log_{10} K_a + \log_{10}\frac{[Salt]}{[Base]}$$

$$[Salt] = \frac{3\times1000}{82\times100}\text{ mol L}^{-1} \quad \left[\begin{array}{l}\text{CH}_3\text{COONa is salt and} \\ \text{molecular mass of this} \\ \text{salt is 82}\end{array}\right]$$

$$[Acid] = \frac{2\times1000}{60\times100}\text{ mol L}^{-1} \quad \left[\begin{array}{l}\text{CH}_3\text{COOH is acid and} \\ \text{molecular mass of this} \\ \text{acid is 60}\end{array}\right]$$

Given, K_a = 1.8 × 10^{-5}

$$\therefore \quad pH = -\log_{10}1.8\times10^{-5} + \log_{10}\left[\frac{\frac{3\times1000}{82\times100}}{\frac{2\times1000}{60\times100}}\right]$$

$$pH = 4.7851$$

The solution is a acidic nature.

251. The van't Hoff factor (i) for a dilute aqueous solution of the strong electrolyte barium hydroxide is

(a) 0
(b) 1
(c) 2
(d) 3

(NEET-II-2016)

Ans. (d) : The dissociation of barium hydroxide is–

$$Ba(OH)_2 \rightarrow Ba^{+2} + 2OH^-$$

$$i = \frac{\text{No. of particle after dissociation}}{\text{No. of particle before dissociation}}$$

$$i = \frac{3}{1}$$

$$i = 3$$

252. The dissociation of water at 25°C is 1.9×10^{-7}% and the density of water is 1.0 g/cm^3 the ionization constant of water is

(a) 3.42×10^{-8}
(b) 3.42×10^{-16}
(c) 1.00×10^{-14}
(d) 2.00×10^{-16}

J & K CET-(1998)

Ans. (d) : Given that,

$\alpha = 1.9 \times 10^{-7}\%$ Density (d) = 1g/cm^3

$\alpha = \dfrac{1.9\times10^{-7}}{100}$ d = 1×1000

$\alpha = 1.9 \times 10^{-9}$ d =1000g/L

Molecular mass of water = 18 g/mol

$$\text{Concentration (C)} = \frac{1000}{18} = 55.55$$

$$\begin{array}{lccc} & H_2O & \rightleftharpoons H^+ & + \ OH^- \\ \text{Initial conc.} & C & 0 & 0 \\ \text{After 't'} & C - C\alpha & C\alpha & C\alpha \end{array}$$

$$K = \frac{[H^+][OH^-]}{[H_2O]}$$

$$K = \frac{[C\alpha][C\alpha]}{C - C\alpha}$$

$$K = \frac{C\alpha^2}{1-\alpha} \quad (\alpha << 1)$$

$$K = C\alpha^2$$

$$K = 55.55 \times (1.9 \times 10^{-9})^2$$

$$K = 55.55\times3.61\times10^{-18}$$

$$K = 2.00 \times 10^{-16}$$

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5. Vapour Density

253. On increasing temperature, the equilibrium constant of exothermic and endothermic reactions, respectively :

(a) Increases and decreases
(b) Decreases and increases
(c) Increases and increases
(d) Decreases and decreases

AP-EAMCET (Engg.) 2015

Ans. (b) : For $A+B \underset{K_b}{\overset{K_f}{\rightleftharpoons}} C+D$

$$\therefore \quad \text{Equilibrium constant (K)} = \frac{K_f}{K_b}$$

For exothermic reaction K_f decrease with increase of temperature so that K decreases and endothermic reaction (K_f) increases with increase of temperature. So K increases.

254. An oxygen containing organic compound was found to contain 52% carbon and 13% of hydrogen. Its vapour density is 23. The compound reacts with sodium metal to liberate hydrogen. A functional isomer of this compound is

(a) Ethanal
(b) Methoxy methane
(c) Methoxy ethane
(d) Ethanol

Karnataka-CET-2012

Ans. (b) : Molecular mass = 2 × vapour density
Molecular mass = 2 × 23 = 46

Element	Percentage	Atomic mass	Relative number of atoms	Simplest ratio
C	52%	12	$52/12=4.33$	$1.9-2$
H	13%	1	$13/1=13$	$5.9-6$
O	35%	16	$35/16=2.18$	1

Empirical formula = C_2H_6O
Empirical formula mass = 12 × 2 + 6 × 1 + 16 = 46

$$n=\frac{\text{Empirical formula mass}}{\text{Molecular formula mass}}=\frac{46}{46}=1$$

Molecular formula = C_2H_6O
Alcohols liberate hydrogen on reaction with sodium metal.
The functional isomer of ethanol is methoxy methane.

$\underset{\text{Ethanol}}{CH_3CH_2OH} \qquad \underset{\text{Methoxy methane}}{CH_3OCH_3}$

6. Le-Chatelier Principle and It's Application

255. What is the effect of increasing pressure on the dissociation of PCl_5 according to the equation? $PCl_5(g) \rightleftharpoons PCl_3(g) + Cl_2(g)$

(a) Dissociation decreases
(b) Dissociation increases
(c) Dissociation does not change
(d) None of the above

Tripura JEE-2022
UPTU/UPSEE-2004

Ans. (a) : $PCl_5(g) \rightleftharpoons PCl_3(g) + Cl_2(g)$

For this reaction Δn = 2 –1 =1
The dissociation of PCl_5 take forward by decrease in pressure & by increase in pressure the dissociation of PCl_5 decrease because the value of Δn is positive.

256. On doubling P and V with constant temperature the equilibrium constant will

(a) remain constant
(b) become double
(c) become one–fourth
(d) None of the above

UP CPMT-2007
UPTU/UPSEE-2004

Ans. (a) : At constant temperature,
PV = Constant
The equilibrium constant depend on the temperature. On doubling P and V with constant T, the equilibrium constant (K) will remain constant.
Pressure will never affect the value of K. It may result in the shifting of equilibrium, but not the equilibrium constant value. Temperature always changes K because on adding heat to a system in state of equilibrium will always alter the forward reaction rate differently than the reverse reaction rate. Also by doubling the volume, the concentrations of both reactants and products evenly became half. Therefore, overall there is no change in equilibrium constant value (K).

257. Le-Chateliar's principle is not applicable to —

(a) $H_2(g) + I_2(g) \rightleftharpoons 2HI(g)$
(b) $Fe(s) + S(s) \rightleftharpoons Fe(s)$
(c) $N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$
(d) $N_2(g) + O_2(g) \rightleftharpoons 2NO(g)$

AP EAPCET 20.08.2021 Shift-I
AMU-2011

Ans. (b) : Le chartelier's principle state that an equilibrium is subjected to a change of concentration, pressure or temperature, the equilibrium shifts in the direction that trends to undo the effect of the change. It is not explain the solid state compound.
e.g. – $Fe(s) + S(s) \rightleftharpoons FeS(s)$

258. The yield of the products in the reaction,

$$\mathbf{A_2(g)+2B(g) \rightleftharpoons C(g)+Q\,(kJ)}$$

would be higher at

(a) high temperature and high pressure
(b) high temperature and low pressure
(c) low temperature and high pressure
(d) low temperature and low pressure

NEET-2018
Karnataka-CET-2013

Ans. (c) : $A_2(g)+2B(g) \rightleftharpoons C(g)+QkJ$

The forward reaction is exothermic. Thus, according to Le-Chatelier's principal, the lower is temperature, greater would be the yield of ammonia. Also, the forward reaction occurs with decrease in number of gaseous molecules. Thus according to Le-Chatelier's principal an increase in pressure, will shift the equilibrium in a direction in which the number of gaseous molecules decreases. In other word high pressure will favour the formation of products.

@apna_pdf

259. The supply of oxygen to tissues by blood, can be explained by

(a) Le-Chatelier's principle (b) Boyle's law

(c) Charis' law (d) Dalton's law

AP EAMCET (Engg.) 21.09.2020, Shift-II

Ans. (a) : Le-Chatelier's principle drives the following reaction forward as blood passes through the alveoli

$$H^+ + HCO_3 \rightarrow H_2CO_3 \rightarrow CO_2 + H_2O$$

The carbon dioxide produced here continually diffuses into the alveoli and is exhaled, ensuring favorable kinetics for the reaction to proceed. Thus, correct answer is option (a).

260. $CaCO_3(s) \rightarrow CaO(s) + CO_2(g)$ at constant temp, the pressure will increase if:

(a) Vol. of container increase

(b) Temperature increases

(c) Concentration of CaO increases.

(d) Concentration of $CaCO_3$ increases.

AIIMS-27.05.2018-(E)

Ans. (b): $CaCO_3(s) \rightarrow CaO(s) + CO_2(g)$

$$K_p = P_{CO_2}$$

Pressure will increase only be increasing temperature as it will change K_p value.

261. Which statement is incorrect for a catalyst?

(a) It does not affect the equilibrium constant

(b) It increases the proportion of products in less time

(c) It decreases the activation energy of a reaction

(d) It increases the free energy change for the reaction

GUJCET-2018

Ans. (d) : It increases the free energy change for the reaction a catalyst does not affect the energies of reactants and products of the reaction and hence, the energies are same for both catalyzed and non-catalyzed reactions.

262. In a reaction $A + B \rightleftharpoons C + D$, Le Chatelier's principle asserts that an equilibrium between A and B producing C and D can be shifted towards C and D by

(i) increasing the concentration of A or B

(ii) increasing the concentration of C or D

(iii) decreasing the concentration of A or B

(a) (ii) only (b) Both (i) and (ii)

(c) (iii) only (d) (i) only

J & K CET-(2018)

Ans. (d) : $A + B \rightleftharpoons C + D$

Thus, in the given equilibria, if concentration of A and B is increased the reaction will move in forward direction to reduce the effect of increase in concentration of A and B. According to Le-Chatelier's principal, if a system in equilibrium is subjected to a change in any of the factors that determine the equilibrium conditions of a system then the equilibrium will shift in the direction so, as to reduce or to counteract the effects of the change

263. A reaction has both ΔH and ΔS –ve. The rate of reaction

(a) Increases with increases in temperature

(b) Cannot be predicated for change in temperature

(c) Increases with decreases in temperature

(d) Remains unaffected by change in temperature

Karnataka-CET-2017

Ans. (c) : $\Delta G = \Delta H - T\Delta S$

So, ΔG = –ve then the ΔS must be less than ΔH i.e. $\Delta H > T\Delta S$.

Negative value of enthalpy change ΔH corresponds to exothermic reaction with decrease in temperature, the rate of reaction increases, Hence the option (c) is correct.

264. For the reaction, $CO(g) + H_2O(g) \rightleftharpoons CO_2(g) + H_2(g)$ at a given temperature the equilibrium amount of $CO_2(g)$ can be increased by

(a) adding a suitable catalyst

(b) adding an inert gas

(c) increasing the volume of the container

(d) increasing the amount of $CO_{(g)}$.

J & K CET-(2017)

Ans. (d) : $CO(g) + H_2O(g) \rightleftharpoons CO_2(g) + H_2(g)$

Δn_g = No. of moles of product – No. of moles of reactant.

$\therefore \quad \Delta n_g = 2 - 2 = 0$

The amount of CO_2 will increase when the reaction moves to forward direction. This can be achieved by increasing the amount of CO in the reaction mixture as according to Le-Chatelier's principal the reactions moves in a direction where the added substance are consumed.

265. The chemical reaction of a gas phase is given below.

$$2A(g) + B(g) \rightleftharpoons C(g) + D(g)$$

Which one of the following changes will affect the value of K_c?

(a) Addition of inert gas

(b) Increasing in temperature

(c) Addition of reactants

(d) Addition of catalyst

Manipal-2016

Ans. (b) : According to Vant Hoff equation–

$$\log\frac{K_2}{K_1} = \frac{\Delta H}{2.303R}\left(\frac{1}{T_1} - \frac{1}{T_2}\right)$$

If, ΔH is positive then the reaction is endothermic then temperature increase also the K is increases.

ΔH is negative then the reaction is exothermic then temperature increases also K is decreases.

K_c is a function of temperature only.

266. For the chemical equilibrium,

$$2NO_2(g) \rightleftharpoons N_2O_4(g) + 14.6\text{kcal}$$

increase in temperature :

(a) favours the formation of N_2O_4

(b) favours the decomposition of N_2O_4

(c) does not affect equilibrium

(d) stop the reaction

Manipal-2016

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Ans. (b) : The given reaction is exothermic and according to Le-chatelier's principal, high temperature shifts the equilibrium in backward direction i.e. high temperature favours the decomposition of N_2O_4.

267. Which one of the following is correct?

(a) The equilibrium constant (K_c) is independent of temperature

(b) The value of K_c is independent of initial concentrations of reactants and products

(c) At equilibrium, the rate of the forward reaction is twice the rate of the backward reaction

(d) The equilibrium constant (K_c) for the reaction $Ni(s)+4CO(g) \rightleftharpoons Ni(CO)_4(g)$ is, $\frac{[Ni(CO)_4]}{[CO]}$

TS-EAMCET-2016

Ans. (b) : (a) Equilibrium constant is temperature dependent having one unique value for a particular reaction represented by a balanced equation at a given temperature.

(b) The value of equilibrium constant is independent of initial concentration of the reactants and products.

(c) At equilibrium, the rate of forward reaction is equal to the rate of backward reaction.

(d) For the equilibrium reaction–

$$Ni(s) + 4CO(g) \rightleftharpoons Ni(CO)_4(g)$$

$$\therefore \quad K_c = \frac{[Ni(CO)_4]}{[CO]^4}$$

268. The reaction $SO_2 + O_2 \rightleftharpoons 2SO_3 + Heat$

The equilibrium reaction proceeds in forward direction by

(a) addition of O_2 (b) removal of O_2

(c) addition of inert gas (d) cannot proceed

UPTU/UPSEE-2015

Ans. (a) : According to Le- Chatelier's principle, equilibrium shift towards forward direction by addition of reactant.

269. Which of the following according to Le-Chatelier's principle is correct?

(a) Increase in temperature favours the endothermic reaction

(b) Increase in temperature favours the exothermic reaction

(c) Increase in pressure shifts the equilibrium in that side in which number of gaseous moles increases

(d) All of the above are true

BITSAT 2015

Ans. (a) : According to Le-chatelier's principle increase in temperature favours the endothermic reaction while a decrease in temperature favour the exothermic reaction.

Increase in pressure shifts the equilibrium in that side in which the number of moles of gaseous species decreases.

270. For the reversible reactions,

$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$ + heat

The equilibrium, shifts is forward direction

(a) by increasing the concentration of $NH_3(g)$

(b) by decreasing the pressure

(c) by decreasing the concentrations of $N_2(g)$ and $H_2(g)$

(d) by increasing pressure and decreasing temperature

NEET-2014

Ans. (d) : By increasing pressure and decreasing temperature the given reaction is exothermic as heat is released during the reaction. For an exothermic reaction, on decreasing the temperature equilibrium will shift in forward direction.

According to Le-Chatelier's principal, on increasing pressure, equilibrium will shift in the direction where leasser number of gaseous moles are present.

Hence, on increasing pressure equilibrium will shift in forward direction for the given system.

271. Consider the following reaction $CaCO_3(s) \rightleftharpoons CaO(s) + CO_2(g)$ in closed container at equilibrium. What would be the effect of addition of $CaCO_3$ on the equilibrium concentration of CO_2?

(a) Increases (b) Decreases

(c) Data is insufficient (d) Remains unaffected

SRMJEEE – 2014

Ans. (d) : $CaCO_3(s) \rightleftharpoons CaO(s) + CO_2(g)$

$$\because \quad K_c = \frac{[CO_2][CaO]}{[CaCO_3]}$$

$$\therefore \quad [CaCO_3] = [CaO] = 1$$

Then, $K_c = [CO_2] = P_{CO_2}$

Hence, the equilibrium constant remain unaffected.

272. Which of the following equilibrium will shift to right side on increasing the temperature?

(a) $CO(g)+H_2O(g) \rightleftharpoons CO_2(g)+H_2(g)$

(b) $2SO_2(g)+O_2(g) \rightleftharpoons +2SO_3(g)$

(c) $H_2O(g) \rightleftharpoons H_2(g)+\frac{1}{2}O_2(g)$

(d) $4HCl(g)+O_2(g) \rightleftharpoons 2H_2O(g)+2Cl_2(g)$

AIIMS-2014

Ans. (c): $H_2O(g) \rightleftharpoons H_2(g)+\frac{1}{2}O_2(g)$

According to Le-chatelier's principle, increasing the temperature shifts the equilibrium to the right side since, volume is increasing in the forward reaction. So on increasing the temperature reaction will proceed in the forward direction.

273. In a reaction, A + B $\rightleftharpoons$ C + D, 40% of B has reacted at equilibrium, when 1 mole of A was heated with 1 mole of B in a 10 L closed vessel. The value of K_c is

(a) 0.44 (b) 0.18

(c) 0.22 (d) 0.36

AP-EAMCET (Engg.) - 2014

Ans. (a) : Given that,

$$A + B \rightleftharpoons C + D$$

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At t = 0	1	1	0	0
At equi.	(1–0.4)	(1–0.4)	0.4	0.4

$$\therefore K_c = \frac{[C][D]}{[A][B]}$$
$$= \frac{0.4 \times 0.4}{0.6 \times 0.6}$$
$$= 0.44$$

274. $KMnO_4$ can be prepared from K_2MnO_4 as per the reaction,

$$3MnO_4^{2-} + 2H_2O \rightleftharpoons 2MnO_4^- + MnO_2 + 4OH^-$$

The reaction can go to completion by removing OH^- ions by adding

(a) CO_2 (b) SO_2
(c) HCl (d) KOH

NEET-2013

Ans. (a) : The reaction for the oxidation of magnate ion to permagnate ion can go to completion by removing hydroxide ions by adding CO_2.

$$CO_2 + 2OH^- \rightarrow CO_3^{2-} + H_2O$$

275. In which of the following reactions, increase in pressure will favour the forward reaction?

(a) $PCl_5(g) \rightleftharpoons PCl_3(g) + Cl_2(g)$
(b) $2NO(g) + O_2(g) \rightleftharpoons 2NO_2(g)$
(c) $C(s) + H_2O(g) \rightleftharpoons CO(g) + H_2(g)$
(d) $2HI(g) \rightleftharpoons H_2(g) + I_2(g)$

J & K CET-(2013)

Ans. (b) : An increase in pressure favours the reaction in the direction that produced smaller number of moles of gases. As in reaction (b), 3 moles of reactants produces lesser i.e. 2 mole of products. Therefore, the reaction will move in forward direction.

276. In which reaction will an increase in the volume of the container favour the formation of products?

(a) $C(s) + H_2O(g) \rightleftharpoons CO(g) + H_2(g)$
(b) $H_2(g) + I_2(g) \rightleftharpoons 2HI(g)$
(c) $4NH_3(g) + 5O_2(g) \rightleftharpoons 4NO(g) + 6H_2O(l)$
(d) $3O_2(g) \rightleftharpoons 2O_3(g)$

SCRA 2012

Ans. (a) : As we increase the volume of the container the concentration decreases of all the gaseous states in the reaction by Le-Chatelier's principle, the reaction will move in the direction of increasing no. of moles.

277. According to Le-Chartelier's principle, the equilibrium constant of a reversible reaction will not shift by

(a) Increasing the temperature of an exothermic reaction
(b) Increasing the temperature of an endothermic reaction
(c) Charging the concentrations of the reactants
(d) The effect of a catalyst.

J & K CET-(2012)

Ans. (d) : According to Le-Chatelier's principal, the equilibrium state of a reversible reaction will not shift by the effect of a catalyst but equilibrium constant remain unaffected by the effect of catalyst as well as change in concentration of the reactants.

278. For the reaction, $SO_2Cl_2(g) \rightleftharpoons SO_2(g) + Cl_2(g)$ If at equilibrium volume of the reaction vessel is increased then the amount of

(a) SO_2 will decrease
(b) SO_2 Cl_2 will increase
(c) Cl_2 will increase
(d) Cl_2 will remain unchanged.

SRMJEEE – 2012

Ans. (c) : For the given reaction –

$$SO_2Cl_2(g) \rightleftharpoons SO_2(g) + Cl_2(g)$$

As we know that if we increase the vessel of reaction mixture then the equilibrium shifts, where the no. of moles of side is major. Hence, the amount of Cl_2 will be increased.

279. For the reaction $2A + B \rightleftharpoons C, \Delta H = x$ cal, which one of the following conditions-would favour the yield of C on the basis of Le-Chatelier principle?

(a) High pressure, high temperature
(b) Only low temperature
(c) High pressure, low temperature
(d) Only low pressure

VITEEE- 2011

Ans. (a) : The reversible reaction is :

$$2A + B \rightleftharpoons C \quad \Delta H = +x \text{ cal}$$

When pressure is increased in an equilibrium reaction, then the reaction moves towards the less number of moles. So, after increasing the temperature, the reaction move in forward direction. As the reaction is endothermic, high temperature is favorable and low temperature is unfavourable.

280. H_2S gas when passed through a solution of cations containing HCl precipitates the cations of second group of qualitative analysis but not those belonging to the fourth group. It is because

(a) Presence of HCl decreases the sulphide ion concentration.
(b) Solubility product of group II sulphides is more than that of group IV sulphides.
(c) Presence of HCl increases the sulphide ion concentration.
(d) Sulphides of group IV cations are unstable in HCl.

BITSAT 2011

Ans. (a) : H_2S gas is passed in presence of HCl, in qualitative analysis of cation of second group, therefore, due to common ion effect, lower concentration of sulphide ions is obtained which is sufficient for the precipitation of second group cations in form of their sulphides due to lower value of their solubility product (K_{sp}). Here, fourth group cations are not precipitated because they require for exceeding their ionic product to their solubility products and higher sulphide ions concentration due to their higher K_{sp} which is not obtained here due to common ion effect.

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281. Which of the following comments about the following equilibrium reaction is the most correct?

$$H_2SO_4(aq)+NH_3(aq) \rightleftharpoons HSO_4^-(aq)+NH_4^+(aq)$$

(a) The equilibrium lies mostly to the right
(b) The equilibrium lies mostly to the left
(c) The equilibrium is exactly in between where the concentration of each of the reactants is exactly equal to the concentration of each of the products
(d) The equilibrium depends on the temperature of the equilibrium raction

UPTU/UPSEE-2011

Ans. (a) : H_2SO_4 when dissolves in water dissociate almost completely and produces H^+ ions. These ions are taken by NH_3 and its conjugate acid NH_4^+ forms of NH_3.
Thus, the equilibrium lies mostly to right side or forward reaction.

$$H_2SO_4(aq)+NH_3(aq) \rightleftharpoons HSO_4^-(aq)+NH_4^+(aq)$$

282. The value of ΔH for the reaction

$X_2(g) + 4Y_2(g) \rightleftharpoons 2XY_4(g)$ is less than zero formation of $XY_4(g)$ will favoured at

(a) high temperature and high pressure
(b) low pressure and low temperature
(c) high temperature and low pressure
(d) high pressure and low temperature

NEET-2011

Ans. (d) : The reaction is:

$$X_2(g) + 4Y_2(g) \rightleftharpoons 2XY_4(g)$$

$\Delta n_g = -Ve$

And, $\Delta H = -Ve$

So, formation of $XY_4(g)$ will favoured at high pressure and low temperature.

283. To an equilibrium mixture of

$$2SO_{2(g)} + O_{2(g)} \rightleftharpoons 2SO_{3(g)}$$

Some helium, an inert gas, is added at constant volume. The additiona of helium causes the total pressure to double. Which of the following is true?

(a) The concentration of all three gases is unchanged.
(b) The concentration of sulphur trioxide increases.
(c) The numberof moles of sulphur trioxide increases.
(d) The concentration of sulphur dioxide increases.

J & K CET-(2010)

Ans. (a) : As volume remains constant, the concentration of the three gases will remain unchanged on adding the helium. Since, the inert gas is added at constant volume, i.e. the volume is not allowed to increase, the concentrations of all the free gases remain unchanged.

284. Which of the following is not a physical equilibrium?

(a) Ice $\rightleftharpoons$ Water
(b) $I_2(s) \rightleftharpoons I_2(g)$
(c) $S(l) \rightleftharpoons S(g)$
(d) $3O_2 \rightleftharpoons 2O_3$

UPTU/UPSEE-2009

Ans. (d) : In physical equilibrium there should be a change in the physical state of the compounds involved in the equilibrium.
In $3O_2(g) \rightleftharpoons 2O_3(g)$

there is no change in the physical state, O_2 is gas and O_3 is also in gaseous state.
∴ It is not a physical equilibrium.

285. In which one of the following equilibria, the increase of pressure over the equilibrium will favour the backward reaction?

(a) Decomposition equilibrium of HI
(b) Formation equilibrium of SO_3
(c) Decomposition equilibrium of NH_3
(d) Formation equilibrium of PCl_5

J & K CET-(2009)

Ans. (c) : In the decomposition reaction of NH_3 the number of moles of products formed is greater that of reactant involved.

$$2NH_3 \rightleftharpoons N_2 + 3H_2$$

According to Le-Chatelier's principal, the increase of pressure on a chemical equilibrium shift in that direction in which the number of gaseous molecules decreases and vice-versa thus in this reaction, increase in pressure favours the backward reaction.

286. For the equilibrium,

$2NO_2(g) \rightleftharpoons N_2O_4(g) + 14.6$ kcal,

Increase in temperature

(a) favours the formation of N_2O_4
(b) favours the decomposition of N_2O_4
(c) does not affect equilibrium of N_2O_4
(d) stop the reaction

UP CPMT-2009

Ans. (b): The given reaction is exothermic and according to Le-Chatelier principle high temperature shifts the equilibrium in backward direction. In other words, high temperature favours the decomposition of N_2O_4.

287. According to Le-equilibrium's Principle, the addition of temperature to the following reaction: $CO_2(g) + 2H_2O(g) \rightarrow CH_4(g) + 2O_2(g)$ will cause it to the right. This reaction is therefore,

(a) Exothermic
(b) Unimolecular
(c) Endothermic
(d) Spontaneous

MPPET-2008

Ans. (c) : For the endothermic reaction with increase in temperature rate of forward reaction increases. According to Le-equilibrium's principle when the concentration of a chemical will be shift the equilibrium to the side that would counter the change in concentrating. In this reaction temperature is increased then the process is endothermic.

288. $N_2 + 3H_2 \rightleftharpoons 2NH_3 + \text{heat}$. What is the effect of the increase of temperature on the equilibrium of the reaction?

(a) Equilibrium is shifted to the left
(b) Equilibrium is shifted to the right
(c) Equilibrium is unaltered
(d) Reaction rate does not change

KARNATAKA-CET, 2008

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Ans. (a) : $N_2 + 3H_2 \rightleftharpoons 2NH_3 + \text{heat}$

It is an exothermic reaction, so high temperature favours backward reaction. Hence, equilibrium is shifted towards the left.

289. What happens to the yield on application of high pressure in the Haber's synthesis of ammonia?

(a) Increases (b) decreases

(c) unaffected (d) reaction stops

J & K CET-(2008)

Ans. (a) : Haber's process of synthesis of ammonia

$$N_2 + 3H_2 \rightleftharpoons 2NH_3$$

High pressure favours the reaction that decrease the number of gas molecules. Since, the number of molecules of gaseous products are less than the number of molecules of gaseous reactants, thus according to Le-chatelier's principal, high pressure favour the forward reaction. i.e more ammonia will be abtained.

290. The basic principle of Cottnell' s precipitation is

(a) Le-Chatelier's principle

(b) Peptisation

(c) Neutralization of charge on colloidal particles

(d) Scattering of light

KARNATAKA-CET, 2008

Ans. (c) : In Cottnell's precipitator, the charged particles are attracted towards the walls of precipitator, here they lose their charge and coagulate. Hence, the basic principle of Cottnell's precipitator is the neutralisation of charge on colloidal particles.

291. For a system in equilibrium, ΔG = 0 under conditions of constant

(a) temperature and pressure

(b) temperature and pressure

(c) energy and volume

(d) pressure and volume

BITSAT 2008

Ans. (a) : When a system is at equilibrium under constant temperature and pressure. Its free energy change is zero ($\Delta G = 0$)

292. When hydrogen molecule decompose into it's atoms which consitions gives maximum yields of H atoms?

(a) High temperature and low pressure

(b) Low temperature and high pressure

(c) High temperature and high pressure

(d) Low temperature and low pressure

BITSAT-2007

Ans. (a) : $H_2 \rightarrow 2H - \Delta H$

The reaction is endothermic accompanied by increase in the number of moles. According to Le-chatelier's principal, to increase the rate of forward reaction. temperature should be increased and pressure should be decrease.

293. Given the equilibrium system:

$NH_4Cl\,(s) \rightarrow NH_4^+(aq) + Cl^-(aq)$

($\Delta H = +3.5$kcal/mol).

What change will shift the equilibrium to the right?

(a) Decreasing the temperature

(b) Increasing the temperature

(c) Dissolving NaCl crystals in the equilibrium mixture

(d) Dissolving NH_4NO_3 crystals in the equilibrium mixture

VITEEE- 2007

Ans. (b) :

$NH_4Cl\,(s) \rightarrow NH_4^+(aq) + Cl^-(aq)$, $\Delta H = +3.5$kcal/mol

Endothermic reactions are favoured at high temperature. Therefore, increasing the temperature will shift equilibrium to the right.

294. The equilibrium reaction that is not influenced by volume change at constant temperature is

(a) $H_2(g) + I_2(g) \rightleftharpoons 2HI(g)$

(b) $N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$

(c) $N_2O_4(g) \rightleftharpoons 2NO_2(g)$

(d) $2NO(g) + O_2 \rightleftharpoons 2NO_2(g)$

J & K CET-(2006)

Ans. (a) : According to Le-Chatelier's principal, when $\Delta n_g = 0$ there is no effect of pressure and volume change on the equilibrium

So,

(a) $H_2(g) + I_2(g) \rightleftharpoons 2HI(g)$, $\Delta n_g = 0$

(b) $N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$, $\Delta n_g = -2$

(c) $N_2O_4(g) \rightleftharpoons 2NO_2(g)$, $\Delta n_g = 1$

(d) $2NO(g) + O_2 \rightleftharpoons 2NO_2(g)$, $\Delta n_g = -1$

Hence, $H_2(g) + I_2(g) \rightleftharpoons 2HI(g)$ is correct answer.

295. For NaC1, the $K_{sp} = 36 mol^2L^{-2}$, the molar concentration of it will be

(a) $\frac{1}{36}$M (b) $\frac{1}{16}$M

(c) 36M (d) 6M

CG PET -2006

Ans. (d) : For NaCl

$K_{sp} = S^2$

Where, S = solubility

$36 = S^2$

$\therefore$ S= 6 $molL^{-1}$

Hence, molarity = 6M

296. For the gaseous reaction

$C_2H_4 + H_2 \rightleftharpoons C_2H_6$, $\Delta H = -130$ kjmol^{-1} carried in a closed vessel, the equilibrium concentration of the C_2H_6 can definitely be increased by:

(a) increasing temperature and decreasing pressure

(b) decreasing temperature and increasing pressure

(c) increasing temperature and pressure both

(d) decreasing temperature and pressure both

UPTU/UPSEE-2005

Ans. (b) : According to Le-Chatelier's principal exothermic reactions are favourable at low temperature. The reaction in which number of moles decrease are favourable at high pressure or low volume.

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$$C_2H_4 + H_2 \rightleftharpoons C_2H_6 \quad \Delta H = -130 \text{ kJ mol}^{-1}$$

$\because$ The reaction is exothermic and number of moles of reactants are decreasing.

$\therefore$ The reaction rate is increased by decreasing temperature and increasing pressure.

297. According to Le-Chatelier's principle which of the following factors influence a chemical system?

(a) Concentration only
(b) Pressure only
(c) Temperature only
(d) concentration, pressure and termperature

CG PET -2005

Ans. (d) : Le-Chatelier's principal can be used to predict the behaviour of a system duo to change in pressure, temperature, or concentration.

298. If pressure increases then its effect on given equilibrium $2NO \rightleftharpoons N_2(g) + O_2(g)$ is shift in:

(a) Forward direction
(b) Backward direction
(c) No effect
(d) None of the above

BCECE-2005

Ans. (c) : The reaction is-

$$2NO(g) \rightleftharpoons N_2(g) + O_2(g)$$

$$\Delta n_g = 2 - 2 = 0$$

$\because$ There is no change in number of moles of reactant and products.

$\therefore$ The reaction is not effected by change in pressure.

299. A chemical reaction is in equilibrium when

(a) the reactants are completely transformed into products
(b) the rate of forward reaction is equal to the rate of backward reaction
(c) the formation of products is minimised
(d) equal amount of reactants and products are present

CG PET -2005

Ans. (b) : If the rate of forward reaction equals rate of backward reaction, then the reaction is said to be in equilibrium. At the stage, there is no further change in the concentrations of reactants as well as products.

300. If a system is at equilibrium, the rate of forward to the reverse reaction is:

(a) Less
(b) Equal
(c) High
(d) At equilibrium

UPTU/UPSEE-2004

Ans. (b) : If the system at equilibrium, the rate of forward and backward reaction become equal

301. The formation of SO_3 takes place according to the following reaction:

$2SO_2 + O_2 \rightleftharpoons 2SO_3$; $\Delta H = -45.2$ kcal

The formation of SO_3 is favoured by

(a) Increase in temperature
(b) Removal of oxygen
(c) Increase of volume
(d) Increase of pressure

UPTU/UPSEE-2004

Ans. (d) : According to Le-Chatelier's principal, when we increase pressure, reaction proceeds in that direction where volume is decreasing.

302. When pressure is applied to the equilibrium system ice $\rightleftharpoons$ water. Which of the following phenomenon will happen?

(a) More ice will be formed
(b) Water will evaporate
(c) More water will be formed
(d) Equilibrium will not be formed

BCECE-2004

Ans. (c) : When the pressure is applied to the equilibrium system between ice and water, the phase transition temperature of ice reduces. Thus the equilibrium shifts more to right side. Also when pressure is increased the equilibrium shifts in the direction of less volume.

Therefore, more ice will melt into water

303. Of the following which change will shift the reaction towards the product?

$I_2(g) \rightleftharpoons 2I(g), \Delta H_r^0(298K) = +150kJ$

(a) Increase in concentration of I_2
(b) Decrease in concentration of I_2
(c) Increase in temperature
(d) Increase in total pressure

AIIMS-2004

Ans. (c): The reaction is

$$I_2(g) \rightleftharpoons 2I(g)$$

$$\Delta H_r^0(298K) = +150 \text{kJ}.$$

According to Le-chateliers principal, the condition favouring the formation of I are given below.

(i) High concentration of $I_2(g)$
(ii) High temperature
(iii) Low pressure

Hence option (c) is correct.

304. How will increase of pressure affect the equation?

$C(s) + H_2O(g) \rightleftharpoons CO(g) + H_2(g)$

(a) Shift in the forward direction
(b) Shift in the reverse direction
(c) Increase in the yield of hydrogen
(d) No effect.

J & K CET-(2003)

Ans. (b) : Reverse reaction, Le-Chatelier's principal when there is change in number of moles the equilibrium will shift in the direction having smaller number of moles, when the pressure is increased and vice-verssa

305. Equilibrium constant K, for the reaction,

$$2HI(g) \rightleftharpoons H_2(g) + I_2(g)$$

at room temperature is 2.85 and that at 698 K is 1.4×10^{-2}. This implies that the forward reaction is :

(a) exothermic
(b) endothermic
(c) exergonic
(d) unpredictable

BCECE-2003

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Ans. (a) : For the given reaction–

$$2HI \rightleftharpoons H_2 + I_2$$

Equilibrium constant k = 2.85

At room temperature 698 K, $k' = 1.4 \times 10^{-2}$

The increases of temperature value of k is decreases, so the forward reaction decreases with increases temperature.

Implies that reaction will proceed in forward direction with decrease of temperature i.e. heat is librated and hence forward reaction is exothermic.

306. Reaction $BaO_2(s) \rightleftharpoons BaO(s) + O_2(g); \Delta H =$ + ve. In equilibrium condition pressure of O_2 depends on

(a) Increase mass of BaO_2
(b) Increase mass of BaO
(c) Increase temperature on equilibrium
(d) Increase mall of BaO_2 and BaO both

NEET-2002

Ans. (c) : $BaO_2(s) \rightleftharpoons BaO(s) + O_2$; H = +ve

Since H is +ve for this reaction So, it is endothermic process. On increasing the temperature, by applying Le-Chaterliers principal, we can see that the reaction proceed in a forward direction on increasing temperature, so, the pressure of O_2 will increase on increasing the temperature at equilibrium.

307. In the reaction

$O_2(g) + N_2(g) \rightleftharpoons 2NO(g), \ \Delta H = 180$ KJ.

(a) Increasing concentration of N_2
(b) Increase in pressure
(c) Increase in temperature
(d) Decrease in temperature

J & K CET-(2002)

Ans. (d) : $N_2(g) + O_2(g) \rightleftharpoons 2NO(g)$

$\Delta H = +180$ KJ

Since this is an endothermic reaction, thus according to Le-Chatalier's principal increase in temperature favours the formation of NO and hence decomposition of NO is favoured by decrease in temperature.

308. For any reversible reaction, if we increase concentration of the reactions, then effect in equilibrium constant

(a) depends on amount of concentration
(b) unchange
(c) decrease
(d) increase

NEET-2000

Ans. (b) : Equilibrium constant independent of change in concentration of reactants or products. It depend only on temperature.

309. In an exothermic reaction. 10^0C rise in temperature will

(a) Decrease the value of equilibrium constant
(b) Double the value of K_c
(c) Do not produce any change in K_c
(d) Produce some change in K_c

J & K CET-(2000)

Ans. (a) : In exothermic reaction, increase in temperature favours the backward reaction i.e. decreases the value of equilibrium constant.

310. The equilibrium will be shifted in the opposite direction if

$PCl_3(g) + Cl_2(g) \rightleftharpoons PCl_5(g)$

(a) PCl_3 is added
(b) Helium gas is added
(c) Catalyst is added
(d) Pressure is reduced

J & K CET-(2000)

Ans. (d) : In the reaction

$$PCl_3(g) + Cl_2(g) \rightleftharpoons PCl_5(g)$$

As the backward reaction is accompanied by increase in the number of moles hence, decreasing pressure will favour the backward reaction.

311. In the chemical reaction,

$2SO_2 + O_2 \rightleftharpoons 2SO_3$,

increasing the total pressure leads to

(a) Increase in the amount of SO_3
(b) Increase in the partial pressure of O_2
(c) Increase in the partial pressure of SO_2
(d) Change in the equilibrium constant

J & K CET-(1999)

Ans. (a) : When pressure is increased, at constant temperature the equilibrium will shift in such a way as to reduce this stress on its position. It shift towards product sides. So, the amount of SO_3 increased

312. According to Le Chatelier's principle, adding heat to a solid and liquid in equilibrium will cause the

(a) temperature to increase
(b) temperature to decrease
(c) amount of liquid to decrease
(d) amount of solid to decrease

NEET-1993

Ans. (d) : When we add heat to the equilibrium between solid and liquid, then the equilibrium shifts towards liquid and hence, the amount of solid decreases and amount of liquid increases.

313. Which of the following information can be obtained in the basis of Le Chatelier principle?

(a) dissociation constant of a weak acid
(b) Entropy change in a reaction
(c) Equilibrium constant of a chemical reaction
(d) Shift in equilibrium position of changing value of a constraint

NEET-1992

Ans. (d) : According to Le-Chatelier's principal whenever a constraint is applied to a system in equilibrium, the system tends to readjust so as to reellify the effect of the constraints by bringing a shift in an equilibrium position.

314. The exothermic formation of ClF_3 is represented by the equation :

$Cl_2(g) + 3F_2(g) \rightleftharpoons 2ClF_3(g); \ \Delta H = -329$ kJ

Which of the following will increase the quantity of ClF_3 in an equilibrium mixture of Cl_2, F_2 and ClF_3 ?

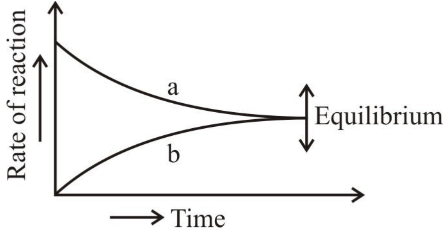
@apna_pdf

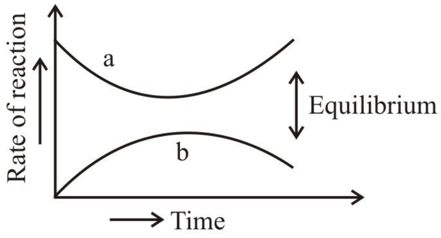
(a) Adding F_2
(b) Increasing the volume of the container
(c) Removing Cl_2
(d) Increasing the temperature

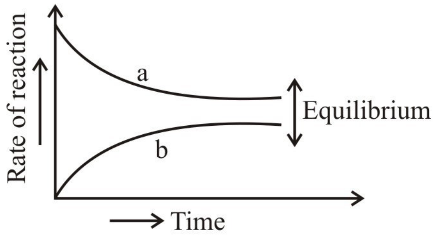
VITEEE-2017

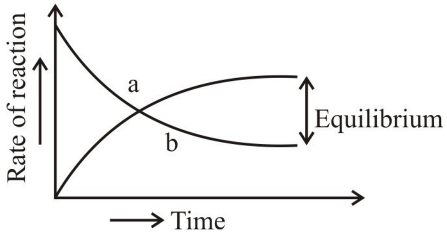
Ans. (a) : The given reaction is exothermic reaction. Thus according to Le Chatelier's principle lowering the temperature F_2 and Cl_2 favour the forward direction and production of ClF_3.

315. For the equilibrium $A \rightleftharpoons B$, the variation of the rate of the forward (a) and reverse (b) reaction with time is given by

(a)


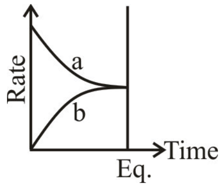
(b)


(c)


(d)


JEE-Main-11.09.2020

Ans. (a) : At equilibrium rate of forward reaction = rate of backward reaction.
Hence,



7. Application of K_p and K_f

316. $3O_2$ (g) $\rightleftharpoons$ 2 O_3 (g) for thr above reaction at 298 K, K_c is found to be 3.0 × 10^{-59}. If the concentration of O_2 at equilibrium is 0.040 M then concentration of O_3 in M is

(a) 1.2 × 10^{21} (b) 4.38 × 10^{-32}
(c) 1.9 × 10^{-63} (d) 2.4 × 10^{31}

NEET-17.07.2022

Ans. (b) : Given that, $K_c = 3 \times 10^{-59}$
At equilibrium 0.04 M

$$3O_2(g) \rightleftharpoons 2O_3(g)$$

$$K_c = \frac{[O_3]^2}{[O_2]^3} = 3\times10^{-59}$$

$$= \frac{[O_3]^2}{[4\times10^{-2}]^3} = 3\times10^{-59}$$

$$[O_3]^2 = 64 \times 3 \times 10^{-6} \times 10^{-59}$$
$$= 19.2 \times 10^{-64}$$
$$[O_3] = 4.38 \times 10^{-32}$$

The concentration of $O_3 = 4.38 \times 10^{-32}$

317. 4.0 moles of argon and 5.0 moles of PCl_5 are introduced into an evacuated flask of 100 litre capacity at 610 K. The system is allowed to equilibrate. At equilibrium, the total pressure of mixture was found to be 6.0 atm. The K_p for the reaction is [Given:R = 0.082L atm $K^{-1}mol^{-1}$]

(a) 2.25 (b) 6.24
(c) 12.13 (d) 15.24

JEE Main-29.06.2022, Shift-II

Ans. (a) : Given, $n_{Ar} = 4$, $n_{PCl_5} = 5$
V = 100 litre At 600 K, $P_T = 6$ atm
R = 0.082 L atm K^{-1} mol^{-1}, K_p = ?

$$\begin{array}{llll} & PCl_5 & \rightleftharpoons PCl_3(g) & + \ Cl_2(g) \\ t=0 & 5 & 0 & 0 \\ t=eq. & 5-n & n & n \end{array}$$

Total moles = 5-n+n+n = 5+n
We know, PV =nRT
∵ For argon, $n_{Ar} = 4$
Total moles = $n_{Ar} + n_{PCl_5} + n_{PCl_3} + n_{PCl_2}$ = 4+5+n = 9+n
Since, PV = nRT
6 × 100 = (9 + n) × 0.082 × 610
n = 3

$$K_p = \frac{P_{PCl_3} \cdot P_{Cl_2}}{P_{PCl_5}}$$

$$= \frac{\left(\frac{3}{12}\times6\right)\times\left(\frac{3}{12}\times6\right)}{\left(\frac{2}{12}\times6\right)}$$

$$= \frac{9}{4} = 2.25$$

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318. For the following reaction in gaseous phase

$$\mathbf{CO(g)+\frac{1}{2}O_2(g)\rightarrow CO_2(g), K_p/K_c \text{ is}}$$

(a) $(RT)^{1/2}$ (b) $(RT)^{-1/2}$
(c) (RT) (d) $(RT)^{-}$

(2017)
BITSAT-2013
CGPET-2013
UPTU/UPSEE-2008

Ans. (b): The reaction is-

$$CO(g)+\frac{1}{2}O_2(g)\rightarrow CO_2(g)$$

The relation between K_p and K_c is -

$$K_p=K_c(RT)^{\Delta n_g}$$

Where, Δn_g = no. of mole of gaseous product – no. of mole of gaseous reactant

$$\therefore \quad \Delta n_g=1-\left(1+\frac{1}{2}\right)=1-\frac{3}{2}=\frac{-1}{2}$$

So, $\dfrac{K_p}{K_c}=(RT)^{-1/2}$

319. For the following gaseous reaction, $H_2 + I_2 \rightleftharpoons 2HI$, the equilibrium constant

(a) $K_p > K_c$ (b) $K_p < K_c$
(c) $K_p = K_c$ (d) $K_p = \dfrac{1}{K_c}$

CG PET - 2006, 2005
BCECE - 2006
JCECE - 2005

Ans. (c) : $H_2 + I_2 \rightleftharpoons 2HI$

For the above chemical reaction–

Δn_g = No. of moles of product – No. of moles of reactant.

$\Delta n_g = 2 - 2 = 0$

Then, $K_p = K_c$

320. For which one of the following reactions $K_p = K_c$?

(a) $PCl_5 \rightleftharpoons PCl_3 + Cl_2$ (b) $N_2 + O_2 \rightleftharpoons 2NO$
(c) $N_2 + 3H_2 \rightleftharpoons 2NH_3$ (d) $2SO_3 \rightleftharpoons 2SO_2 + O_2$

JCECE - 2010
J&K CET-2003
UP CPMT-2014

Ans. (b) : $\because \quad K_p = K_c(RT)^{\Delta n_g}$

$K_p = K_c$ only when $(RT)^{\Delta n_g} = 0$

(a) $PCl_5 \rightleftharpoons PCl_3 + Cl_2$

$\Delta n_g = n_p - n_r$
$= 2 - 1$
$= 1$

$\therefore \quad K_p \neq K_c$

(b) $N_2 + O_2 \rightleftharpoons 2NO$

$\Delta n_g = 2 - 2$
$= 0$

$\therefore \quad K_p = K_c$

(c) $N_2 + 3H_2 \rightleftharpoons 2NH_3$

$\Delta n_g = 2 - 4$
$\Delta n_g = -2$

$\therefore \quad K_p \neq K_c$

(d) $2SO_3 \rightleftharpoons 2SO_2 + O_2$

$\Delta n_g = 3 - 2 = 1$

$\therefore \quad K_p \neq K_c$

321. In the reaction, $H_2(g) + Cl_2(g) \rightarrow 2HCl(g)$, relation between K_p and K_c is

(a) $K_p = K_c$ (b) $K_p \neq K_c$
(c) $K_p \geq K_c$ (d) $K_p < K_c$

J&K CET-2008
AP-EAMCET-1992

Ans. (a) : Given the reaction,

$$H_2(g)+Cl_2(g)\rightarrow 2HCl(g)$$

$\therefore$ Δn_g = No. of mole of gaseous product – no. of moles of gaseous reactant

$= 2 - (1 + 1)$
$\Delta n_g = 0$

$\therefore \quad K_p = K_c\ (RT)^{\Delta n_g}$
$K_p = K_c \times (RT)^0$
$K_p = K_c$

322. For the reaction $H_2(g)+I_2(g)\rightarrow 2HI(g)$, the equilibrium constant K_p changes with

(a) total pressure (b) catalyst
(c) the amount H_2 and I_2 (d) temperature

VITEEE- 2007
J & K CET-(2011)

Ans. (d) : The equilibrium constant K_p will change with temperature.

For the reaction-

$H_2(g)+I_2(g) \rightleftharpoons 2HI(g)$.

Catalyst does not alter the state of equilibrium. Equilibrium constant depends only upon temperature. The relation of K with temperature can be shown as-

$$\log\frac{K_2}{K_1}=\frac{\Delta H}{2.303R}\left[\frac{1}{T_1}-\frac{1}{T_2}\right]$$

323. In which of the following equilibrium K_c and K_p are not equal?

(a) $2C(s) + O_2(g) \rightleftharpoons 2CO_2(g)$
(b) $2NO(g) \rightleftharpoons N_2(g) + O_2(g)$
(c) $SO_2(g) + NO_2(g) \rightleftharpoons SO_3(g) + NO(g)$
(d) $H_2(g) + I_2(g) \rightleftharpoons 2HI(g)$

JCECE - 2013
NEET-2010

Ans. (a) : The relation between K_p and K_c is -

$$K_p=K_c(RT)^{\Delta n_g}$$

(a) $\quad 2C(s)+O_2(g) \rightleftharpoons 2CO_2(g)$

$\Delta n_g = n_p - n_r$
$= 2-(2+1)$
$= -1$

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∴ $K_p \neq K_c$

(b) $2NO(g) \rightleftharpoons N_2(g) + O_2(g)$

$\Delta n_g = 2 - (2) = 0$

∴ $K_p = K_c$

(c) $SO_2(g) + NO_2(g) \rightleftharpoons SO_3(g) + NO(g)$

$\Delta n_g = 2 - (2) = 0$

∴ $K_p = K_c$

(d) $H_2(g) + I_2(g) \rightleftharpoons 2HI(g)$

$\Delta n_g = 2 - (1 + 1) = 0$

∴ $K_p = K_c$

324. Two moles of PCl_5 is heated in a closed vessel of 2L capacity. When the equilibrium is attained 40% of it has been found to be dissociated. What is the K_c in mol/dm^3?

(a) 0.532
(b) 0.266
(c) 0.133
(d) 0.174
(e) 0.25

UPTU/UPSEE-2006, 2004
Kerala-CEE-2005

Ans. (b) : Degree of dissociation = 0.4

$$\begin{array}{lccc} & PCl_5 \rightleftharpoons & PCl_3 & + Cl_2 \\ \text{At equi.} & a(1-x) & ax & ax \end{array}$$

$a = 2, \quad x = 0.4, V = 2$

$$[PCl_5] = \frac{2(1-0.4)}{2} = 0.6 \text{ mol/L}$$

$$[PCl_3] = \frac{2 \times 0.4}{2} = 0.4 \text{ mol/L}$$

$$[Cl_2] = \frac{2 \times 0.4}{2} = 0.4 \text{ mol/L}$$

$$\therefore \quad K_c = \frac{[PCl_3][Cl_2]}{[PCl_5]}$$

$$= \frac{0.4 \times 0.4}{0.6}$$

$= 0.266$

325. 9.2g of $N_2O_4(g)$ is taken in a closed one litre vessel on heated till the following equilibrium is reached.

$$N_2O_4(g) \rightleftharpoons 2NO_2(g)$$

at equilibrium 50% of $N_2O_4(g)$ dissociated. What is the equilibrium constant (in mol L^{-1})? (Molecular weight of N_2O_4 is 92)

(a) 0.1
(b) 0.2
(c) 0.4
(d) 2

JIMPER-2009
UPCPMT-2008
AP-EAMCET (Medical)- 2007, 2001

Ans. (b) : Given the equilibrium reaction–

$$\begin{array}{lcc} & N_2O_4 \rightleftharpoons & 2NO_2 \\ \text{Initially} & 1 & 0 \\ \text{At equil.} & (1-x) & 2x \end{array}$$

At equilibrium molar concentration–

$$[N_2O_4] = \frac{(1-x)}{V}$$

$$[NO_2] = \frac{2x}{V}$$

$$\therefore \text{Moles of } N_2O_4 = \frac{\text{weight}}{\text{Molecular weight}} = \frac{9.2}{92} = 0.1\text{mole}$$

Concentration of $N_2O_4 = \frac{0.1}{1} = 0.1\text{mol/L}$

50% of N_2O_4 is dissociated at equilibrium,

$$= \frac{0.1 \times 50}{100} = 0.05\text{mol/L}$$

$$\therefore \quad K_c = \frac{[NO_2]^2}{(N_2O_4)}$$

$$\text{or} \quad K_c = \frac{\left(\frac{2x}{V}\right)^2}{\frac{1-x}{V}}$$

$$\text{or} \quad K_c = \frac{4(0.05)^2 \times 1}{0.05}$$

$K_c = 0.2$

326. For the reversible reaction:
$A(s) + B(g) \rightleftharpoons C(g) + D(g) : \Delta G° = -350kJ$.
Which one of the following statements is true?

(a) The entropy change is negative.
(b) Equilibrium constant is greater than one.
(c) The reaction should be instantaneous.
(d) The reaction is thermodynamically not feasible.

COMEDK-2020
Karnataka CET-2011

Ans. (b) : ΔG° has a negative value so, the reaction is feasible in forward direction and equilibrium constant will have value greater than one.

The relationship between ΔG° and equilibrium constant (K_p) –

$$\Delta G° = -2.303 \, RT \log K_p$$

When, $K_p > 1$, ΔG° is negative

327. The relation between K_p and K_c is correctly shown as

(a) $K_c = K_p(RT)^{\Delta n_g}$
(b) $K_p = K_c(RT)^{-\Delta n_g}$
(c) $K_p = K_c(RT)^{\Delta n_g}$
(d) $K_c = K_p(RT)^{-\Delta n_g}$

BCECE-2009
CG PET -2004

Ans. (c) : The relation between K_p and K_c is given by

$$K_p = K_c(RT)^{\Delta n_g}$$

Where, Δn_g = no. of mole of gaseous products – no. of mole of gaseous reactants

K_p/K_c = equilibrium constant

328. For the reaction $2NO(g) + Cl_2(g) \rightleftharpoons 2NOCl(g)$ which is true ?

(a) $K_p = K_c \times RT$
(b) $K_p = K_c \, (RT)^2$
(c) $K_p = \frac{K_c}{RT}$
(d) $K_p = \frac{K_c}{(RT)^2}$

MPPET-2013
CGPET-2011

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Ans. (c) : $2NO(g) + Cl_2(g) \rightleftharpoons 2NOCl(g)$

Δn_g = No. of mole of gaseous product – No. of mole of gaseous reactant

$\because \quad \Delta n_g = 2 - 3 = -1$

$\therefore \quad K_p = K_c(RT)^{\Delta n_g}$

$K_p = K_c(RT)^{-1}$

$K_p = \dfrac{K_c}{RT}$

329. For a reaction $2A \rightleftharpoons B + C$, K_c is 2×10^{-3}. At a given time, the reaction mixture has [A]=[B]=[C]= 3×10^{-4} M. Which of the following options is correct?

(a) The system is at equilibrium
(b) The reaction proceeds to the left
(c) The reaction proceeds to the right
(d) The reaction is complete

TS EAMCET 05.08.2021, Shift-I
JIMPER-2019, 2018

Ans. (b) : Given data:

$K_c = 2 \times 10^{-3}$

$[A] = [B] = [C] = 3 \times 10^{-4}$ M

For the reaction,

$2A \rightleftharpoons B + C$

The reaction quotient is given by

$\therefore \quad Q_c = \dfrac{[B][C]}{[A]^2}$

$Q_c = \dfrac{(3\times10^{-4})(3\times10^{-4})}{(3\times10^{-4})^2} = 1$

here, $Q_c > K_c$

Hence, the reaction will proceed in the direction of reactants (reverse reaction).

330. For the reaction $H_2(g) + I_2(g) \rightleftharpoons 2HI(g)$

(a) $K_p = K_c \neq 0$ (b) $K_p > K_c$
(c) $K_p < K_c$ (d) $K_p = K_c = 0$

TS-EAMCET (Engg.), 06.08.2021
VITEEE-2006

Ans. (a): For the reaction,

$H_2(g) + I_2(g) \rightleftharpoons 2HI(g)$

Δn_g = no. of mole of gaseous product – no. of mole of gaseous reactant

From the given balanced equation, we have 2 mole of product and 1 mole of each reactant.

$\Delta n_g = 2 - (1+1) = 0$

$\therefore \; K_p = K_c(RT)^{\Delta n_g} = K_c \; (\because \Delta n_g = 0)$

So, $K_p = K_c \neq 0$

331. If the equilibrium constant for the reaction $2AB \rightleftharpoons A_2 + B_2$ is 49. What is the value of equilibrium constant for $AB \rightleftharpoons \frac{1}{2}A_2 + \frac{1}{2}B_2$?

(a) 49 (b) 2401
(c) 7 (d) 0.02

AP-EAMCET (Engg.)2011
A.P.EAMCET 1998

Ans. (c) : Given that,

$2AB \rightleftharpoons A_2 + B_2$

We assume that the equilibrium constant for above reaction is K_{c_1}.

$\therefore \quad K_{c_1} = 49 = \dfrac{[A_2][B_2]}{[AB]^2}$ .....(i)

and $\quad AB \rightleftharpoons \frac{1}{2}A_2 + \frac{1}{2}B_2$

Again, we assume that the equilibrium constant for above reaction is K_{c_2}.

$\therefore \quad K_{c_2} = \dfrac{[A_2]^{1/2}[B_2]^{1/2}}{[AB]}$ .....(ii)

From equation (i) & (ii), we get–

$K_{c_2} = \sqrt{K_{c_1}} = \sqrt{49}$

$K_{c_2} = 7$

332. A(g) + 3B(g) $\rightleftharpoons$ 4C(g) is a reversible reaction where all the reactants and product are in gaseous state.

Conditions:

(i) Concentrations of both A and B are equal at the initiation

(ii) Concentration of both A and C are equal at the equilibrium.

Considering the imposed condition, find the value of K_c of this reversible reaction.

(a) 0.08 (b) 0.8
(c) 8.0 (d) 80.0

Tripura JEE-2022

Ans. (c): The reversible reaction is -

$A(g) + 3B(g) \rightleftharpoons 4C(g)$

	A	B	C
Initial conc.	a	a	0
Eq.conc.	(a – x)	(a – 3x)	4x

But [A] = [C]

$\therefore (a - x) = 4x$

$a = 5x$

$K_c = \dfrac{[C]^4}{[A][B]^3} = \dfrac{(4x)^4}{(5x-x)(5x-3x)^3} = \dfrac{(4x)^4}{(4x)(2x)^3} = 8.$

333. The reaction $2SO_2(g) + O_2(g) \rightleftharpoons 2SO_3(g)$ was carried out in a closed vessel of 1L capacity at a suitable temperature. The initial concentrations of SO_2 and O_2 are 2 and 1 moles/L respectively. At equilibrium, 1.6 moles of $SO_3(g)$ was found. The value of K_c at the same temperature is

(a) 10 (b) 40
(c) 60 (d) 80

TS EAMCET 10.08.2021, Shift-I

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Ans. (d) : The equilibrium reaction is -

$$2SO_2(g)+O_2(g)\rightleftharpoons 2SO_3(g)$$

Initially	2	1	0
At equilibrium	$2-1.6$	$1-0.8$	1.6
Conc.	$0.4/1$	$0.2/1$	$1.6/1$

$$\therefore \quad K_c=\frac{[SO_3]^2}{[SO_2]^2[O_2]}=\frac{(1.6)^2}{(0.4)^2(0.2)}$$

$$=\frac{2.56}{0.16\times0.2}$$

$$=\frac{2560}{16\times2}=\frac{640}{4\times2}=\frac{160}{2}=80$$

334. At 1990K and 1 atm pressure, there are equal number of Cl_2 molecules and Cl atoms in the reaction mixture. The value of K_p for the reaction $Cl_2(g)$ under the above conditions is $x \times 10^{-1}$. The value of x is ____.(Rounded off to the nearest integer)

JEE Mains 24.02.2021, Shift-I

Ans. : Given data :

T = 1990K,

P = 1 atm, $K_p = x \times 10^{-1}$

Given reaction is : $Cl_2(g)\rightleftharpoons 2Cl(g)$

Let mole of both Cl_2 and Cl is x –

Partial pressure of Cl = $p_{Cl} = 1\times\frac{x}{2x}=\frac{1}{2}$

Partial pressure of Cl_2 = $p_{Cl_2} = 1\times\frac{x}{2x}=\frac{1}{2}$

$$\therefore \quad K_p=\frac{(p_{Cl})^2}{p_{Cl_2}}=\frac{\left(\frac{1}{2}\right)^2}{\frac{1}{2}}$$

or $\quad K_p = 5\times10^{-1}$

$\because \quad K_p = x\times10^{-1}$

$\therefore \quad x\times10^{-1}=5\times10^{-1}$

$x = 5$

335. Which among the following denotes the correct relationship between K_p and K_c for the reaction $2A_{(g)} \rightleftharpoons B_{(g)} + C_{(g)}$

(a) $K_p > K_c$

(b) $K_c > K_p$

(c) $K_c = (K_p)^2$

(d) $K_p = K_c$

AP EAPCET 19-08-2021 Shift-I

Ans. (d) : $2A_{(g)} \rightleftharpoons B_{(g)} + C_{(g)}$

From the relation between K_p and K_c we get –

$K_p = K_c (RT)^{\Delta n}$ (Wher Δn = No. of mol in RHS – No. of mol in LHS).

$\therefore \quad \Delta n = 1 + 1 - 2 = 0$

$\therefore \quad K_p = K_c (RT)^0$

$K_p = K_c$

336. Given K_p for the reaction, $\frac{1}{2}C(g)\rightleftharpoons\frac{1}{2}A(g)+\frac{1}{2}B(g)$ at a fixed temperature is 0.25 atm^{-2}. Then find the K_p for the reaction $A(g) + B(g) \rightleftharpoons C(g)$ at the same temperature.

(a) 16

(b) 25

(c) 9

(d) 36

AP EAPCET 25.08.2021, Shift-II

Ans. (a) : Given reaction is –

$$\frac{1}{2}C(g)\rightleftharpoons\frac{1}{2}A(g)+\frac{1}{2}B(g) \qquad K_{p_1}=0.25$$

K_{p_1} for first reaction -

$$K_{p_1}=\frac{(p_A)^{1/2}(p_B)^{1/2}}{(p_C)^{1/2}}$$

$$K_{p_1}^2=\frac{p_Ap_B}{p_C} \qquad .....(i)$$

and

$$A(g)+B(g)\rightleftharpoons C(g)$$

$$\therefore \quad K_{p_2}=\frac{p_C}{p_Ap_B}$$

or

$$K_{p_2}=\frac{1}{\frac{p_Ap_B}{p_C}} \quad \{\text{from equation (i)}\}$$

$$K_{p_2}=\frac{1}{K_{p_1}^2}$$

or $\quad K_{p_2}=\frac{1}{0.25\times0.25}$

or $\quad K_{p_2}=16$

Reverse reaction

$$\frac{1}{2}A(g)+\frac{1}{2}B(g)\rightleftharpoons\frac{1}{2}C(g) \quad K_{p_1}=\frac{1}{K_p}=\frac{1}{0.25}$$

multiplying by 2

$$A(g)+B(g)\rightleftharpoons C(g)$$

$$\text{then}, K_{P_2}=(K_{P_1})^2$$

$$K_{P_2}=\left(\frac{1}{0.25}\right)^2=16$$

337. The equilibrium constant for the reaction is $P_4(s)+5O_2(g)\rightleftharpoons P_4O_{10}(s)$

(a) $K_c=\sqrt{5O_2}$

(b) $K_c=[O_2]^5$

(c) $K_c=[P_4O_{10}]/[P_4][O_2]^5$

(d) $K_c=\frac{1}{[O_2]^5}$

TS-EAMCET (Engg.), 05.08.2021 Shift-II

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Ans. (d) : The equilibrium reaction is –

$$P_4(s) + 5O_2(g) \rightleftharpoons P_4O_{10}(s)$$

The expression for the equilibrium constant is –

$$K_c = \frac{[P_4O_{10}]}{[P_4][O_2]^5} \Rightarrow \frac{1}{1\times[O_2]^5} \quad [\text{Here, } [P_4O_{10}] = [P_4] = 1]$$

$$\therefore \quad K_c = \frac{1}{[O_2]^5}$$

338. Identify the correct expression for the equilibrium constant of the following reaction: $2X(g) + Y(g) \rightleftharpoons 3Z(g)$

(a) $K = \frac{[X]^2[Y]}{[Z]^3}$ (b) $K = \frac{[Z]^3}{[X]^2[Y]}$

(c) $K = \frac{3[Z]}{2[X][Y]}$ (d) $K = [Z]^3[X]^2[Y]$

AP EAPCET-23-08-2021, Shift-I

Ans. (b) : Equilibrium constant is defined as, the relationship between the amounts of products and reactants present at equilibrium in a reversible chemical reaction.

Given that, $2X(g) + Y(g) \rightleftharpoons 3Z(g)$

$$\text{Equilibrium constant } (K_c) = \frac{[\text{Product}]}{[\text{Reactant}]}$$

$$K_c = \frac{[Z]^3}{[X]^2[Y]}$$

339. For the reaction $NO_2 + CO \rightleftharpoons NO + CO_2$ one mole of NO_2 and 2 moles of CO were kept in a vessel. Calculate the equilibrium constant K_p, if at equilibrium 25% of initial amount CO is consumed.

(a) $\frac{1}{2}$ (b) $\frac{1}{3}$

(c) 1 (d) $\frac{1}{4}$

AP EAMCET (Engg.) 18.9.2020 Shift-I

Ans. (b) : We have to assume that volume of the vessel is 1L.

	$NO_2(g)$ +	$CO(g)$ ⇌	$NO(g)$ +	$CO_2(g)$
t = 0	1	2	0	0
at equilibrium	1-0.5 = 0.5	2-0.5 = 1.5	0.5	0.5
Molar conc. (mol L^{-1})	$\frac{0.5}{1}$	$\frac{1.5}{1}$	$\frac{0.5}{1}$	$\frac{0.5}{1}$

$$\text{Given, } \alpha = 2\times\frac{25}{100} = 0.5$$

$$\Rightarrow \quad K_c = \frac{[NO][CO_2]}{[NO_2][CO]} = \frac{0.5\times0.35}{0.5\times1.5} = \frac{1}{3}$$

$$\because \quad \Delta n_g = (1+1) - (1+1) = 0$$

$$\therefore \quad K_p = K_c(RT)^{\Delta n_g} = K_c(RT)^0 = K_c$$

$$\Rightarrow \quad K_p = \frac{1}{3}$$

340. For a reaction, X +Y→ 2Z 1.0 mol of x, 1.5 mol of y, and 0.5 mol of Z, were taken in a 1L vessel and allowed to react. At equilibrium, the concentration of Z was 1.0 mol L^{-1}.The equilibrium constant of the reaction is .... $\frac{x}{15}$. The value of x is ....

JEE Mains-05-09.2020, Shift-II

Ans. () : 16

	X +	Y ⇌	2Z
At t = 0	1	1.5	0.5
At t = eq	1–x	1.5–x	0.5 + 2x
Molar conc.	$=\frac{3}{4}$	$=\frac{5}{4}$	= 1

$$\because \quad 2x = \frac{1}{2}$$

$$x = \frac{1}{4}$$

$$\therefore \quad K_c = \frac{(1)^2}{\left(\frac{5}{4}\right)\left(\frac{3}{4}\right)} = \frac{16}{15}$$

Hence, the value of x is 16.

341. For the reaction

$$\mathbf{2NO_2(g) \rightleftharpoons 2NO(g) + O_2(g)}$$

$K_c = 1.8\times10^{-6}$ at 184°C

R= $0.0831 kJK^{-1}mol^{-1}$

The relationship between K_p and K_c at 184°C is

(a) $K_p > K_c$

(b) $K_p < K_c$

(c) $K_p = K_c$

(d) K_p is independent of K_c

CG PET -2019

Ans. (a) : Given,

$$K_c = 1.8\times10^{-6} \quad T = 184 + 273 = 467$$

$$R = 0.0831 \text{ kJK}^{-1}\text{ mol}^{-1}$$

For the reaction-

$$2NO_2(g) \rightleftharpoons 2NO(g) + O_2(g)$$

$$\therefore \quad K_p = K_c(RT)^{\Delta n_g}$$

$$\Delta n_g = 3 - 2 = 1$$

When the value of Δn is 1, the term $(RT)^{\Delta n}$ becomes more than 1.

In such case, $K_p > K_c$

342. At a certain temperature, 2 mole of CO and 4 moles of Cl_2 gases were reacted to form $COCl_2$ in a 10L vessel. At equilibrium if one mole of CO is present then equilibrium constant for the reaction is

(a) 4 (b) 3.3

(c) 1 (d) 2.5

(e) 4.5

Kerala-CEE-2019

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Ans. (b) : Given that,

$$CO + Cl_2 \rightleftharpoons COCl_2$$

Initial moles 2 4 0

At equilibrium $2-x$ $4-x$ x

At equilibrium 1 mole of CO is present then–

$2 - x = 1$

$x = 1$

1 moles of CO in 10L vessel $= \frac{1}{10}$

1 moles of $Cl_2 = \frac{3}{10}$

Conc. of 1 mole of $COCl_2 = \frac{1}{10}$

At equilibrium constant reaction is –

$$K_c = \frac{[COCl_2]}{[CO][Cl_2]} = \frac{\frac{1}{10}}{\frac{1}{10}\times\frac{3}{10}} = \frac{10\times10}{10\times3}$$

$K_c = 3.3$

343. Two solids dissociate as follows: $A(s) \rightleftharpoons B(g) + C(g); K_{p_1} = x\ atm^2$

$D(s) \rightleftharpoons C(g) + E(g); K_{p_2} = y\ atm^2$ The total pressure when both the solids dissociate simultaneously is

(a) $\sqrt{x+y}$ atm (b) $x^2 + y^2\ atm^2$

(c) $(x + y)$ atm (d) $2\sqrt{x+y}$ atm

JEE Mains-2019

Ans. (d) : The dissociation reaction of solid are-

$$A(s) \rightleftharpoons B(g) + C(g)$$
$$\qquad P_1 \quad P_1$$

and $$D(s) \rightleftharpoons C(g) + E(g)$$
$$\qquad P_2 \quad P_2$$

Total pressure of C, $P_C = P_1 + P_2$

$K_{P_1} = x = P_B . P_C$ ....(i)

$x = P_1 (P_1 + P_2)$

$K_{P_2} = y = P_C . P_E$ ....(ii)

$y = (P_1 + P_2)P_2$

Adding (i) and (ii) –

$x + y = (P_1 + P_2)^2$

Now total pressure

$P_T = P_C + P_B + P_E$

$= (P_1 + P_2) + P_1 + P_2$

$= 2 (P_1 + P_2)$

$P_T = 2\left(\sqrt{x+y}\right)$ Ans.

344. $2ICl \rightarrow I_2 + Cl_2; K_c = 0.14$

If initial concentration of ICl is 0.6 M, then equilibrium concentration of I_2 is:

(a) 0.37 M (b) 0.126 M

(c) 0.224 M (d) 0.748 M

(26 May,2018(M))

Ans. (b): $2\ ICl \longrightarrow I_2 + Cl_2$

0.6 0 0

$0.6 - 2x$ x x

$$\therefore \quad K_C = 0.14 = \frac{x^2}{(0.6-2x)^2}$$

or $$\sqrt{0.14} = \left[\frac{x^2}{(0.6-2x)^2}\right]^{1/2}$$

$$0.37 = \frac{x}{0.6-2x}$$

$0.224 - 0.748\ x = x$

$1.748\ x = 0.224$

$x = 0.128$

345. What will be the equilibrium constant of the given reaction carried out in a 5 L vessel and having equilibrium amounts of A_2 and A as 0.5 mole and 2×10^{-6} mole respectively?

The reaction: $A_2 \rightleftharpoons 2A$

(a) 0.16×10^{-11} (b) 0.25×10^{5}

(c) 0.4×10^{-5} (d) 0.2×10^{-11}

J & K CET-(2018)

Ans. (a): Given reaction is– $A_2 \rightleftharpoons 2A$

Concentration of A_2 at equilibrium $= \frac{0.5}{5}$

Concentration of A at equilibrium $= \frac{2\times10^{-6}}{5}$

Equilibrium constant

$$K_c = \frac{[A]^2}{[A_2]} = \frac{\left(\frac{2\times10^{-6}}{5}\right)^2}{\frac{0.5}{5}}$$

$$K_c = \frac{4\times5}{25\times0.5}\times10^{-12}$$

$K_c = 0.16 \times 10^{-11}$

346. K_c for the reaction $N_2(g) + O_2(g) \rightleftharpoons 2NO(g)$ at 300 K is 4×10^{-6}. K_p for the above reaction will be (R = 2 cal $mol^{-1} K^{-1}$)

(a) 2.4×10^{-3} (b) 4×10^{-6}

(c) $4\times10^{-6}(RT)^2$ (d) 16×10^{-12}

AIIMS-[27-May, 2018 (E)]

Ans. (b): The reaction is :–

$$N_2(g) + O_2(g) \rightleftharpoons 2NO(g)$$

$\therefore \quad K_p = K_c (RT)^{\Delta n_g}$

Δn_g = no. of mole of gaseous product–no. of mole of gaseous reactant

$\Delta n_g = 2 - (1+1)$

$\Delta n_g = 0$

So, $K_p = 4\times10^{-6} (RT)^0$

$K_p = 4\times10^{-6}$

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347. A sample of HI(g) is placed in a flask at a pressure of 0.2 atm. At equilibrium, partial pressure of HI(g) is 0.04 atm. What is K_p for the given equilibrium?

$$2HI(g) \rightleftharpoons H_2(g) + I_2(g)$$

(a) 0.04 (b) 0.4
(c) 40 (d) 4

J & K CET-(2018)

Ans. (d): From equilibrium reaction-

$$\begin{array}{llll} & 2HI(g) \rightleftharpoons & H_2 + & I_2 \\ \text{Initial} & 0.2 & 0 & 0 \\ \text{At equilibrium} & 0.2-2x & x & x \end{array}$$

But pressure of HI is 0.04 atm.
So,

$$0.2 - 2x = 0.04$$
$$2x = 0.2 - 0.04$$
$$x = 0.08$$

So, $$K_p = \frac{p_{H_2}p_{I_2}}{p^2_{HI}} = \frac{0.08 \times 0.08}{(0.04)^2}$$

$$K_p = 4$$

348. What will be the expression of K_p for the given reaction if the total pressure inside the vessel is P and degree of dissociation of the reactant is a ? The reaction : $N_2O_4(g) \rightleftharpoons 2NO_2(g)$

(a) $4a^2P/(1+a^2)$ (b) $4a^2P/(1–a^2)$
(c) $a^2P/(1–a^2)$ (d) $a^2/(1–a)$

J & K CET-(2018)

Ans. (b): The dissociation of N_2O_4 is-

$$\begin{array}{lll} & N_2O_4 \rightleftharpoons & 2NO_2 \\ \text{At } t = 0 & 1 & 0 \\ \text{At equilibrium} & 1-a & 2a \end{array}$$

Total moles at equilibrium = 1 – a + 2a
= 1 + a

$$p_{N_2O_4} = \left(\frac{1-a}{1+a}\right)P$$

$$p_{NO_2} = \left(\frac{2a}{1+a}\right)P$$

$$\therefore \quad K_p = \frac{(p_{NO_2})^2}{p_{N_2O_4}} = \frac{\left(\frac{2a}{1+a}\right)^2 P^2}{\left(\frac{1-a}{1+a}\right)P}$$

$$K_p = \frac{4a^2P}{1-a^2}$$

349. For the reaction taking place at certain temperature
$NH_2COONH_4(s) \rightleftharpoons 2NH_3(g) + CO_2(g)$,
if equilibrium pressure is 3X bar then Δ_rG^0 would be

(a) –RT ln 9 – 3RT ln X
(b) RT ln 4 – 3 RT ln X
(c) –3RT ln 4X
(d) None of these

BITSAT 2018

Ans. (d) : From the relation b/w standard Gibb's free energy and equilibrium constant-

$$\Delta G^o = -RT \ln K_p ; K_p = (2X)^2 X = 4X^3$$

$$\therefore \quad \Delta G^o = -RT \ln (4X^3)$$

$$\Delta G^o = -RT \ln 4 - 3RT \ln X$$

350. The relationship between K_p and K_c is $K_p = K_c (RT)^{\Delta n}$. What would be the value of Δn for the reaction

$$NH_4Cl(s) \rightleftharpoons NH_3(g) + HCl(g)?$$

(a) 1 (b) 0.5
(c) 1.5 (d) 2

Karnataka-CET-2018

Ans. (d) : For the reaction –

$$NH_4Cl(s) \rightleftharpoons NH_3(g) + HCl\,(g)$$

$$\therefore \quad K_p = K_c\,(RT)^{\Delta n_g}$$

So, Δn_g = no. of mole of gaseous product – no of mole of gaseous reaction
= 2 – 0
= 2

351. A + 2B ⇌ 2C; K_c = ?

2 moles of each A and B are present in 10 lit solution. The product C formed 1 mole. Calculate K_c

(a) 1.5 (b) 6.67
(c) 0.15 (d) 2.3

AIIMS-[27-May, 2018 (M)]

Ans. (b): The reaction is -

$$\begin{array}{llll} & A + & 2B \rightleftharpoons & 2C \\ \text{Initial mole} & 2 & 2 & 0 \\ \text{At equilibrium} & 2-x & 2-2x & 2x \\ & =1.5 & =1 & =1 \end{array}$$

As 1 mole of C is formed at equilibrium,

$$2x = 1$$
$$x = 0.5$$

Number of moles of A at equilibrium
= 1.5, B=1, C=1

∴ Equilibrium concentration of A, B and C are -

$$[A] = \frac{1.5}{10}, [B] = \frac{1}{10}, [C] = \frac{1}{10}$$

$$\therefore \quad K_c = \frac{[C]^2}{[A][B]^2} = \frac{[1/10]^2}{[1.5/10][1/10]^2} = 6.67$$

352. For $NH_4HS(s) \rightleftharpoons NH_3(g) + H_2S(g)$, the observed pressure for the reaction mixture in equilibrium is 1.12 atm at 106 °C. What is the value of K_p for the reaction?

(a) 0.56 atm^2 (b) 0.3136 atm^2
(c) 1.25 atm^2 (d) 1.12 atm^2

AMU-2017

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Ans. (b) : The reaction is-

$$NH_4HS(s) \rightleftharpoons NH_3(g) + H_2S(g)$$

	$NH_4HS(s)$	$NH_3(g)$	$H_2S(g)$
Initially	—	—	—
At equil.	—	p	p

∴ Total pressure (P) = p + p

$$1.12 = 2p$$

or $$p = \frac{1.12}{2} = 0.56$$

$$K_p = \frac{p_{NH_3} \times p_{H_2S}}{1}$$

or $$K_p = 0.56 \times 0.56 = 0.3136\,atm^2$$

$$= 056 \times 0.56$$

$$= 0.3136\,atm^2$$

353. The equilibrium constant K_c value for a gaseous homogeneous equilibrium at 227°C is 2.05×10^{-5} mol L^{-1}. The K_p value in atmosphere for this equilibrium at this same temperature is ($R = 8.2 \times 10^{-2}$ L atm K^{-1} mol^{-1})

(a) 5.0×10^{-6} (b) 8.405×10^{-4}

(c) 5.0×10^{-5} (d) 8.405×10^{-3}

J & K CET-(2016)

Ans. (b) : Given data, $K_c = 2.05 \times 10^{-5}$ mol/L

$T = 227 + 273 = 500$ K, $K_p = ?$

relation between K_p and K_c is-

$$K_p = K_c (RT)^{\Delta n_g}$$

∵ $$(RT)^{\Delta n_g} = 1$$

∴ $$K_p = 2.05 \times 10^{-5} (8.2 \times 10^{-2} \times 500)$$

$$= 8.405 \times 10^{-4}$$

354. At 400K, in a 1.0 L vessel, N_2O_4 is allowed to attain equilibrium, $N_2O_4(g) \rightleftharpoons 2NO_2(g)$. At equilibrium, the total pressure is 600 mm Hg, when 20% of N_2O_4 is dissociated. The value of K_p for the reaction is

(a) 50 (b) 100

(c) 150 (d) 200

AP-EAMCET – 2016

Ans. (b) : Given that, T=400K, V=1 L, P = 600 mm Hg

In reversible reaction -

$$N_2O_4(g) \rightleftharpoons 2NO_2(g)$$

	$N_2O_4(g)$	$2NO_2(g)$
Initial mole	100	0
At equilibrium	(100 - 20) = 80	40

∴ Total number of moles = 40 + 80 = 120

∴ $$K_p = \frac{(p_{NO_2})^2}{p_{N_2O_4}}$$

$$K_p = \frac{\left(\frac{40}{120} \times 600\right)^2}{\frac{80}{120} \times 600}$$

$$K_p = 100$$

355. The equilibrium pressure for the reaction $MSO_4 \cdot 2H_2O(s) \rightleftharpoons MSO_4(s) + 2H_2O(g)$ is π/4 atm at 400 K. The K_p for the given reaction (in atm^2) is

(a) $\pi^2/4$ (b) $\pi/6$

(c) $\pi^2/16$ (d) $\pi/16$

(d) $16/\pi$

Kerala-CEE-2016

Ans. (c) : For the reaction-

$$MSO_4 \cdot 2H_2O(s) \rightleftharpoons MSO_4(s) + 2H_2O(g)$$

$$K_p = \frac{(p)^x_{product}}{(p)^y_{reactant}}$$

(Where x and y are power over gaseous products and reactants respectively)

∴ $$K_p = \frac{(p)^2_{product}}{(p)^0_{reactant}} = (p)^2_{product}$$

$$K_p = \left(\frac{\pi}{4}\right)^2$$

$$K_p = \frac{\pi^2}{16}$$

356. The K_{sp} of Ag_2CrO_4, AgCl, AgBr and AgI are respectively 1.1×10^{-12}, 1.8×10^{-10}, 5.0×10^{-13}, 8.3×10^{-17}. which one of the following salts will precipitate last if $AgNO_3$ solution is added to the solution containing equal moles of NaCl, NaBr, BaI and Na_2CrO_4?

(a) AgBr (b) Ag_2CrO_4

(c) AgI (d) AgCl

NEET-2015, Cancelled

Ans. (b) : For Ag_2CrO_4

$$Ag_2CrO_4 \rightarrow 2Ag^+ + CrO_4^{2-}$$

	Ag_2CrO_4	$2Ag^+$	CrO_4^{2-}
Initially	1	0	0
At time t	1–S	S	S

$$K_{sp} = \frac{(2S)^2 S}{(1-S)} \quad \text{as} \quad S <<< 1$$

So, $$K_{sp} = (2S)^2 S$$

$$1.1 \times 10^{-12} = 4S^3$$

$$S = 6.5 \times 10^{-5}$$

For AgCl :-

$$AgCl \rightarrow Ag^+ + Cl^-$$

$$\quad\quad\quad S \quad\; S$$

$$K_{sp} = S^2$$

$$1.8 \times 10^{-10} = S^2$$

$$S = 1.34 \times 10^{-5}$$

Similarly, for AgBr and AgI is 7.1×10^{-7} and 9.1×10^{-9} respectively. Since, solubility of Ag_2CrO_4 is the highest, it will precipitate last

357. The value of K_c for the dissociation reaction $H_2(g) \rightleftharpoons 2H(g)$ is 2.1×10^{-42} This equilibrium mixture contains mainly

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(a) $H_2(g)$
(b) H(g) atom
(c) 1 : 1 molar mixture of H_2 and H
(d) 1 : 2 molar mixture of H_2 and H

UPTU/UPSEE-2015

Ans. (a) : For the dissociation reaction -

$$H_2(g) \rightleftharpoons 2H\,(g) \qquad K_c = 2.1 \times 10^{-42}$$

Since, K_c is very small.
Hence, $[H_2]$ is predominant.

358. For a reaction $C(s) + CO_2(g) \rightleftharpoons 2CO(g)$ the partial pressures of CO_2 and CO are 4 and 8 atm, respectively, K_p for the reaction is
(a) 0.5 (b) 2 (c) 16 (d) 4

J & K CET-(2015)

Ans. (c) : Given data: $p_{CO_2} = 4$ atm, $p_{CO} = 8$ atm

For the reaction-

$$C(s) + CO_2(g) \rightleftharpoons 2CO(g)$$

$$\therefore \qquad K_p = \frac{(p_{CO})^2}{p_{CO_2}}$$

$$K_p = \frac{(8)^2}{4}$$

$$K_p = \frac{64}{4}$$

$$K_p = 16$$

359. K_p/K_c for the reaction,

$A(g) + 2B(g) \rightleftharpoons AB_2(g)$ is
(a) RT (b) $(RT)^2$
(c) $1/RT$ (d) $1/(RT)^2$

J & K CET-(2015)

Ans. (d) : For the reaction:

$$A + 2B \rightleftharpoons AB_2$$

$$\therefore \qquad K_p = K_c(RT)^{\Delta n_g}$$

$$\Delta n_g = 1-(1+2) = -2$$

So,

$$K_p = K_c(RT)^{-2}$$

$$\frac{K_p}{K_c} = \frac{1}{(RT)^2}$$

360. If K_c is the equilibrium constant for the formation of NH_3, the dissociation constant of NH_3 under the same condition will be
(a) $\frac{1}{K_c}$ (b) K_c^2 (c) $\sqrt{K_c}$ (d) K_c

CG PET- 2015

Ans. (a) : The equilibrium reaction is-

$$N_2 + 3H_2 \underset{K_c'}{\overset{K_c}{\rightleftharpoons}} 2NH_3$$

If the equation representing equilibrium constant is reversed. The new equilibrium constant is inverse of the first value.

i.e. $$K_c' = \frac{1}{K_c}$$

361. Which of the following statements is correct for a reversible process in a state of equilibrium ?
(a) $\Delta G^o = -2.30\ RT \log K$
(b) $\Delta G^o = 2.30\ RT \log K$
(c) $\Delta G = -2.30\ RT \log K$
(d) $\Delta G = 2.30\ RT \log K$

NEET-2015, Cancelled

Ans.(a): A mathematical expression of this thermodynamic view of equilibrium can be described by the following equation-
$\Delta G = \Delta G^o + RT\ln Q$ …..(i)]
At equilibrium, when $\Delta G = 0$ and $Q = K_c$
equation (i) becomes,
$\Delta G = \Delta G^o + RT\ln K_c = 0$
$\Delta G^o = -RT\ln K$
$\Delta G^o = -2.303RT \log K$

362. What will be the value of $[OH^-]^2$ in the 0.1 M solution of ammonium hydroxide having $K_b = 1.8 \times 10^{-5}$?
(a) 1.8×10^{-7} (b) 1.8×10^{-6}
(c) 1.8×10^{-4} (d) 1.8×10^{-3}

AMU-2015

Ans. (b) : The dissociation reaction of NH_4OH is -

$$NH_4OH \rightleftharpoons NH_4^+ + OH^-$$

Initial conc.	0.1	0	0
At equilibrium	$0.1(1-\alpha)$	0.1α	0.1α

$$\therefore \qquad K_b = \frac{[NH_4^+][OH^-]}{[NH_4OH]}$$

$$1.8\times10^{-5} = \frac{(0.1\alpha)(0.1\alpha)}{0.1(1-\alpha)}$$

$$1.8\times10^{-5} = (0.1)\alpha^2 \qquad ......(i) \quad [\because \alpha <<< 1]$$

Now,

$$[OH^-]^2 = (0.1)^2\alpha^2 = 0.1[(0.1)\alpha^2] \quad ......(ii)$$

From eqn (i) and (ii), we get

$$[OH^-]^2 = 0.1\times1.8\times10^{-5} = 1.8\times10^{-6}\ M$$

363. Consider the following statements with regard to chemical equilibrium –
1. **Equilibrium constant is dependent of initial concentrations of reactants and products.**
2. **Equilibrium constant is independent of initial concentrations of reactants and products.**
3. **Equilibrium constant for the reverse reaction is equal to the inverse of the equilibrium constant for the forward reaction.**

Which of the above statements are correct?
(a) 1 and 2 only (b) 2 and 3 only
(c) 1 and 3 only (d) 1, 2 and 3

SCRA-2015

Ans. (b): Application of equilibrium constant is given as –
(i&ii) The value of equilibrium constant is independent of initial concentration of the reactant and product.

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(iii) Let us write equilibrium constant for the reaction,

$$H_2(g) + I_2(g) \rightleftharpoons 2HI(g)$$

$$\therefore \quad K_c = \frac{[HI]^2}{[H_2][I_2]} \quad .....(i)$$

The equilibrium constant for the reverse reaction, $2HI(g) \rightleftharpoons H_2(g) + I_2(g)$, at the same temperature is,

$$K'_c = \frac{[H_2][I_2]}{[HI]^2} \quad .....(ii)$$

From equation (i) and (ii)–

$$K'_c = \frac{1}{K_c}$$

Hence, statement is true.

364. In a closed cylinder of capacity 24.6 L, the following reaction occurs at 27° C.

$$\mathbf{A_2(s) \rightleftharpoons B_2(s) + 2C(g)}$$

At equilibrium, 1 g of B_2 (s) (molor mass = 50 g mol^{-1}) is present. The equilibrium constant K_p for the equilibrium in atm^2 unit is
(R = 0.082 L atm K^{-1} mol^{-1})

(a) 1.6×10^{-2} (b) 1.6×10^{-5}
(c) 1.6×10^{-3} (d) 1.6×10^{-4}
(e) 1.6×10^{-1}

Kerala-CEE-2014

Ans. (c) : Given data : V = 24.6 L, T = 27°C amount of B_2 = 1g, K_p = ?

For the reaction,

$$\underset{(a-x)}{A_2(s)} \rightleftharpoons \underset{\substack{0\\x}}{B_2(s)} + \underset{\substack{0\\2x}}{2C(g)}$$

since, at equilibrium, $[B_2] = \frac{\text{mass}}{\text{molor mass} \times \text{volume}}$

$$= \frac{1}{50 \times 24.6}$$

$$= \frac{1}{1230} = 0.000813 = 8.13 \times 10^{-4}$$

$$K_c = [C]^2 = (2 \times 8.13 \times 10^{-4})^2$$
$$= (16.26)^2 \times 10^{-8}$$
$$= 264.38 \times 10^{-8}$$
$$= 2.64 \times 10^{-6}$$

$$K_p = K_c (RT)^{\Delta n_g}$$

$$K_p = 2.64 \times 10^{-6} (0.082 \times 300)^{2-0}$$
$$= 2.64 \times 10^{-6} (24.6)^2$$
$$= 2.64 \times 605.16 \times 10^{-6}$$
$$= 1597.62 \times 10^{-6}$$
$$= 1.59 \times 10^{-3}$$
$$\approx 1.6 \times 10^{-3}$$

365. In which of the following case, does the reaction go farthest to completion if

(a) $K_c = 10^2$ (b) $K_c = 10$
(c) $K_c = 10^{-2}$ (d) $K_c = 1$

COMEDK 2014

Ans. (a) : $K_c = \frac{[\text{Products}]}{[\text{Reactants}]}$

Higher value of K_c, indicates higher concentration of products which means the reaction goes more towards the completion.

366. The equilibrium constant for the reaction, $H_2(g) + I_2(g) \rightleftharpoons 2HI(g)$ is 64. If the volume of the container is reduced to half of the original volume, the value of the quilibrium constant will be

(a) 16 (b) 32
(c) 64 (d) 128

JCECE - 2014

Ans. (c) : $H_2(g) + I_2(g) \rightleftharpoons 2HI(g)$

For this reaction, $\Delta n_g = 0$

∴ The reaction and its equilibrium constant is not affected by change in volume. Moreover, equilibrium constant depends only on temperature.

367. Using the Gibbs energy change, ΔG^o = +63.3 kJ for the following reaction,

$$\mathbf{Ag_2CO_3(s) \rightleftharpoons 2Ag^+(aq) + CO_3^{2-}(aq)}$$

the K_{sp} of $Ag_2CO_3(s)$ is water at 25ºC is
(R = 8.314 J K^{-1} mol^{-1})

(a) 3.2×10^{-26} (b) 8.0×10^{-12}
(c) 2.9×10^{-3} (d) 7.9×10^{-2}

NEET-2014

Ans. (b) : ΔG^o is related to K_{sp} by the equation,

$$\Delta G^o = -2.303 \, RT \log K_{sp}$$

Given,

$$\Delta G^o = +63.3 \text{ kJ}$$
$$= 63.3 \times 10^3 \text{ J}$$

Thus, Substitute $\Delta G^o = 63.3 \times 10^3$ J

R = 8.314 J K^{-1} mol^{-1} and T = 298K

From the above equation we get : -

$$63.3 \times 10^3 = -2.303 \times 8.314 \times 298 \times \log K_{sp}$$

$$\therefore \quad \log K_{sp} = -11.09$$
$$K_{sp} = \text{antilog}(-11.09)$$
$$K_{sp} = 8.0 \times 10^{-12}$$

368. For a given exothermic reaction, K_p and K'_p are the equilibrium constants at temperature T_1 and T_2 respectively. Assuming that heat of reactions is constant if temperature range between T_1 and T_2 it is readily observed that

(a) $K_p > K'_p$ (b) $K_p < K'_p$
(c) $K_p = K'_p$ (d) $K_p = \frac{1}{K'_p}$

NEET-2014

Ans. (a) : For a given exothermic reaction, K_p and K'_p are the equilibrium constants at temperature T_1 and T_2 respectively. Assuming that heat of reactions is constant in temperature range between T_1 and T_2 it is readily observed that $K_p > K'_p$

$$\log \frac{K_2}{K_1} = \frac{\Delta H^o}{2.303R}\left(\frac{1}{T_1} - \frac{1}{T_2}\right)$$

$$T_2 > T_1$$

So, $K_p > K'_p$ (exothermic reaction)

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369. In a reaction, A + B $\rightleftharpoons$ C + D, 40% of B has reacted at equilibrium; when 1 mole of 'A' was heated with 1 mole of B in a 10 L closed vessel the value of K_c is

(a) 0.44 (b) 0.18
(c) 0.22 (d) 0.36

AP-EAMCET (Engg.) -2014

Ans. (a) : The equilibrium reaction is-

	A	+ B	$\rightleftharpoons$ C	+ D
At t = 0	100	100	0	0
At eqi.	(100 – 40) = 60	(100 – 40) = 60	40	40

$$\therefore \quad K_c = \frac{[C][D]}{[A][B]} = \frac{40\times 40}{60\times 60} = 0.44$$

370. The value of K_{sp} of $CaCO_3$ and CaC_2O_4 are 4.7×10^{-9} and 1.3×10^{-9} respectively at 25ºC. If the mixture of these two is washed with water, what is the concentration of Ca^{2+} ions in water?

(a) 5.831×10^{-5} M (b) 6.856×10^{-5} M
(c) 3.606×10^{-5} M (d) 7.746×10^{-5} M

Karnataka NEET-2013

Ans. (d) : $CaCO_3 \longrightarrow Ca^{2+} + CO_3^{2-}$ 4.7×10^{-9} ….(i)

$S + S_1$ S

$CaC_2O_4 \longrightarrow Ca^{2+} + C_2O_4^{2-}$ 1.3×10^{-9} ….(ii)

$S + S_1$ S_1

On dividing (i) and (ii) –

$$\frac{(S+S_1)\times S}{(S+S_1)\times S_1} = \frac{4.7\times10^{-9}}{1.3\times10^{-9}}$$

$$\frac{S}{S_1} = \frac{47}{13} = 3.61$$

$S = 3.61\ S_1$ …….(iii)

From (i) :-

$(S + S_1) \times S = 4.7 \times 10^{-9}$

From (ii) :-

$(S + S_1) \times S_1 = 1.3 \times 10^{-9}$

Putting the value of S from equation (iii) we get

$4.61\ S_1^2 = 1.3 \times 10^{-9}$

$S_1^2 = 0.281 \times 10^{-9}$

$S_1 = \sqrt{0.281 \times 10^{-9}}$

$S_1 = 1.67 \times 10^{-5}$

From (iii):-

$S = 3.61S_1 = 3.6 \times 1.67 \times 10^{-5}$

$S = 6.02 \times 10^{-5}$

$[Ca^{2+}] = S + S_1$

$= (6.02 + 1.67) \times 10^{-5}$

$= 7.69 \times 10^{-5}$

371. For the equilibrium, A(g) $\rightleftharpoons$ B(g) + C(g); K_p = 0.82 atm at 27°C. At the same temperature, its K_c in mol L^{-1} is (R = 0.082 L atm $mol^{-1}K^{-1}$)

(a) 0.033 (b) 3.3
(c) 1.0 (d) 0.33

AP EAMCET (Medical) - 2013

Ans. (a) : For the equilibrium reaction-

$$A(g) \rightleftharpoons B(g) + C(g)$$

Given values-

$K_p = 0.82$ atm

$T = 27°C + 273 = 300K$

$K_c = ?\ (molL^{-1})$

$R = 0.082\ atm\ mol^{-1}K^{-1}$

Now, from the relation between K_p and K_c - we get

$K_p = K_c(RT)^{\Delta n_g}$

or $0.082 = K_c(0.082\times300)^{1+1-1}$

or $0.082 = K_c \times 0.082 \times 300$

or $K_c = 0.033$

372. At equilibrium, if K_p = 1, then

(a) $\Delta G^o > 1$ (b) $\Delta G^o < 1$
(c) $\Delta G^o = 0$ (d) $\Delta G^o = 1$

UPTU/UPSEE-2013

Ans. (c) : Given, $K_p = 1$

Since, at equilibrium, $\Delta G = 0$

$\Rightarrow$ $\Delta G^o = 0 - RT \ln K_p$

$\Rightarrow$ $\Delta G^o = -RT \ln 1$

$\Delta G^o = 0$

373. In the following equilibrium reaction,

$$2A \rightleftharpoons B + C$$

the equilibrium concentrations of A, B and C are 1 × 10^{-3} M, 2 × 10^{-3} M and 3 × 10^{-3} M respectively at 300 K. The value of K_c for this equilibrium at the same temperature is

(a) $\frac{1}{6}$ (b) 6
(c) $\frac{1}{36}$ (d) 36
(e) $\frac{1}{24}$

Kerala-CEE-2012

Ans. (b) : Given that, $[A] = 1 \times 10^{-3}$ M

$[B] = 2 \times 10^{-3}$ M

$[C] = 3\times10^{-3}$ M

We have the equilibrium reaction is

$$2A \rightleftharpoons B + C$$

Equilibrium constant, $K_c = \frac{[B][C]}{[A]^2}$

By putting all those values, we get

$$K_c = \frac{(2\times10^{-3})(3\times10^{-3})}{(1\times10^{-3})^2}$$

$K_c = 6$

374. Given the reaction between 2 gases represented by A_2 and B_2 to give the compound AB(g).

$$A_2(g) + B_2(g) \rightleftharpoons 2AB(g)$$

At equilibrium the concentration of
$A_2 = 3.0 \times 10^{-3}$ M of $B_2 = 4.2 \times 10^{-3}$ M of
$AB = 2.8 \times 10^{-3}$ M
If the reaction takes place in sealed vessel at 527ºC, then the value of K_c will be

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(a) 2.0 (b) 1.9
(c) 0.62 (d) 4.5

NEET-Mains 2012

Ans. (c) : Given that,

$A_2 = 3.0 \times 10^{-3}$ M

$B_2 = 4.2 \times 10^{-3}$ M

$AB = 2.8 \times 10^{-3}$ M

The reaction is

$$A_2(g) + B_2(g) \rightleftharpoons 2AB(g)$$

$$\therefore \quad K_c = \frac{[AB]^2}{[A_2][B_2]} = \frac{2.8 \times 2.8 \times 10^{-6}}{3 \times 10^{-3} \times 4.2 \times 10^{-3}}$$

$$= 0.62$$

375. At room temperature, for the reaction

$NH_4SH(s) \rightleftharpoons NH_3(g) + H_2S(g)$

(a) $K_p = K_c$
(b) $K_p > K_c$
(c) $K_p < K_c$
(d) K_p and K_c do not relate.

J & K CET-(2012)

Ans. (b) : The equilibrium reaction is-

$$NH_4SH(s) \rightleftharpoons NH_3(g) + H_2S(g)$$

$$\therefore \quad K_p = K_c\ (RT)^{\Delta n_g}$$

$$\Delta n_g = 2 - 0$$

$$= 2$$

When the value of $\Delta n \geq 1$

In such case $K_p > K_c$

376. On passing H_2S into a solution containing both Zn^{2+} and Cu^{2+} in acidic medium, only CuS gets precipitated. This is because

(a) K_{sp} of CuS < K_{sp} of ZnS
(b) K_{sp} of CuS = K_{sp} of ZnS
(c) K_{sp} of CuS > K_{sp} of ZnS
(d) CuS is more stable than ZnS.

COMEDK-2012

Ans. (a) : $H_2S \rightleftharpoons 2H^+ + S^{2-}$

In acidic medium ionisation of H_2S is suppressed due to common ion effect. This decrease the concentration of S^{2-} ions in solution as such K_{sp} of only CuS is exceeded resolving in the precipitation of CuS. K_{sp} of ZnS is much higher.

Since the solubility product of CuS is less than of ZnS, CuS gets precipitated.

K_{sp} (CuS) < K_{sp} (ZnS)

K_{sp} (CuS) = 8×10^{-37}

K_{sp} (Zns) = 1.2×10^{-23}

377. The equilibrium constant K_c for the reaction

$SO_2(g) + NO_2(g) \rightleftharpoons SO_3(g) + NO(g)$

is 16. If one mole of all four gases is taken in a one litre container, the equilibrium concentration of SO_3 would be:

(a) 0.4 m (b) 0.6 m
(c) 1.4 m (d) 1.6 m

MPPET-2012

Ans. (d) : Given $K_c = 16$, $[SO_3] = ?$

The reaction is–

$$SO_2(g) + NO_2(g) \rightleftharpoons SO_3(g) + NO(g)$$

	$SO_2(g)$	$NO_2(g)$	$SO_3(g)$	$NO(g)$
Initial conc^n.	1	1	1	1
At equi.	1–z	1–z	1+z	1+z
Molar conc.	$\frac{1-z}{1}$	$\frac{1-z}{1}$	$\frac{1+z}{1}$	$\frac{1+z}{1}$

Applying law of mass action-

$$K_c = \frac{[SO_3][NO]}{[SO_2][NO_2]} = 16$$

$$16 = \frac{[1+z][1+z]}{[1-z][1-z]} = \frac{(1+z)^2}{(1-z)^2}$$

$(1 + z)^2 = 16(1 - z)^2$

$1 + z = 4\ (1 - z)$

$1 + z = 4 - 4z$

$5z = 3$

$z = \frac{3}{5}$

$[SO_3]$ at equilibrium is-

$$\therefore \quad (1 + z) = 1 + \frac{3}{5}$$

$$= \frac{5+3}{5}$$

$$= \frac{8}{5} = 1.6\,m$$

378. For the reaction, $2NH_3(g) \rightleftharpoons N_2(g) + 3H_2(g)$ the units of K_p will be

(a) atm (b) $(atm)^3$
(c) $(atm)^{-2}$ (d) $(atm)^2$

UP CPMT-2011

Ans. (d) : For the reaction,

$$2NH_3(g) \rightleftharpoons N_2(g) + 3H_2(g)$$

$$K_p = \frac{p_{N_2} \times p^3_{H_2}}{p^2_{NH_3}} = \frac{(atm)^4}{(atm)^2} = (atm)^2$$

379. A vessel at 1000 K contains CO_2 with a pressure of 0.5 atm. Some of the CO_2 is converted into CO on the addition of graphite. The value of K if the total pressure at equilibrium is 0.8 atm, is

(a) 1.8 atm (b) 3 atm
(c) 0.3 atm (d) 0.18 atm

VITEEE- 2011

Ans. (a) : Given data: T = 1000K, pressure of CO_2 = 0.5 atm, P = 0.8 atm

The equilibrium reaction-

$$CO_2(g) + C(s) \rightleftharpoons 2CO(g)$$

	$CO_2(g)$	$2CO(g)$
Intial	0.5 atm	0
At equi.	0.5–x	2x

Total pressure at equilibrium

= 0.5–x + 2x = 0.5 + x = 0.8

$\therefore$ x = 0.3 atm

$$K_p = \frac{p^2_{CO}}{p_{CO_2}} = \frac{(2x)^2}{(0.5-x)} = \frac{(2 \times 0.3)^2}{0.5 - 0.3} = 1.8\,atm.$$

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380. For a chemical reaction A + B $\rightleftharpoons$ C, the thermodynamic equilibrium constant K_p is

(a) in atm^{-2} (b) in atm^{-3}
(c) in atm^{-1} (d) dimensionless

JCECE - 2011

Ans. (c) : For the reaction,

$$A + B \rightleftharpoons C$$

$$\Delta n_g = 1 - 2 = -1$$

$$K_p = (\text{atmosphere})^{-1}$$

381. Four moles of PCl_5 are heated in a closed 4 dm^3 container to reach equilibrium at 400 K. At equilibrium 50% of PCl_5 is dissociated. What is the value of K_c for the dissociation of PCl_5 in to PCl_3 and Cl_2 at 400 K?

(a) 0.50 (b) 1.00
(c) 1.25 (d) 0.05
(e) 0.25

Kerala-CEE-2011

Ans. (a) : $PCl_5(s) \rightleftharpoons PCl_3(g) + Cl_2(g)$

At, 400 K, PCl_5 is solid

Vol. 4 0 0
Vol. 2 2 2

$$K_c = \frac{[PCl_3][Cl_2]}{[PCl_5]}$$

At high pressure, the PCl_3 will be a liquid

So, $K_c = \frac{2}{4} \text{mol dm}^{-3}$

$K_c = 0.5 \text{ mol dm}^{-3}$

382. In the preparation of CaCO from $CaCO_3$ using the equilibrium $CaCO_3(s) \rightleftharpoons CaCO(s) + CO_2(s)$ K_p is expressed as:

$$\log K_p = 7.282 - \frac{8500}{T}$$

The complete decomposition of $CaCO_3$, the temperature in Celsius to be used is

(a) 1167 (b) 894
(c) 8500 (d) 850

AMU-2011

Ans. (b) : In the preparation of CaO from $CaCO_3$ using the equilibrium.

$$CaCO_3(s) \rightleftharpoons CaO(s) + CO_2(g)$$

K_p is expressed as

$$\log K_p = 7.282 - \frac{8500}{T}$$

For complete decomposition of $K_p = 1$

$$\log K_p = 0$$

So, $\log K_p = 7.282 - \frac{8500}{T}$

$$0 = 7.282 - \frac{8500}{T}$$

$$7.282 = \frac{8500}{T}$$

$T = 1167.26$ K
$T = 1167.26 - 273.15°C$
$T = 894.11°C$

383. For the equilibrium,

$$2SO_2(g) + O_2(g) \rightleftharpoons 2SO_3(g)$$

(a) $K_p = K_c$ (b) $K_p = \frac{K_c}{RT}$
(c) $K_p = K_cRT$ (d) $K_p = K_c(RT)^2$

COMEDK-2011

Ans. (b) : The given equilibrium reaction,

$$2SO_2(g) + O_2(g) \rightleftharpoons 2SO_3(g)$$

$\therefore$ Δn_g = no. of moles of product – no. of moles of reactant

or $\Delta n_g = n_P - n_R = 2 - 3 = -1$

$$K_p = K_c(RT)^{\Delta n_g}$$

or $K_p = K_c(RT)^{-1}$ or $K_p = \frac{K_c}{RT}$

384. If the equilibrium constant for the reaction, $H_2(g) + I_2(g) \rightleftharpoons 2HI(g)$ is K, what is the equilibrium constant of

$$HI(g) \rightleftharpoons \frac{1}{2}H_2(g) + \frac{1}{2}I_2(g)?$$

(a) $\frac{1}{K}$ (b) $\sqrt{K}$
(c) K (d) $\frac{1}{\sqrt{K}}$

AP-EAMCET- (Engg.) - 2010

Ans. (d) : Given,

$$H_2(g) + I_2(g) \rightleftharpoons 2HI(g).$$

$$K_c = \frac{[HI]^2}{[H_2][I_2]} \quad .....(i)$$

For the reaction

$$HI(g) \rightleftharpoons \frac{1}{2}H_2(g) + \frac{1}{2}I_2(g)$$

$$K'_c = \frac{[H_2]^{1/2}[I]^{1/2}}{[HI]} \quad .....(ii)$$

Multiplying equation (i) and (ii) , we get-

$$K_c \times K'_c = \frac{[HI]^2}{[H_2][I_2]} \times \frac{[H_2]^{1/2}[I_2]^{1/2}}{[HI]}$$

$$K_c \cdot K'_c = \frac{[HI]}{[H_2]^{1/2}[I_2]^{1/2}} \quad \text{[from equation (ii)]}$$

$$K_c \cdot K'_c = \frac{1}{K'_c}$$

$$(K'_c)^2 = \frac{1}{K_c}$$

$$K'_c = \frac{1}{\sqrt{K_c}}$$

385. For the reaction,

$$2A(g) + B_2(g) \rightleftharpoons 2AB_2(g)$$

the equilibrium constant, K_p at 300 K is 16.0. The value of K_p for $AB_2(g) \rightleftharpoons A(g) + 1/2\,B_2(g)$ is

@apna_pdf

(a) 8 (b) 0.25
(c) 0.125 (d) 32

VITEEE- 2010

Ans. (b) : For the given reaction,

$$2A(g)+B_2(g) \rightleftharpoons 2AB_2(g)$$

The equilibrium constant,

$$K_p=\frac{p^2_{AB_2}}{p^2_A.p_{B_2}}=16 \qquad .....(i)$$

For the other given reaction,

$$AB_2(g) \rightleftharpoons A(g)+\frac{1}{2}B_2(g)$$

The equilibrium constant,

$$K'_p=\frac{p_A.p^{1/2}_{B_2}}{p_{AB_2}} \qquad .....(ii)$$

On squaring eq. (ii), we obtain,

$$(K'_p)^2=\frac{p^2_A.p_{B_2}}{p^2_{AB_2}} \qquad ....(iii)$$

Now, from eq. (i) and (iii), we obtain,

$$K_p.(K'_p)^2=1 \Rightarrow 16.(K'_p)^2=1 \qquad (\because K_p=16)$$

$$\Rightarrow \qquad (K'_p)=\left(\frac{1}{16}\right)^{1/2} \Rightarrow K'_p=\frac{1}{4}=0.25$$

386. For the reaction,
$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$ at 400 K, $K_p = 41$.
Find the value of K_p for the following reaction.

$$\frac{1}{2}N_2(g)+\frac{3}{2}H_2(g) \rightleftharpoons NH_3(g)$$

(a) 6.4 (b) 0.02
(c) 50 (d) 4.6

J & K CET-(2010)

Ans. (a) : Given, T = 400 K, $K_p = 41$

For the first reaction -

$$N_2 + 3H_2 \rightleftharpoons 2NH_3$$

$$\therefore \qquad K_p=\frac{(p_{NH_3})^2}{p_{N_2}(p_{H_2})^3}$$

$$41=\frac{(p_{NH_3})^2}{p_{N_2}(p_{H_2})^3} \qquad ....(i)$$

For the second reaction -

$$\frac{1}{2}N_2+\frac{3}{2}H_2 \rightleftharpoons NH_3$$

$$K'_p=\frac{p_{NH_3}}{(p_{N_2})^{1/2}(p_{H_2})^{3/2}}$$

On squaring both sides –

$$(K'_p)^2=\frac{(p_{NH_3})^2}{(p_{N_2})(p_{H_2})^3} \qquad \text{[from equation (i)]}$$

$$(K'_p)^2=K_p=41$$

$$K'_p=(41)^{1/2}$$

$$=6.4\ atm^{-1}$$

387. For the decomposition reaction of lime stone, the correct expression for rate constant, K_p is

(a) $K_p=\frac{P_{CaO}\cdot P_{CO_2}}{P_{CaCO_3}}$

(b) $K_p=\frac{[CaO][CO_2]}{[CaCO_3]}$

(c) $K_p=\frac{P_{CaO}+P_{CO_2}}{P_{CaCO_3}}$

(d) $K_p=P_{CO_2}$

UPTU/UPSEE-2010

Ans. (d) : The decomposition reaction of $CaCO_3$ is -

$$CaCO_3(s) \rightleftharpoons CaO(s) + CO_2(g)$$

Thus, $K_p = P_{CO_2}$

As concentration of solid remain unchanged it is taken as unity.

388. In which of the following reactions $K_p > K_c$?

(a) $N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$
(b) $H_2(g) + I_2(g) \rightleftharpoons 2HI(g)$
(c) $PCl_3(g) + Cl_2(g) \rightleftharpoons PCl_5(g)$
(d) $2SO_3(g) \rightleftharpoons 2SO_2(g) + O_2(g)$

UP CPMT-2010

Ans. (d): We know that,

$$K_p=K_c\ (RT)^{\Delta n_g}$$

Where, $\Delta n_g=n_p-n_r$

(n_p = number of moles of gaseous products)
(n_r = number of moles of gaseous reactants)

For $K_p > K_c$,
$\Delta n_g \geq +1$
or $n_p > n_r$

In reaction, $2SO_3(g) \rightleftharpoons 2SO_2(g) + O_2(g)$
$n_p = 3$
$n_r = 2$

Thus, for this reaction, $K_p > K_c$.

389. What is the effect of a ten-fold increase in pressure on K_p in the reaction $N_2(g)+3H_2(g) \rightleftharpoons 2NH_3(g)$ at equilibrium?

(a) A ten-fold increase (b) A ten-fold decrease
(c) No change (d) Equal to K_c

AP- EAMCET(Medical) -2010

Ans. (c): For the reaction-

$$N_2(g)+3H_2(g) \rightleftharpoons 2NH_3(g)$$

The relation between K_p and K_c is given as-

$$K_p=K_c(RT)^{\Delta n} \quad \left(\begin{array}{l}\text{where, } \Delta n=\sum n_p-\sum n_r \\ \Delta n=2-4=-2\end{array}\right)$$

or $$K_p=K_c\times(RT)^{-2}$$

or $$K_p=\frac{K_c}{(RT)^2}$$

Thus, the value of K_p is depends upon the temperature of the reaction. Hence, no change occure during the increments of pressure.

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390. Calculate K_c for the reversible process given below if K_p=167 and T =800^{0}C.

$$CaCO_3(s) \rightleftharpoons CaO(s) + CO_2(g)$$

(a) 1.95 (b) 1.85
(c) 1.89 (d) 1.60

WB-JEE-2010

Ans. (c) : Given, $K_p = 167$, T= 800°, K_c = ?
The decomposition reaction of lime stone is -

$$CaCO_3(s) \rightleftharpoons CaO(s) + CO_2(g)$$

$$\therefore \quad K_p = K_c\,(RT)^{\Delta n_g}$$

$$\Delta n_g = 1 - 0 = 1$$

$$\therefore \quad K_c = \frac{K_p}{[0.0821\times(800+273)]^1}$$

$$K_c = \frac{167}{88.09}$$

$$K_c \approx 1.89$$

391. In an equilibrium reaction, if Δn_g is positive then

(a) $K_c = K_p$ (b) $K_c < K_p$
(c) $K_c > K_p$ (d) $K_c = 0$

SRMJEEE – 2009

Ans. (b) : As we know the relation between K_p and K_c is –

$$K_p = K_c\ (RT)^{\Delta n_g}$$

If, $\Delta n_g = +ve$ (Given)
Then, $K_p > K_c$

392. For the reaction $SO_2 + \frac{1}{2}O_2 \rightleftharpoons SO_3$ if we write $K_p=K_c(RT)^x$, then x becomes

(a) 1 (b) $-\frac{1}{2}$
(c) $\frac{1}{2}$ (d) 1

WB-JEE-2009

Ans. (b) : For the reaction -

$$SO_2 + \frac{1}{2}O_2 \rightleftharpoons SO_3$$

x = no. of mole of gaseous product – no. of mole of gaseous reactant

$$x = 1 - \left(\frac{1}{2}+1\right) = 1 - \frac{3}{2} = -\frac{1}{2}$$

393. If the equilibrium constant of the reaction $2HI \rightleftharpoons H_2 + I_2$ is 0.25, then the equilibrium constant for the reaction $H_2 + I_2 \rightleftharpoons 2HI$ would be

(a) 1 (b) 2
(c) 3 (d) 4

BITSAT 2009

Ans. (d) : $2HI \rightleftharpoons H_2 + I_2$ For this chemical reaction equilibrium constant -

$K_c = 0.25$

Now the reaction is reveres

$$H_2 + I_2 \rightleftharpoons 2HI$$

Hence, new equilibrium constant is -

$$K'_c = \frac{1}{K_c}$$

$$= \frac{1}{0.25}$$

$$= \frac{100}{25}$$

$$K'_c = 4$$

394. For the reaction, $2B + A \rightleftharpoons C$, the equilibrium constant is–

(a) $\frac{[A][B]^3}{[C]}$ (b) $\frac{[C]}{[A][2B]}$
(c) $\frac{[C]}{[A][B]^2}$ (d) $\frac{[A][B]}{[C]}$

BCECE-2009

Ans. (c) : We know equilibrium constant of any reaction is –

$$K_c = \frac{[Product]}{[Reactent]}$$

So, $2B + A \rightleftharpoons C$

$$K_c = \frac{[C]}{[B]^2[A]}$$

395. One mole of N_2O_4 is heated in a flask with a volume of 0.1 dm^3. At equilibrium 1.708 mole of NO_2 and 0.146 mole of N_2O_4 were found at 134^{0}C. The equilibrium constant will be

(a) 250 mol dm^{-3} (b) 300 mol dm^{-3}
(c) 200 mol dm^{-3} (d) 230 mol dm^{-3}

MPPET-2009

Ans. (c) : Given data :
Initially–
Mole of N_2O_4 = 1
Volume = 0.1 dm^3
At equilibrium–
Moles of NO_2 = 1.708
Moles of N_2O_4 = 0.146
For the equilibrium reaction–

$$N_2O_4 \rightleftharpoons 2NO_2$$

$$\therefore \quad K_c = \frac{[NO_2]^2}{[N_2O_4]}$$

$$K_c = \frac{(1.708 mole/0.1 dm^3)^2}{0.146 mole/0.1 dm^3}$$

K_c = 200 mol dm^{-3}

396. Assertion : For reaction
$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$
Unit of $K_c = L^2mol^{-2}$
Reason : For the reaction
$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$

Equilibrium constant, $K_c = \frac{[NH_3]^2}{[N_2][H_2]^3}$

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(a) If both Assertion and Reason are correct and the Reason is a correct explanation of the Assertion.
(b) If both Assertion and Reason are correct but Reason is not a correct explanation of the Assertion.
(c) In the Assertion is correct but Reason is incorrect.
(d) If both the Assertion and Reason are incorrect.
(e) If the assertion is incorrect but the Reason is correct.

AIIMS-(2008)

Ans. (a): For the reaction –

$$N_2(g)+3H_2(g)\rightleftharpoons 2NH_3(g)$$

$$K_C=\frac{[NH_3]^2}{[N_2][H_2]^3}=\frac{[\text{mol}\,L^{-1}]^2}{[\text{mol}\,L^{-1}]\,[\text{mol}\,L^{-1}]^3}$$

$$=\text{mol}^{-1}\,L^2$$

397. The value of equilibrium constant of the reaction, $HI(g)\rightleftharpoons\frac{1}{2}H_2(g)+\frac{1}{2}I_2(g)$ is 8.0. the equilibrium constant of the reaction $H_2(g)+I_2(g)\rightleftharpoons 2HI(g)$ will be

(a) 16
(b) 1/8
(c) 1/16
(d) 1/64

NEET-2008

Ans. (d) : $HI(g)\rightleftharpoons\frac{1}{2}H_2(g)+\frac{1}{2}I_2(g)$

$$K_c=\frac{[I_2]^{1/2}[H_2]^{1/2}}{[HI]}=8 \quad .....(i)$$

$$H_2(g)+I_2(g)\rightleftharpoons 2HI(g)$$

$$K_c'=\frac{[HI]^2}{[H_2][I_2]} \quad .....(ii)$$

From eq. (i) & (ii)

$$K_c'=\left(\frac{1}{K_c}\right)^2=\left(\frac{1}{8}\right)^2=\frac{1}{64}$$

398. At constant temperature, the equilibrium constant (K_p) for decomposition reaction N_2O_4 ⇌ $2NO_2$ is expressed by $K_p = (4x^2P)/(1 - x^2)$, where, P = pressure; x = extent of decomposition, which one of the following statement is true?

(a) K_p increases with increase of P?
(b) K_p increases with increase of x.
(c) K_p increases with decrease of x.
(d) K_p remains constant with change in P and x.

SRMJEEE – 2008

Ans. (d) : At constant temperature, the equilibrium constant (K_p) for the decomposition reaction $N_2O_4 \rightleftharpoons 2NO_2$ is expressed by $K_p=\frac{(4x^2P)}{(1-x^2)}$, where P = pressure and x = extent of decomposition. K_p remains constant with change in P and x. The value of the equilibrium constant is independent of the partial pressure or degree of dissociation.

399. For equilibrium $PCl_5(g)\rightleftharpoons PCl_3(g) + Cl_2(g)$ K_p and K_c will hold the following relationship

(a) $K_p = K_c$
(b) $K_p = K_c(RT)$
(c) $K_p = K_c/RT$
(d) $K_c = K_p/RT$.

A.M.U. – 2008

Ans. (b) : For the reaction ,

$$PCl_5(g)\rightleftharpoons PCl_3(g) + Cl_2(g)$$

$$\therefore \quad K_p=K_c\,(RT)^{\Delta n_g}$$

Where, $\Delta n_g = n_p - n_r$ (gaseous moles only)

$$\Delta n_g = 2-1=1$$

So, $K_p = K_c(RT)^{2-1}$

$$K_p = K_c\,RT$$

400. What is the equation for the equilibrium constant (K_c) for the following reaction?

$$\frac{1}{2}A(g)+\frac{1}{3}B(g)\xrightleftharpoons{T(K)}\frac{2}{3}C(g)$$

(a) $K_c=\frac{[A]^{1/2}[B]^{1/3}}{[C]^{3/2}}$
(b) $K_c=\frac{[C]^{3/2}}{[A]^2[B]^3}$
(c) $K_c=\frac{[C]^{2/3}}{[A]^{1/2}[B]^{1/3}}$
(d) $K_c=\frac{[C]^{2/3}}{[A]^{1/2}+[B]^{1/3}}$

UP CPMT-2008

Ans. (c): The equilibrium reaction is-

$$\frac{1}{2}A(g)+\frac{1}{3}B(g)\xrightleftharpoons{T(K)}\frac{2}{3}C(g)$$

$$\text{Equilibrium constant }(K_c)=\frac{\text{concentration of product}}{\text{concentration of reactant}}$$

$$K_c=\frac{[C]^{2/3}}{[A]^{1/2}B^{1/3}}$$

401. 1.1 moles of A and 2.2 moles of B are mixed in a container of one litre volume to obtain the equilibrium A + 2B ⇌ 2C + D.

At equilibrium 0.2 moles of C are formed. The equilibrium constant for the above reaction is

(a) 0.001
(b) 0.002
(c) 0.003
(d) 0.004

CG PET -2007

Ans. (a) : The equilibrium reaction is-

	A	+ 2B ⇌	2C	+ D
t = 0	1.1	2.2	0	0
$t = t_{eq}$	1.1 − 2	2.2 − 2x	2x	x

At equilibrium -

$$0.2 = 2x$$

$$x = 0.1$$

$$\therefore \quad K_c=\frac{[C]^2[D]}{[A][B]^2}$$

$$K_c=\frac{(2x)^2(x)}{1(2)^2}$$

$$K_c=\frac{(0.2)^2(0.1)}{4}$$

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$$K_c = \frac{0.004}{4}$$
$$K_c = 0.001$$

402. For the reaction, $H_2 + I_2 \rightleftharpoons 2HI$, the equilibrium concentration of H_2, I_2 and HI are 8.0, 3.0 and 28.0 mol/L respectively. The equilibrium constant is–

(a) 28.34 (b) 32.66
(c) 34.78 (d) 38.88

BCECE-2007

Ans. (b) : The reaction is –

$$H_2 + I_2 \rightleftharpoons 2HI$$
$$K_c = \frac{[HI]^2}{[H_2][I_2]}$$
$$K_c = \frac{[28.0]^2}{[8.0][3.0]}$$
$$K_c = \frac{784}{24}$$
$$K_c = 32.66$$

403. The equilibrium constant for the reaction $2NO_2(g) \rightleftharpoons 2NO\ (g) + O_2\ (g)$ is 2×10^{-6} at 185°C. Then the equilibrium constant for the reaction $4NO\ (g) + 2O_2\ (g) \rightleftharpoons 4NO_2\ (g)$ at the same temperature would be

(a) 2.5×10^{-5} (b) 4×10^{-12}
(c) 2.5×10^{11} (d) 2×10^{6}
(e) 5×10^{5}

Kerala-CEE-2007

Ans. (c) : The given reaction is:

$$2NO_2(g) \rightleftharpoons 2NO(g) + O_2(g)$$
$$\therefore \quad K_c = \frac{[NO]^2[O_2]}{[NO_2]^2} = 2\times10^{-6} \quad .....(i)$$

Now, $4NO(g) + 2O_2(g) \rightleftharpoons 4NO_2(g)$

$$K_c' = \frac{[NO_2]^4}{[NO]^4[O_2]^2}$$
$$K_c' = \left(\frac{1}{K_c}\right)^2$$
$$K_c' = \left(\frac{1}{2\times10^{-6}}\right)^2$$
$$K_c' = 2.5\times10^{11}$$

404. For the reaction

$CH_4(g) + 2O_2(g) \rightleftharpoons CO_2(g) + 2H_2O(l)$

$\Delta H_r = -170.8$ kJ mol^{-1}. Which of the following statements is not true ?

(a) The reaction is exothermic
(b) At equilibrium, the concentration of $CO_2(g)$ and $H_2O(l)$ are not equal
(c) The equilibrium constant for the reaction if given by $K_p = \frac{[CO_2]}{[CH_4][O_2]}$
(d) Addition of $CH_4(g)$ or $O_2(g)$ at equilibrium will cause shift to the right

NEET-2006

Ans. (c) : We have the reaction:

$$CH_4 + 2O_2 \rightleftharpoons CO_2 + 2H_2O(l)$$
$$K_c = \frac{[CO_2][H_2O]^2}{[CH_4][O_2]^2}$$

Now, H_2O is pure liquid, so $[H_2O]=1$

$$\Rightarrow \quad K_c = \frac{[CO_2]}{[CH_4][O_2]^2}$$
$$\because \quad \Delta H_r = -170.8 \text{ kJ/mol is negative}$$

So, reaction is exothermic by adding $O_2(g)$ or $CH_4(g)$ at equilibrium, by Le Chartelier's principle, the equilibrium shift towards right side.

405. What is the equation for the equilibrium constant (K_c) for the following reaction?

$$\frac{1}{2}A(g) + \frac{1}{3}B(g) \rightarrow \frac{2}{3}C(g)$$

(a) $K_c = \frac{[A]^{1/2}[B]^{1/3}}{[C]^{3/2}}$

(b) $K_c = \frac{[C]^{3/2}}{[A]^2[B]^3}$

(c) $K_c = \frac{[C]^{2/3}}{[A]^{1/2}[B]^{1/3}}$

(d) $K_c = \frac{[C]^{2/3}}{[A]^{1/2} + [B]^{3/2}}$

AP-EAMCET (Medical), 2006

Ans. (c) : Given that the following reaction:-

$$\frac{1}{2}A(g) + \frac{1}{3}B(g) \rightarrow \frac{2}{3}C(g)$$

Equilibrium constant $(K_c) = \frac{[Products]}{[Reactants]}$

The expression of K_c can be written as-

$$K_c = \frac{[C]^{2/3}}{[A]^{1/2}[B]^{1/3}}$$

406. $N_2O_4 \rightleftharpoons 2NO_2 - Q$

The unit of K_p for the given reaction is

(a) atmosphere (b) $atmosphere^2$
(c) $atmosphere^{-1}$ (d) None of these

CG PET -2006

Ans. (a) : $N_2O_4 \rightleftharpoons 2NO_2 - Q$

Applying law of mass action –

$$K_p = \frac{(p_{NO_2})^2}{(p_{N_2O_4})}$$
$$K_p = \frac{(atmosphere)^2}{atmosphere}$$
$$\therefore \quad \text{Unit of } K_p \text{ is atmosphere.}$$

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407. The equilibrium constant K_p for the reaction, $H_2(g) + I_2(g) \rightleftharpoons 2HI(g)$ is :

(a) more than one (b) less than one
(c) equal to K_c (d) zero

BCECE-2006

Ans. (c) : $H_2(g) + I_2(g) \rightleftharpoons 2HI(g)$

$$K_p = K_c(RT)^{\Delta n_g}$$

$$\Delta n_g = 2 - 2 = 0$$

$$\therefore \quad K_p = K_c\ (RT)^0 = K_c$$

408. At 550K, the K_c for the following reaction is 10^4 mol L^{-1}.

$X(g) + Y(g) \rightleftharpoons Z(g)$

At equilibrium, it was observed that

$$[X] = \frac{1}{2}[Y] = \frac{1}{2}[Z]$$

What is the value of [Z] (in mol L^{-1}) at equilibrium?

(a) 2×10^{-4} (b) 10^{-4}
(c) 2×10^4 (d) 10^4

A.P.EAMCET 2005

Ans. (a) : For equilibrium -

$$X(g) + Y(g) \rightleftharpoons Z(g)$$

$$K_c = \frac{[Z]}{[X][Y]} \quad \text{....(i)}$$

Given, $[X] = \frac{1}{2}[Y] = \frac{1}{2}[Z]$, $K_c = 10^4$ mol L^{-1}

$\therefore \quad [X] = \frac{1}{2}[Y] = \frac{1}{2}[Z] = v\text{(say)}$

$[Z] = 2v$, $[Y] = 2v$, $[X] = v$

From eqn (i),

$$K_c = \frac{[Z]}{[X][Y]}$$

$$10^4 = \frac{2v}{v.2v} \quad \left[K_c = 10^4\right]$$

$$v = 10^{-4}$$

$$\therefore \quad [Z] = 2v = 2 \times 10^{-4}.$$

409. Which of the following is correct for the reaction? $N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$

(a) $K_p = K_c$
(b) $K_p < K_c$
(c) $K_p > K_c$
(d) Pressure is required to predict the correlation

UPTU/UPSEE-2005

Ans. (b) : We know that – $K_p = K_c\ (RT)^{\Delta n_g}$

For, $K_p > K_c$ and $K_P < K_c$
$\Delta n_g \geq 1$ $\quad \Delta n_g < 1$

In reaction –

$$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$$

$$\Delta n_g = 2 - (3 + 1) = 2 - 4 = -2$$

So, $K_p < K_c$

410. For reaction, $2NOCl(g) \rightleftharpoons 2NO(g) + Cl_2(g); K_c$ at 427°C is 3×10^{-6}L mol^{-1}. The value of K_p is nearly:

(a) 7.50×10^{-5} (b) 2.50×10^{-5}
(c) 2.50×10^{-4} (d) 1.75×10^{-4}

AIIMS-2005

Ans. (d): Given data: $K_c = 3 \times 10^{-6}$ mol L^{-1}
$T = 427^oC$, $K_p = ?$

The equilibrium reaction is-

$$2NOCl(g) \rightleftharpoons 2NO(g) + Cl_2(g)$$

Now, $\quad K_p = K_c\ (RT)^{\Delta n_g}$

$$\Delta n_g = (2 + 1) - 2 = 1$$

So, $\quad K_p = 3 \times 10^{-6} \times (RT)^1$

$$K_p = 3 \times 10^{-6} \times (0.0821 \times 700)^1$$

$$K_p = 1.722 \times 10^{-4}$$

$$K_p \approx 1.75 \times 10^{-4}$$

411. Which of the following is true for the reaction

$$CO(g) + \frac{1}{2}O_2(g) \rightleftharpoons CO_2(g)$$

(a) $K_p > K_c$ (b) $K_p < K_c$
(c) $K_p = K_c$ (d) $K_p \geq K_c$

JCECE - 2004

Ans. (b) : For the reaction-

$$CO(g) + \frac{1}{2}O_2(g) \rightleftharpoons CO_2(g)$$

$$\therefore \quad K_p = K_c(RT)^{\Delta n_g}$$

$$\Delta n_g = 1 - \left(1 + \frac{1}{2}\right) = 1 - \left(\frac{3}{2}\right) = \frac{-1}{2}$$

Here, Δn_g is < 1

In such case $K_c > K_p$

412. For the reaction, $2NO_2 \rightleftharpoons 2NO + O_2$, the value of K_p is equal to K. What will the value of K_p for reaction.

$$NO + \frac{1}{2}O_2 \longrightarrow NO_2$$

(a) $\sqrt{K}$ (b) $\frac{1}{K}$
(c) $\sqrt{\frac{1}{K}}$ (d) $\frac{1}{K^2}$

JIMPER-2004

Ans. (c) : For the reaction – $2NO_2 \rightleftharpoons 2NO + O_2$

$$\therefore \quad K_p = \frac{(p_{NO})^2 (p_{O_2})}{(p_{NO_2})^2}$$

$$K = \frac{(p_{NO})^2 (p_{O_2})}{(p_{NO_2})^2} \quad \text{.....(1)}$$

And, $\quad NO + \frac{1}{2}O_2 \rightarrow NO_2$

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$$K_p = \frac{p_{NO_2}}{(p_{NO})(p_{O_2})^{1/2}}$$

Squaring on both sides – we get

$$(K_p)^2 = \frac{(p_{NO_2})^2}{(p_{NO})^2(p_{O_2})}$$

$$(K_p)^2 = \left(\frac{1}{K}\right) \qquad \text{by equation ….(i)}$$

$$K_p = \sqrt{\frac{1}{K}}$$

413. In the reaction, H_2+I_2—— 2HI

In a 1 L flask, 0.4 mole of each H_2 and I_2 are taken. At equilibrium 0.5 mole of HI are formed. What will be the value of equilibrium constant, K_c?

(a) 20.2 (b) 25.4

(c) 0.284 (d) 11.1

UP CPMT-2004

Ans. (d) : For the reaction,

	H_2	+	$I_2 \rightleftharpoons$	2HI
Initial moles	0.4		0.4	0
No, of moles at equilibrium	(0.4 – 0.25) =0.15		(0.4 – 0.25) =0.15	0.50

$$\therefore \qquad K_C = \frac{[HI]^2}{[H_2][I_2]}$$

Given, V = 1 L

∴ [HI] = 0.5/1 = 0.5 mol/L

$[H_2]$ = $[I_2]$ =0.15/1 = 0.15 mol/L

$$\therefore \qquad K_C = \frac{(0.5)^2}{(0.15)\times(0.15)}$$

= 11.11

414. In which of the following reactions, the concentration of product is higher than the concentration of reactant at equilibrium?

(K_c = equilibrium constant)

(a) $A \rightleftharpoons B; K_c = 0.001$

(b) $M \rightleftharpoons N; K_c = 10$

(c) $X \rightleftharpoons Y; K_c = 0.005$

(d) $R \rightleftharpoons P; K_c = 0.01$

A.P.EAMCET 2004

Ans. (b) : For a reaction

$$K_c = \frac{[Product]}{[reactant]}$$

Hence, If $K_c > 1$, then, [Product] > [Reactant].

As per option,

(a) K_c = 0.001 which is <1

(c) K_c = 0.005 which is <1

(d) K_c = 0.01 which is <1

So, in option (b) K_c = 10 which is >1.

Hence, (b) is correct answer.

415. For reaction,

$$PCl_3(g) + Cl_2(g) \rightleftharpoons PCl_5(g)$$

the value of K_c at 250ºC is 26. At the same temperature, the value of K_p is:

(a) 0.46 (b) 0.61

(c) 0.95 (d) 0.73

JCECE - 2003

Ans. (b): Given data: K_c = 26, T = 250ºC = 250 + 273

K_p = ? = 523 K

For the reaction,

$$PCl_3 + Cl_2 \rightleftharpoons PCl_5$$

$$\therefore \qquad K_p = K_c(RT)^{\Delta n_g}$$

$$\Delta n_g = 1 - 2 = -1$$

R = 0.0821, T = 250 + 273.15 = 523.15

$$\text{So,} \qquad K_p = K_c(RT)^{-1}$$

$$K_p = \frac{26}{0.0821\times 523.15}$$

K_p = 0.61

416. Equilibrium constant K_p of following reaction

$MgCO_3(s) \rightleftharpoons MgO(s) + CO_2(g)$

(a) $K_p = p_{CO_2}$

(b) $K_p = p_{CO_2} \times \frac{p_{CO_2} \times p_{MgO}}{p_{MgCO_3}}$

(c) $K_p = \frac{p_{CO_2} \times p_{MgO}}{p_{MgCO_3}}$

(d) $K_p = \frac{p_{MgCO_3}}{p_{CO_2} \times p_{MgO}}$

NEET-2000

Ans. (a) : The given reaction is –

$$MgCO_3(s) \rightleftharpoons MgO(s) + CO_2(g)$$

$$\therefore \qquad K_p = \frac{p_{CO_2} \cdot p_{MgO}}{p_{MgCO_3}}$$

But $MgCO_3$ and MgO are pure solids

So, $K_p = p_{CO_2}$

417. 4.5 moles, each of hydrogen and iodine was heated in a sealed 10 L vessel. At equilibrium, 3 moles of HI were found. The equilibrium constant for $H_2(g) + I_2(g) \rightarrow 2HI(g)$, is

(a) 1 (b) 10

(c) 5 (d) 0.33

A.P.EAMCET 1998

Ans. (a) : The equilibrium reaction is -

	$H_2(g)$	+ $I_2(g) \rightarrow$	2HI (g)
Initially	4.5	4.5	0
At equilibrium	(4.5–x)	(4.5–x)	3 or (2x)

$$\therefore \qquad K_c = \frac{[HI]^2}{[H_2][I_2]}$$

$$\therefore \qquad 2x = 3$$

$$x = \frac{3}{2} = 1.5$$

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Since, (4.5 –x) ⇒ (4.5 – 1.5) = 3

Hence, $K_c = \dfrac{\left(\dfrac{3}{10}\right)^2}{\left(\dfrac{3}{10}\right)\left(\dfrac{3}{10}\right)}$

$K_c = 1$

418. For the reaction $C(s) + CO_2(g) \rightleftharpoons 2CO(g)$, the partial pressures of CO_2 and CO are 2.0 and 4.0 atm respectively at equilibrium. What is the value of K_p for the reaction?

(a) 0.5 (b) 4.0
(c) 8.0 (d) 32

AP EAMCET (Medical) -1998

Ans. (c): For the reaction–

$$C(s) + CO_2(g) \rightleftharpoons 2CO(g)$$

The concentration of solid and liquid are taken as unity

$C(s) = 1$

Given– $P_{CO_2} = 2.0$ atm

$P_{CO} = 4.0$ atm

$K_p = ?$

$\because \quad K_p = \dfrac{[P_{CO}]^2}{[P_{CO_2}]}$

or $\quad K_p = \dfrac{(4)^2}{2}$

or $\quad K_p = 8$ atm

419. The value of K_p for the reaction $2H_2S(g) \rightleftharpoons 2H_2(g) + S_2(g)$ is 1.2×10^{-2} at 1065 ºC. The value of K_c for this reaction is

(a) 1.2×10^{-2} (b) $<1.2 \times 10^{-2}$
(c) 83 (d) $>1.2 \times 10^{-2}$

AP – EAMCET - (Medical)-1997

Ans. (b) : Given that,

$K_p = 1.2 \times 10^{-2}$

$T = 1065 + 273 = 1338$ K

$\therefore \quad K_p = K_c (RT)^{\Delta n_g}$

Since, Δn_g = no. of mole of gaseous product – no of mole of gaseous reaction

= (2 + 1) – 2 = 1

Putting the value, we get–

$1.2 \times 10^{-2} = K_c [0.082 \times 1338]^1$

$K_c = \dfrac{1.2\times10^{-2}}{109}$

$K_c = 1.1 \times 10^{-4}$

Hence, $K_c < 1.2 \times 10^{-2}$

420. At 80ºC distilled water has $[H_3O^+]$concentration equal to 1×10^{-6} mole/litre. The value of K_p at this temperature will be

(a) 1×10^{-12} (b) 1×10^{-15}
(c) 1×10^{-6} (d) 1×10–9

NEET-1994

Ans. (a) : Given data: $[H^+] = 1 \times 10^{-6}$ mole /L

Now, $K_w = [H^+][OH^-]$

But $[H^+] = [OH^-]$

$\therefore \quad K_w = [H^+]^2$

$= (1 \times 10^{-6})^2$

$= 1 \times 10^{-12}$

421. In the equilibrium reaction, $A(g) + 2B(g) \rightleftharpoons C(g) + D(g)$, the equilibrium constant, K_c is given by the expression

(a) $K_c = \dfrac{[C][D]}{[A][B]}$ (b) $K_c = \dfrac{[C][D]^2}{[A][B]}$

(c) $K_c = \dfrac{[A][B]^2}{[C][D]}$ (d) $K_c = \dfrac{[C][D]}{[A][B]^2}$

AP-EAMCET-1994

Ans. (d) : The equilibrium reaction is given below-

$$A(g) + 2B(g) \rightleftharpoons C(g) + D(g)$$

The expression of equilibrium constant (K_c) for above reaction is-

$$K_c = \frac{[C][D]}{[A][B]^2}$$

422. For the reaction, $CO(g) + Cl_2(g) \rightleftharpoons COCl_2(g)$, the K_p/K_c is equal to

(a) 1/RT (b) RT
(c) √RT (d) 1.0

AIEEE-2004

Ans. (a) : For the reaction -

$$CO(g) + Cl_2(g) \rightleftharpoons COCl_2(g)$$

$\therefore \quad K_p = K_c (RT)^{\Delta n_g}$

$\Delta n_g = 1 - 2 = -1$

$K_p = K_c (RT)^{-1}$

$\dfrac{K_p}{K_c} = \dfrac{1}{RT}$

423. For the reaction equilibrium $N_2O_4(g) \rightleftharpoons 2NO_2(g)$ the concentrations of N_2O_4 and NO_2 at equilibrium are 4.8×10^{-2} and 1.2×10^{-2} mol L^{-1}, respectively. The value of K_c for the reaction is

(a) 3.3×10^2 mol L^{-1} (b) 3×10^{-1} mol L^{-1}
(c) 3×10^{-3} mol L^{-1} (d) 3×10^3 mol L^{-1}

BITSAT-2007

Ans. (c) : Given data: $[N_2O_4] = 4.8\times10^{-2}$ mol/L

$[NO_2] = 1.2\times10^{-2}$ mol/L

$K_c = ?$

For the equilibrium reaction -

$$N_2O_4(g) \rightleftharpoons 2NO_2(g)$$

$\therefore \quad K_c = \dfrac{[NO_2]^2}{[N_2O_4]} = \dfrac{1.2\times10^{-2}\times1.2\times10^{-2}}{4.8\times10^{-2}}$

$K_c = 3 \times 10^{-3}$ mol lit^{-1}

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424. A vessel at 1000 K contains CO_2 with a pressure of 0.5 atm. Some of the CO_2 is converted into CO on the addition of graphite. If the total pressure at equilibrium is 0.8 atm, the value of K_p is

(a) 1.8 atm (b) 3 atm
(c) 0.3 atm (d) 0.18 atm

AIEEE-2011

Ans. (a) : The reaction is -

$$CO_2(g) + C(s) \longrightarrow 2CO(g)$$

Initial pressure 0.5 0

Final pressure (0.5 –x) 2x

Total pressure at equilibrium = Partial pressure of CO_2 and CO

$$(0.5-x) + 2x = 0.8$$
$$x = 0.3$$
$$\therefore \quad P_{CO} = 2x = 2\times 0.3 = 0.6$$
$$P_{CO_2} = 0.5 - x = 0.5 - 0.3 = 0.2$$

Now, $K_p = \dfrac{P_{CO}^2}{P_{CO_2}} = \dfrac{(0.6)^2}{0.2} = 1.8$ atm

425. The standard Gibbs energy change at 300 K for the reaction, $2A \rightleftharpoons B + C$ is 2494.2 J. At a given time, the composition of the reaction mixture is [A] = ½, [B] = 2 and [C] = ½. The reaction proceeds in the 'R = 8.314 JK/mol, e = 2.718]

(a) forward direction because $Q > k_c$
(b) reverse direction because $Q > k_c$
(c) forward direction because $Q < k_c$
(d) reverse direction because $Q < k_c$

JEE-Main-2015

Ans. (b) : Given data: T = 300 K, $\Delta G^o = 2494.2$ J

$$[A] = \frac{1}{2}, \quad [B] = 2, \quad [C] = \frac{1}{2}$$

For equilibrium reaction -

$$2A \rightleftharpoons B + C$$

$$\therefore \quad Q_c = \frac{[B][C]}{[A]^2} = \frac{2\times\frac{1}{2}}{\left(\frac{1}{2}\right)^2} = 4$$

We know,

$$\Delta G^o = -2.303RT \log K_c$$
$$2494.2 = -2.303 \times 8.314 \times 300 \log K_c$$
$$K_c = 0.37$$

Hence, $Q_c > K_c$ so the equilibrium will shift in the reverse direction.

426. Consider the following reversible chemical reactions,

$$A_2(g) + B_2(g) \overset{K_1}{\rightleftharpoons} 2AB(g) \ldots(I)$$
$$6AB(g) \overset{K_2}{\rightleftharpoons} 3A_2(g) + 3B_2(g) \ldots(II)$$

The relation between K_1 and K_2 is

(a) $K_2 = K_1^3$ (b) $K_1K_2 = 3$
(c) $K_2 = K_1^{-3}$ (d) $K_1K_2 = \dfrac{1}{3}$

JEE-Main-2019

Ans. (c) : $A_2(g) + B_2(g) \rightleftharpoons 2AB(g)$

Multiply by (3) and reverse the reaction -

$$6AB(g) \rightleftharpoons 3A_2(g) + 3B_2(g)$$

$$\Rightarrow \quad \left(\frac{1}{K_1}\right)^3 = K_2$$

$$\Rightarrow \quad K_2 = (K_1)^{-3}$$

427. For the equilibrium, $2H_2O \rightleftharpoons H_3O^+ + OH^-$, the value of ΔG^o at 298 K is approximately

(a) -80kJ mol^{-1} (b) 100kJ mol^{-1}
(c) 80kJ mol^{-1} (d) -100kJ mol^{-1}

JEE-Main-2019

Ans. (c) : Given, $K = 10^{-14}$, T = 298 K

$$2H_2O \rightleftharpoons H_3O^+ + OH^-$$

Standard Gibbs free energy is given by,

$$\Delta G^o = -RT \ln k$$
$$\Delta G^o = -2.303\times 8.314\times 298 \log 10^{-14}$$
$$\Delta G^o = 79.88 \text{ kJ mol}^{-1}$$
$$\Delta G^o \approx 80 \text{ kJ / mole}$$

428. Equivalent amounts of H_2 and I_2 are heated in a closed vessel till equilibrium is obtained. If 80% of the hydrogen can be converted to HI, the K_c at the temperature is

(a) 64 (b) 16 (c) 0.25 (d) 4

VITEEE-2007

Ans. (a) :

	H_2	+	I_2	$\rightleftharpoons$	2HI
Initial moles	1		1		0
At equilibrium	(1 – x)		(1 – x)		(2x)

$$\therefore \quad K_c = \frac{[HI]^2}{[H_2][I_2]} = \frac{(2x)^2}{(1-x)^2}$$

Given, x = 80% = 0.80

$$\therefore \quad K_c = \frac{(2\times 0.80)^2}{(1-0.80)^2} = 64$$

429. For the reaction,

$$Fe_2N(s) + \frac{3}{2}H_2(g) \rightleftharpoons Fe(s) + NH_3(g)$$

(a) $K_c = K_p(RT$ (b) $K_c = K_p(RT)^{-1/2}$
(c) $K_c = K_p(RT)^{1/2}$ (d) $K_c = K_p^p(RT)^{3/2}$

JEE-Main-2020

Ans. (c) : For the reaction –

$$Fe_2N(s) + \frac{3}{2}H_2(g) \rightleftharpoons Fe(s) + NH_3(g)$$

$$\therefore \quad K_p = K_c\,(RT)^{\Delta n_g}$$

$$\Delta n_g = (1 + 0) - \left(\frac{3}{2} + 0\right) = 1 - \frac{3}{2} = -\frac{1}{2}$$

So, $K_p = K_c\,(RT)^{-1/2}$

or $K_c = K_p\,(RT)^{1/2}$

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430. Value of K_p for the equilibrium reaction

$$N_2O_4(g) \rightleftharpoons 2NO_2(g)$$

at 288 K is 47.9.

The K_c for this reaction at same temperature is ...... (Nearest integer)

($R=0.083$ L bar $K^{-1}mol^{-1}$)

AIEEE-2012

Ans. (2) : Given data: T = 288 K, $K_p = 47.9$, K_c = ?

The reaction is –

$$N_2O_4(g) \rightleftharpoons 2NO_2(g)$$

So, $K_p = K_c (RT)^{\Delta n_g}$

$\because$ $\Delta n_g = 2 - 1 = 1$

$\therefore$ $K_p = K_c (RT)$

$\Rightarrow$ $47.9 = K_c \times 0.083 \times 288$

$\Rightarrow$ $47.9 = K_c \times 23.904$

$K_c = 2.00$

431. In a chemical reaction,

$A + 2B \overset{k}{\rightleftharpoons} 2C + D$, the initial concentration of B was 1.5 times of the concentration of A, but the equilibrium concentrations of A and B were found to be equal. The equilibrium constant (K) for the chemical reaction is

(a) $\frac{1}{4}$ (b) 16 (c) 1 (d) 4

JEE-Main-2013

Ans. (d) : $A + 2B \rightleftharpoons 2C + D$

	A	2B	2C	D
Initial	1	1.5	0	0
Equi.	1-x	1.5–2x	2x	x

At equilibrium [A] = [B]

$1 - x = 1.5 - 2x$

$x = 0.5$

$$\therefore \quad K_c = \frac{[C]^2[D]}{[A][B]^2}$$

$$K_c = \frac{(2x)^2(x)}{(1-x)(1.5-2x)^2}$$

$$K_c = \frac{1\times1\times0.5}{0.5\times0.5\times0.5}$$

$K_c = 4$

432. The gas phase reaction $2A(g) \rightleftharpoons A_2(g)$ at 400 K has $\Delta G^o = +25.2$ kJ mol^{-1} The equilibrium constant K_c for this reaction is ....$\times10^{-2}$. (Round off to the nearest integer). [Use:$R=8.3 J mol^{-1}K^{-1}$, ln 10=2.3] $\log_{10} 2 = 0.30$, 1 atm = 1bar] [antilog (-0.3)=0.501]

JEE-Main-18.03.2021, Shift-I

Ans. (1.66) : Given reaction is,

$$2A(g) \rightleftharpoons A_2(g)$$

Given, $\Delta G° = + 25.2$ kJ

= 25200 joule

T = 400 K

Using the formula,

$\Rightarrow$ $\Delta G° = -RT \ln K_p$

$\Rightarrow$ $25200 = -2.303 \times 8.314 \times 400 \log K_p$

$\Rightarrow$ $K_p = 10^{-3.3} = 10^{-3} \times 0.501$

$= 5.01 \times 10^{-4}$ bar^{-1}

$= 5.01 \times 10^{-9}$ Pa^{-1}

$$= \frac{K_c}{8.3\times400}$$

$K_c = 1.66\times10^{-5}$ m^3/mol

$= 1.66\times10^{-2}$ L/mol

433. Consider the reaction, $N_2O_4(g) \rightleftharpoons 2NO_2(g)$. The temperature at Which K_c=20.4 and K_p =600.1, is ...... K. (Round off to the nearest integer.) [Assume all gases are ideal and R=0.0831L bar, k^{-1} mol^{-1}].

JEE-Main-18.03.2021, Shift-II

Ans. (354) : The reaction is–

$$N_2O_4(g) \rightleftharpoons 2NO_2(g)$$

We have, $K_c = 20.4$, $K_p = 600.1$

Now, $K_p = K_c (RT)^{\Delta n_g}$

$\Delta n_g = 2 - 1 = 1$

So, $K_p = K_c (RT)^1$

$600.1 = 20.4 \times 0.0831 \times T$

$$\Rightarrow \quad \frac{600.1}{1.69524} = T$$

$\Rightarrow$ $T = 353.99$

$\approx$ $T = 354$

434. The value of K_c for the reaction : $A + 3B \rightleftharpoons 2C$ at 400° C is 0.5 Calculate the value of K_p

(a) 1.64×10^{-4} (b) 1.64×10^{-6}

(c) 1.64×10^{-5} (d) 1.64×10^{-3}

VITEEE-2019

Ans. (a) : Given,

$K_c = 0.5$

$T = 400°C = 400+273 = 673$ K

K_p = ?

$A + 3B \rightleftharpoons 2C$

$\Delta n = 2 - 4 = -2$

$K_p = K_c (RT)^{\Delta n}$

$K_p = 0.5 \times (0.082\times673)^{-2}$

$K_p = 1.64 \times 10^{-4}$ atm.

435. For the reaction:

$2BaO_2(s) \rightleftharpoons 2BaO(s) + O_2(g)$;

ΔH = +ve. In equilibrium condition, pressure of O_2 is dependent on

(a) mass of BaO_2

(b) mass of BaO

(c) temperature of equilibrium

(d) mass of BaO_2 and BaO both

VITEEE-2018

Ans. (c) : The given reaction is

$$2BaO_2(s) \rightleftharpoons 2BaO(s) + O_2(g), \Delta H = +Ve$$

Pure solids do not change state of equilibrium.

Hence, at equilibrium–

$K_p = PO_2$

Only, a change in temperature, changes K_P hence PO_2 will be affected by increasing temperature.

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436. For the rection

$$\mathbf{2NO_2(g) \rightleftharpoons 2NO(g) + O_2(g),}$$

(K_c=1.8×10^{-6} at 184°C) (R = 0.0831 kJ/(mol.K) When K_p and K_c are compared at 184°C, it is found that

(a) Whether K_p is greater than, less than or equal to K_c depends upon the total gas pressure
(b) $K_p = K_c$
(c) K_p is less than K_c
(d) K_p is greater than K_c

VITEEE-2017

Ans. (d) : : Given, $K_c = 1.8\times10^{-6}$, T = 184°C
R = 0.0831 kJ/mol.K

The reaction is-

$$2NO_2(g) \rightleftharpoons 2NO(g) + O_2(g)$$

∵ $\Delta n_g = 2 + 1 - 2 = 1$

So, $K_p = K_c(RT)^{\Delta n_g}$

$$K_p = 1.8\times10^{-6}(0.0831\times457)^1$$

$$K_p = 6.836\times10^{-6}$$

Hence it is clear that $K_p > K_c$

437. A moles of PCl_5 is heated in a closed container to equilibrium $\mathbf{PCl_5(g) \rightleftharpoons PCl_3(g) + Cl_2(g)}$ at a pressure of P atm. If x moles of PCl_5 dissociate at equilibrium, then

(a) $\frac{x}{a} = \frac{K_p}{K_p + P}$
(b) $\frac{x}{a} = \left(\frac{K_p + P}{K_p}\right)^{1/2}$
(c) $\frac{x}{a} = \left(\frac{K_p}{P}\right)^{1/2}$
(d) $\frac{x}{a} = \left(\frac{K_p}{K_p + P}\right)^{1/2}$

VITEEE-2016

Ans. (d) : Given reaction -

$$\underset{1-\alpha}{PCl_5(g)} \rightleftharpoons \underset{\alpha}{PCl_3(g)} + \underset{\alpha}{Cl_2(g)}$$

Moles of PCl_5 dissociated = x
Moles of PCl_5 left = a – x
moles of PCl_3 formed = x
moles of Cl_2 formed = x
Total moles = (a+x)

degree of dissociation $\alpha = \frac{x}{a}$

Pressure due to PCl_5 = $\left(\frac{1-\alpha}{1+\alpha}\right)P$

Pressure due to PCl_3 = $\left(\frac{\alpha}{1+\alpha}\right)P$

Pressure due to Cl_2 = $\left(\frac{\alpha}{1+\alpha}\right)P$

Now, $\frac{X_{PCl_3}.X_{PCl_2}}{X_{PCl_5}}.P = \frac{\alpha^2}{1-\alpha^2}P$

$$K_p(1-\alpha) = \alpha^2 P$$

$$K_p - K_p\alpha^2 = \alpha^2 P$$

$$K_p = (K_p + P)\alpha^2$$

$$\alpha = \sqrt{\frac{K_p}{K_p + P}} = \frac{x}{a} \Rightarrow \frac{x}{a} = \sqrt{\frac{K_p}{K_p + P}}$$

8. Relation Between Equilibrium Constant (K), Reaction Quient (Q) and Gibb's Energy

438. For the process,

$\frac{3}{2}A \rightarrow B$, at 298 K, ΔG^0 is 163 kJ mol^{-1}. The composition of the reaction mixture is [B]= 1 and [A]=10000. Predict the direction of the reaction and the relation between reaction quotient (Q) and he equilibrium constant (K)

(a) Forwards direction because Q>K
(b) Reverse direction because Q>K
(c) Forward direction because Q<K
(d) Reverse direction because Q<K
(e) It is equilibrium as Q=K

Kerala-CEE-2017

Ans. (b) : For the process, $\frac{3}{2}A \rightarrow B$

$$Q = \frac{[\text{conc. of product}]^n}{[\text{conc. of reaction}]^n} = \frac{[B]}{[A]^{3/2}}$$

$$Q = \frac{1}{[10000]^{3/2}} = 10^{-6}$$

Also, $\Delta G = -2.303RT \log K$

$163\times1000 = -2.303\times8.314\times298 \log K$

∴ $\log K = -\frac{163\times1000}{2.303\times8.314\times298} = -\frac{163000}{5705.8}$

$\log K \approx -28.57$

∴ $K = 2.7\times10^{-29}$

i.e., K < Q means

The backward reaction is favoured with Q > K.

439. In the lnK vs. $\frac{1}{T}$ plot of a chemical process having $\Delta S^0 > 0$ and $\Delta H^0 < 0$ the slope is proportional to (where K is equilibrium constant)

(a) $-|\Delta H^0|$
(b) $|\Delta H^0|$
(c) ΔS^0
(d) $-\Delta S^0$
(e) ΔG^0

Kerala-CEE-2017

Ans. (b) : We Know that –

$$\log K = \log A - \frac{\Delta H}{2.303R}.\frac{1}{T}$$

And, $\Delta G = \Delta H - T\Delta S = -2.303RT \log K$

On plotting the graph between logK and $\frac{1}{T}$ using straight line equation.

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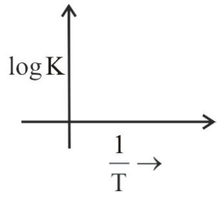

$y = mx+c$

$\log K \propto \frac{1}{T}$

If ΔS° > 0 and ΔS° < 0 then the slope is proportional to |ΔH°|

440. For the equilibrium,

$CaCO_3(s) \rightleftharpoons CaO(s) + CO_2(g);$

$K_p = 1.64 \text{ atm at } 1000 \text{ K}$

50g of $CaCO_3$ in a 10 L closed vessel is heated to 1000 K. Percentage of $CaCO_3$ that remains unreacted at equilibrium is

(Given, R = 0.082 L atm K^{-1} mol^{-1})

(a) 40
(b) 50
(c) 60
(d) 20

Karnataka-CET-2014

Ans. (c) : $CaCO_3(s) \rightleftharpoons CaO(s) + CO_2(g)$

Number of moles of $CaCO_3$ present initially = $\frac{50}{100} = 0.5$ moles

K_p of the given reaction can be written as –

$$K_p = P_{CO_2} = 1.64 \text{ atm}$$

Number of moles of $CO_2 = \frac{P_{CO_2}V}{RT}$

$$= \frac{1.64 \times 10}{0.082 \times 1000} = 0.2 \text{ mole}$$

Number of moles of $CaCO_3$ unreacted = (0.5 – 0.2) = 0.3 moles.

Hence, percentage of $CaCO_3$ unreacted = $\frac{0.3}{0.5} \times 100 = 60\%$

441. The equilibrium constant of a reaction is 0.008 at 298 K. The standard free energy change of the reaction at the same temperature is

(a) –11.96 kJ
(b) –5.43 kJ
(c) –8.46kJ
(d) +11.96 kJ

Karnataka-CET-2012

Ans. (d) : Equilibrium constant of a reaction = 0.008

Standard free energy change

$\Delta G° = – RT\log K$

$= –2.303 \times 8.314 \times 298 \log 0.008$

$= –2.303 \times 8.314 \times 298 \times (–2.1)$

$= 11962$ J/mole

$= 11.96$ kJ/mole

442. Assertion: Reaction quotient is defined in the same way as equilibrium constant at any stage of the reaction.

Reason: If Q_c (reaction quotient) < K_c (equilibrium constant) reaction moves in direction of reactants.

(a) If both Assertion and Reason are correct and the Reason is the correct explanation of Assertion.
(b) If both assertion and Reason are correct, but Reason is not the correct explanation of assertion.
(c) If Assertion if correct but Reason is incorrect.
(d) If both the Assertion and Reason are incorrect.

AIIMS-(2011)

Ans. (c): We know that,

$$aA + bB \rightleftharpoons cC + dD$$

$$Q_c = \frac{[C]^c[D]^d}{[A]^a[B]^b}$$

If $Q_c > K_c$, reaction will proceed in the direction of reactants.

If $Q_c < K_c$, reaction will move in direction of products.

If $Q_c = K_c$, the reaction mixture is already at equilibrium.

So, option (c) is correct.

443. Which of the following is a wrong statement about equilibrium state?

(a) Rate of forward reaction= Rate of backward reaction
(b) Equilibrium is dynamic
(c) Catalysts increase value of equilibrium constant
(d) Free energy change is zero

CG PET -2009

Ans. (c) : Chemical equilibrium is dynamic in nature which in other words means that reactions continue to occur in both forward as well as backward direction with the same speed.

Equilibrium constant has definite value for every chemical reaction at a given temperature. It is independent of concentration and catalyst.

Free energy change :

$$\Delta G = \Delta G^o + 2.303 \text{ RT} \log Q$$

So, option (a), (b), (d) follows equilibrium state but (c) not follows.

Hence, option (c) is correct.

444. The equilibrium constant (K) of a reaction may be written as

(a) $K= e^{-\Delta G/RT}$
(b) $K = e^{-\Delta G^0/RT}$
(c) $K=e^{-\Delta H/RT}$
(d) $K = e^{-\Delta H^0/RT}$

WB-JEE-2009

Ans. (b) : We know that:

$$\Delta G° = –nFE°$$

And, $$E° = \frac{RT}{nF}\log K$$

$$\Delta G° = –RT \log K$$

$$K = e^{-\Delta G°/RT}$$

445. The standard emf of a cell, involving one electron change is found to be 0.591 V at 25^0C. The equilibrium constant of the reaction is (F = 96500Cmol^{-1})

(a) 1.0×10^1
(b) 1.0×10^5
(c) 1.0×10^{10}
(d) 1.0×10^{30}

UPTU/UPSEE-2008

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Ans. (c) : Relation between K_{eq} and E_{cell} us

$$E^{\circ}_{cell} = \frac{2.303RT}{nF}\log K_{eq}$$

$$E^{\circ}_{cell} = \frac{2.303RT}{nF}\log K_{eq} \text{ (at 298 K)}$$

$$E^{\circ}_{cell} = \frac{0.0591}{n}\log K_{eq}$$

$$0.0591 = \frac{0.0591}{n}\log K_{eq}$$

$\log K_{eq} = 10 = K_{eq} = \text{antilog } 10$

$K_{eq} = 1\times10^{10}$

446. The equilibrium constant of the reaction $Cu(s)+2Ag^{+}(aq) \rightarrow Cu^{2+}(aq)+Ag(s)$ [Given : $E^{o} = 0.46$ V] will be

(a) 4×10^{15}

(b) 4×10^{14}

(c) 14×10^{15}

(d) 15.6×10^{5}

AMU-2007

Ans. (a) : The equilibrium constant for the give reaction can be given as, [Given : $E^{o}= 0.46$ V]

$Cu(s)+2Ag^{+}(aq)\rightarrow Cu^{2+}(aq)+Ag(s)$

$$E^{o} = \frac{0.0591}{n}\log K \quad \text{.....(i)}$$

Where, K = Equilibrium constant , n = Number of electrons.

On putting the values in eqn, ….(i) we get

$$0.46 = \frac{0.0591}{n}\log K$$

$$\log K = \frac{0.46\times2}{0.0591}$$

$\therefore \quad K = \text{Antilog } 15.6$

$= 3.688\times10^{15}$ or $= 4\times10^{15}$

447. The standard emf of a cell, involving one electron change is found to be 0.591 V at 25ºC. The equilibrium constant of the reaction is (F = 96500 C mol^{-1})

(a) 1.0×10^{1}

(b) 1.0×10^{5}

(c) 1.0×10^{10}

(d) 1.0×10^{30}

[AIEEE 2004]

Ans. (c) : Equilibrium at 298 K is–

$$E^{o}_{cell} = \frac{0.0591}{n}\log K_c$$

K_c = Equilibrium constant

Given, $E^{o}_{cell} = 0.591$

Now, $$\log K_c = \frac{E^{o}_{cell}\times n}{0.0591} = \frac{0.591\times n}{0.0591}$$

$\log K_c = 10$

Taking antilog both side, we get–

$K_c = 1\times10^{10}$

448. For the equilibrium $H_2O(l) \rightleftharpoons H_2O(g)$ at 1 atm and 298 K:

(a) standard free energy change is equal to zero ($\Delta G^{\circ}=0$).

(b) free energy change is less than zero ($\Delta G<0$).

(c) standard free energy change is less than zero ($\Delta G^{\circ}<0$).

(d) standard free energy change is greater than zero ($\Delta G^{\circ}>0$).

AIIMS-2004

Ans. (b): The process –

$H_2O(l) \rightleftharpoons H_2O(g)$

is an endothermic process, (ΔH = +ve) and entropy increases during this change (ΔS = +ve). Hence this process is spontaneous at all temperatures above $0^{o}C$ ($T\Delta S > \Delta H$), so ΔG^{o} is negative ($\Delta G^{o} = \Delta H - T\Delta S$).

Thus, free energy change (ΔG) will be less than zero (negative) at 1 atm and 298K.

449. The reaction quotient (Q) for the reaction from $N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$ is given by $Q = \frac{[NH_3]^2}{[N_2][H_2]^3}$. The reaction will proceed from right to left if

(a) $Q = K_c$ (b) $Q < K_c$

(c) $Q > K_c$ (d) $Q = 0$

Where K_c is the equilibrium constant.

NEET-2003

Ans. (c) : The reaction quotient for:

$N_2(g)+3H_2(g) \rightleftharpoons 2NH_3(g)$

is given by $Q = \frac{[NH_3]^2}{[N_2][H_2]^3}$

The reaction will proceed in backward direction, when $Q > K_c$. The product concentration is more than equilibrium value.

The reactant concentration is less than the equilibrium value.

450. The equilibrium constant for the reaction, $H_2(g) + I_2(g) \rightleftharpoons 2HI(g)$ is 64 at a certain temperature. The equilibrium concentrations of H_2 and HI are 2 mol/L and 16 mol/L respectively. What is the equilibrium concentration (in mol/L) of I_2?

(a) 16 (b) 4

(c) 8 (d) 2

AP-EAMCET-2000

Ans. (d) : Given that, $K_c = 64$, $[H_2] = 2$ mol/L

[HI] = 16 mol/L

For the equilibrium reaction–

$H_2 + I_2 \rightleftharpoons 2\,HI$

$$\therefore \quad K_C = \frac{[HI]^2}{[H_2][I_2]}$$

@apna_pdf

Substitute values in the above expression–

$$64=\frac{(16)^2}{2\times[I_2]}$$

$$[I_2]=\frac{16\times16}{2\times64}$$

$[I_2]$ = 2 mol/litre

451. For the reaction, $A(g)\rightleftharpoons B(g)$ at 495 k, Δ_rG^0=-9.478 KJ mol^{-1}. If we start the reaction in a closed container at 495 k with 22 millimoles of A, the amount of B is the equilibrium mixture is .... millimoles (Round off to the nearest integer).

[R=8.314 J mol^{-1} K^{-1}, ln10=2.303]

JEE-Main-24.03.2021, Shift-I

Ans. (20) : $\Delta G^0 = -RT\ln K_{eq}$

$-9.478\times10^3 = -495\times8.314\ln K_{eq}$

$\ln K_{eq} = 2.303 = \ln 10$

So, $K_{eq} = 10$

Now, $A(g)\rightleftharpoons B(g)$

t = 0 22 0

t = t 22–x x

$$K_{eq}=\frac{[B]}{[A]}=\frac{x}{(22-x)}$$

$$10=\frac{x}{22-x}$$

x = 20

So, milli moles of B = 20

452. The variation of equilibrium constant with temperature is given below:

Temperature	**Equilibrium constant**
T_1 = 25°C	**K_1=10**
T_2 = 100°C	**K_2 =100**

The values of ΔH^o, ΔG^o at T_1 and ΔG^o at T_2(in KJ Mol^{-1}) respectively are close to [use R= 8.314 JK^{-1} mol^{-1}]

(a) 28.4,-7.14 and -5.71
(b) 0.64,-7.14 and -5.71
(c) 28.4, -5.71and - 14.29
(d) 0.64, - 5.71 and -14.29

JEE-Main-2020

Ans. (c) : T_1 = 298 K, K_1 = 10

T_2 = 373 K, K_2 = 100

For ΔH calculation

$$\log\left(\frac{K_2}{K_1}\right)=\frac{\Delta H}{2.303R}\left(\frac{1}{T_1}-\frac{1}{T_2}\right)$$

$$\log\left(\frac{100}{10}\right)=\frac{\Delta H}{2.303\times\left(\frac{8.314}{1000}\right)}\left(\frac{1}{298}-\frac{1}{373}\right)$$

ΔH = 28.4 kJ/mole

For $\left(\Delta G_1^0\right)$ and $\left(\Delta G_2^0\right)$ calculation

$$\Delta G_1^0 = -2.303\text{ RT}\log K$$

$$\Delta G_1^0 = -2.303\times\frac{8.314}{1000}\times298\times\log 10$$

= –5.71 kJ/mole

$$\Delta G_2^0 = -2.303\times\frac{8.314}{1000}\times373.\times\log 1000$$

= –14.29 kJ/mole

453. For the reaction, $A(g)\longrightarrow B(g)$, The value of the equilibrium constant at 300 k and 1 atm is equal to 100.0. The value of Δ_rG for the reaction at 300 k and 1 atm in J mol^{-1} is - xR, Where x is ....(Rounded off to the nearest integer)

(R=8.31 J mol^{-1} k^{-1} and In10 = 2.3)

JEE-Main-03.03.2021, Shift-I

Ans. 1380 :

$\Delta G^o = -RT\ln k_p$

$= -R(300)\ln(100)$

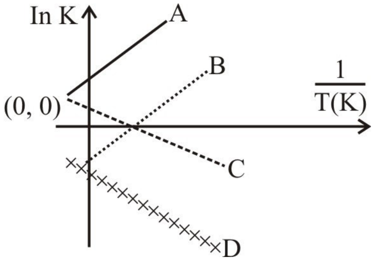
$= -R(300)\,2\ln(10)$

$= -R(300\times2\times2.3)$

$\Delta G^o = -1380R$

∴ x = 1380

454. Which of the following lines correctly show the temperature dependence of equilibrium constant, K, for an exothermic reaction?



(a) A and B
(b) B and C
(c) C and D
(d) A and D

JEE-Main-2018

Ans. (a) : $\Delta G^o = -RT\ln k$

As we know that $\Delta G^o = \Delta H^o - T\Delta S^o$

$\Delta H^o - T\Delta S^o = -RT\ln k$

$$\ln k=\frac{-\Delta H^o}{RT}+\frac{T\Delta S^o}{RT}$$

$$\ln k=\frac{-\Delta H^o}{RT}+\frac{\Delta S^o}{R}$$

For exothermic reaction ΔH^o is negative.

So, In graph of lnk Vs $\frac{1}{T}$ slope is positive.

Hence, line A and B show the correct temperature dependence of equilibrium constant K.

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08.

Ionic Equilibrium

1. Arrhenius Theory

1. An exothermic reaction $X \rightarrow Y$ has an activation energy 30 kJ mol^{-1}. If energy change ΔE during the reaction is –20 kJ, then the activation energy for the reverse reaction in kJ/mol is ______. (Integer answer)

JEE Main 26.02.2021, Shift-I

Ans. (50) : Given an exothermic reaction -

$X \rightarrow Y,\ \Delta H = -20kJ$

$(E_a)_f = 30kJ\ mol^{-1}$

$\therefore \quad \Delta H = (E_a)_f - (E_a)_b$

Putting the value of these, we get –

$-20 = 30 - (E_a)_b$

$(E_a)_b = 50$ kJ/mole

2. At 527ºC temperature the activation energy is 54.7 KJ/mole. The value of Arrhenius factor is 4 × 10^{10}. The rate constant will be

(a) 12.28 × 10^{-7}
(b) 10.76 × 10^{6}
(c) 10^{7}
(d) 10.76 × 10^{-6}

AIIMS-25.05.2019 (Evening)

Ans. (c): Given that, T= 527°C = 527+273 = 800K

$E_a = 54.7$ kJ/mol, A= 4 × 10^{10}, K = ?

We know that,

$$K = Ae^{-E_a/RT}$$

$$\log K = \log A - \frac{E_a}{2.303RT}$$

Putting the value of these, we get -

$$\log K = \log(4\times10^{10}) - \frac{54.7\times10^{3}}{2.303\times8.314\times800}$$

log K = 10.602–3.57

log K = 7.032

K = 10^{7}

3. Find the correct statement about catalyst.

(a) It changes the value of equilibrium constant K_c or K_p.
(b) It decreases the activation energy of a reaction.
(c) It changes the enthalpy of a reaction.
(d) It is not specific in its function.

SRMJEEE–2013

Ans. (b) : A catalyst is a substance which increase the rate of reaction without itself undergoing any permanent chemical change. Catalyst provides an alternate reaction mechanism by reducing the activation energy between reactants and product. A catalyst does not alter Gibbs energy (ΔG).

4. 20 ml of 0.1 M acetic acid is mixed with 50 mL of potassium acetate. K_a of acetic acid = 1.8 × 10^{-5} at 27°C. Calculate concentration of potassium acetate if pH of the mixture is 4.8.

(a) 0.1 M
(b) 0.04 M
(c) 0.4 M
(d) 0.02 M

VITEEE-2009

Ans. (b) : Given that, pH = 4.8, pK_a = 1.8 × 10^{-5}

Let the concentration of potassium acetate is x.

According to Henderson's equation–

$$pH = pK_a + \log\frac{[salt]}{[acid]}$$

or $$4.8 = -\log\left(1.8\times10^{-5}\right) + \log\frac{x\times50}{20\times0.1M}$$

or 4.8 = 4.74 + log 25x

log 25x = 0.06

25x = 1.148

$\therefore$ x = 0.045M

5. In an endothermic reaction A → B, the activation energy is 10 kcal mol^{-1} and enthalpy of reaction is + 5 kcal mol^{-1}. The activation energy for the backward reaction is

(a) 20 kcal mol^{-1}
(b) 10 kcal mol^{-1}
(c) 5 kcal mol^{-1}
(d) 15 kcal mol^{-1}

Assam CEE-2014

Ans. (c) : Given that, $E_{a(f)}$ = 10 kcal Mol^{-1}

ΔH = +5 k.cal mol^{-1}, $E_{a(b)}$ = ?

$\therefore$ We know that,

$\Delta H = E_{a(f)} - E_{a(b)}$

$5 = 10 - E_{a(b)}$

$E_{a(b)} = 10 - 5 = 5$ kcal Mol^{-1}

6. Arrhenius equation is :

(a) $\Delta H = \Delta E + \Delta n_g RT$
(b) $\Delta G = \Delta H - T.\Delta S$
(c) $K = Ae^{-E_a/RT}$
(d) none of the above

BCECE-2006

Ans. (c) : Arrhenius equation is expressed as

$K = Ae^{-E_a/RT}$

- K denotes the rate constant of the reaction.
- A denotes the pre-exponential factor.
- E_a denotes the activation energy.
- R is the universal gas constent.
- T denotes the absolute temperature associated with the reaction (in Kelvin).

7. In terms of Arrhenius equation, $k = Ae^{-E_a/RT}$ the temperature dependence of rate constant (k) of a chemical reaction is written. Then, the activation energy (E_a) of the reaction can be calculate by plotting.

(a) $\log k \text{ vs } \frac{1}{\log T}$
(b) $\log k \text{ vs } \frac{1}{T}$
(c) k vs T
(d) $k \text{ vs } \frac{1}{\log T}$

BCECE-2015

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Ans. (b) : According to the Arrhenius equation -

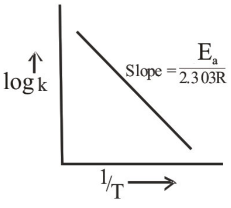
$$K = Ae^{-E_a/RT}$$

Taking 'ln' on both side, we get –

$$\ln k = \ln A + \ln e^{-E_a/RT}$$

$$\ln k = \frac{\ln A}{C} - \frac{E_a}{RT}$$

$$\log k = \frac{\ln A}{2.303} - \frac{E_a}{2.303RT}$$



Thus, log k vs $\frac{1}{T}$

8. The reactivity order of halogenation of alkanes is $F_2 > Cl_2 > Br_2 > I_2$. Choose the correct statements.

(I) Lower the activation energy for the chain initiation step, more reactive is the halogen.
(II) Lower the activation energy for the first chain-propagation step, more reactive is the halogen.
(III) Lower the activation energy for the second chain propagation step, more reactive is the halogen.
(IV) More negative is the overall heat of the reaction (ΔH_r^o of halogenations of alkane) more reactive is the halogen.

(a) I and II
(b) I, II and III
(c) II and IV
(d) II, III and IV

BCECE-2015

Ans. (c) : • Lower the activation energy for the first chain propagation step. More reactive is the halogen.

• More negative is the overall heat of the reaction (ΔH_r^0 of halogenation of alkane) more reactive is the halogen.

Hence, both the statement are correct.

9. The Arrhenius equation gives the dependence of the rate constant of a chemical reaction of the absolute temperature and may be expressed as $K = Ae^{-E_a/RT}$. If the unit of K is s^{-1} the unit of A will be

(a) kJ mol^{-1}
(b) mol^{-1}
(c) s^{-1}
(d) K (kelvin)

CG PET-2019

Ans. (c) : According to the Arrhenius equation–

$$K = Ae^{-E_a/RT}$$

Where, A is the pre-exponential factor.

The unit of the pre-exponential factor A are identical to those of the rate constant and will be vary depending on the order of the reaction. For a first order reaction. it has unit of s^{-1}.

For the reason, it is often called frequency factor.

10. The activation energy for a simple chemical reaction $A \rightarrow B$ is E_a in forward direction. They activation energy for reverse reaction

(a) is negative of E_a
(b) is always less than E_a
(c) can be less than or more than E_a
(d) is always double of E_a

UPTU/UPSEE-2018
CG PET -2007

Ans. (c) : The activation energy of reverse reaction is less than or more than activation energy (E_a) of forward reaction.

∵ $\Delta H = (E_a)_F - (E_a)_R$,

Because it depends. upon the nature of reaction.

If $(E_a)_F < (E_a)_R$ reaction is exothermic

or $(E_a)_F > (E_a)_R$ reaction is endothermic

11. According to Arrhenius equation. The slope of $\log K$ vs $\frac{1}{T}$ plot is…..

(a) $\frac{-E_a}{2.303}$
(b) $\frac{-E_a}{2.303R}$
(c) $\frac{-E_a}{2.303RT}$
(d) $\frac{E_a}{2.303RT}$

MHT CET-2018
JIPMER- 2017
GUJCET-2014

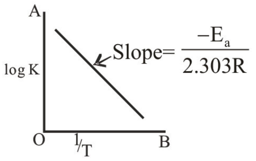
Ans. (b) : According to the Arrhenius equation –

$$K = Ae^{-E_a/RT}$$

Taking log on both sides, we get–

∵ $$\log K = \log A - \frac{E_a}{2.303RT}$$

$$\log K = \frac{-E_a}{2.303R}\frac{1}{T} + \log A$$



When logK is plotted with $\frac{1}{T}$, the slope of will be $\frac{-E_a}{2.303R}$ and intercept given by log A.

12. The activation energy for a reaction at the temperature TK was found to be 2.303 RT J mol^{-1}. The ratio of the rate constant to Arrhenius factor is

(a) 10^{-1}
(b) 10^{-2}
(c) 2×10^{-3}
(d) 2×10^{-2}

Karnataka-CET, 2010

Ans. (a) : Given, that $E_a = 2.303$ RT

According to the Arrhenius equation is –

∵ Rate constant, $k = Ae^{-E_a/RT}$

$$k = Ae^{-2.303\,RT/RT}$$

$$\frac{k}{A} = e^{-2.303}$$

On solving these equation, we get–

$$\frac{k}{A} = 10^{-1}$$

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13. The activation energy of exothermic reaction A→B is 80 kJ mol^{-1}. The heat of reaction is –200 $kJmol^{-1}$. The activation energy for the reaction B→A (in kJ mol^{-1}) will be

(a) 80 (b) 120
(c) 40 (d) 200
(e) 280

Kerala-CEE-2007

Ans. (e) : The activation energy of exothermic reaction
A→ B = 80 kJ mol^{-1}
$E_{a(f)} = 80$ kJ mol^{-1}, ΔH = –200kJ mol^{-1}, $E_{a(b)}$ = ?
∵ $\Delta H = E_{a(f)} - E_{a(b)}$
Putting the value of these, we get -
$-200 = 80 - E_{a(b)}$
or $E_{a(b)} = 200 + 80 = 280$ kJ mol^{-1}

14. Aqueous solution of which of the following compound is the best conductor of electric current?

(a) Hydrochloric acid, HCl
(b) Ammonia NH_3
(c) Fructose $C_6H_{12}O_6$
(d) Acetic acid, $C_2H_4O_2$

NEET-2015

Ans. (a) : The aqueous solution of hydrochloric acid (HCl) is the best conductor of electric current as it is a strong electrolyte and its completely dissociated into ions.

2. Solubility and Solubility Product Constant

15. The K_{sp} for bismuth sulphide (Bi_2S_3) is 1.08 × 10^{-73}. The solubility of Bi_2S_3 in mol L^{-1} at 298 K is

(a) 1.0 × 10^{-15} (b) 2.7 × 10^{-12}
(c) 3.2 × 10^{-10} (d) 4.2 × 10^{-8}

JEE Main-25.06.2022, Shift-II

Ans. (a) : $Bi_2S_3 \rightleftharpoons \underset{2s}{2Bi^{3+}} + \underset{3s}{3S^{2-}}$

Given that,
$K_{sp} = 1.08 \times 10^{-73}$
$K_{sp} = (2s)^2 (3s)^3$
$= 108(s)^5$
$1.08 \times 10^{-73} = (2s)^2 \times (3s)^3$
$108s^5 = 1.08 \times 10^{-73}$
$s^5 = \dfrac{1.08 \times 10^{-73}}{108}$
$s^5 = 0.01 \times 10^{-73}$
$s^5 = 1 \times 10^{-75}$
$s = 1 \times 10^{-15}$ mol/L

16. The solubility product of a sparingly soluble salt A_2X_3 is 1.1 × 10^{-23}. If specific conductance of the solution is 3 × 10^{-5} S m^{-1}, the limiting molar conductivity of the solution is x × 10^{-3} S m^2 mol^{-1}.
The value of x is ————.

JEE Main-28.06.2022, Shift-I

Ans. (3) : Given that the solubility product of A_2X_3 = 1.1 × 10^{-23}
And specific conductance = 3 × 10^{-5} Sm^{-1}
$A_2X_3(s) \rightleftharpoons \underset{2s}{2A^{+3}(aq)} + \underset{3s}{3X^{-2}(aq)}$
$\therefore K_{sp} = (2s)^2 (3s)^3 = 110 \times 10^{-25}$
or $110 \times 10^{-25} = 4 \times s^2 \times 27 \times s^3$
$110 \times 10^{-25} = 4 \times 27 (s)^5$
or $s = 1 \times 10^{-5}$ = M
$\lambda_m = [x] \times 10^{-3}$ Sm^2 mol^{-1}
$\lambda_m = \dfrac{K \times 10^{-3}}{M}$
$= \dfrac{3 \times 10^{-5} \times 10^{-3}}{1 \times 10^{-5}}$
$= 3 \times 10^{-3}$ Sm^2 mol^{-1}

17. The solubility of AgCl will be maximum in which of the following?

(a) 0.01 M KCl (b) 0.01 M HCl
(c) 0.01 M $AgNO_3$ (d) Deionized water

JEE Main-29.06.2022, Shift-I

Ans. (d) : If similar ion is present already in solution, then the solubility of the salt decreases due to common ion effect.
So we need to dissolve AgCl having Ag^+ and Cl^- ions.
So maximum solubility of AgCl will be in water.

18. The dielectric constants of H_2O and D_2O are 82 and 80.5 respectively. Therefore, the solubility of NaCl in D_2O is ..... than in water:

(a) Equal to (b) Slightly less
(c) Slightly higher (d) Very high

AP-EAMCET (Med.)-1999

Ans. (b) : NaCl is more soluble in H_2O in comparison to D_2O because water is more polar than D_2O. Greater the value of dielectric constant, greater will be the polarity of the solvent.
Hence the solubility of NaCl in D_2O is slightly less then in water

19. The ionic product of water $[H^+]$ $[OH^-]$ is

(a) 10^{-11} (b) 10^{-12}
(c) 10^{-5} (d) 10^{-14}

AIMMS- 25.05.2019, Shift-II
AP-EAMCET-1993

Ans. (d) : The product of concentration of H^+ and OH^- ions in water at a particular temperature is known as ionic product of water. The ionic product of water is 10^{-14}.

20. At 90°C, the concentration of H_3O^+ in pure water is 10^{-6} mol L^{-1}. What is the value of K_w at this temperature?

(a) 10^{-6} (b) 10^{-8}
(c) 10^{-14} (d) 10^{-12}

Manipal-2005, AP-EAMCET 1999

Ans. (d) : Given concentration of H_3O^+ in pure water is 10^{-6} mole L^{-1}
We know that,
∵ $K_w = [H^+] [OH^-]$
∴ $[H_3O^+] = [OH^-]$
or $K_w = 10^{-6} \times 10^{-6}$
$= 10^{-12}$

@apna_pdf

21. 250 mL of a sodium carbonate solution contains 2.65 g of Na_2CO_3. If 10 mL of this solution is diluted to one litre, what is the concentration of resultant solution? (molar mass of Na_2CO_3 = 106 g/mol).

(a) 0.1 M (b) 0.001 M

(c) 0.01 M (d) 10^{-4} M

AP-EAMCET-2001

Ans. (b) : Given that, Molar mass of $Na_2CO_3 = 106\ gmol^{-1}$

Mass of Sodium Carbonate = 2.65 gm, V_1 = 10 mL

$$\therefore \quad M_1 = \frac{2.65}{106}\times\frac{1000}{250} = 0.1\ M$$

Therefore, 10 mL of this solution is diluted to 500 mL

Since, $M_1V_1 = M_2V_2$

$0.1 \times 10 = M_2 \times 1000$

$$\text{or} \quad M_2 = \frac{0.1\times10}{1000} = 0.001\ M$$

22. If the ionic product of water (K_w) is 1.96×10^{-14} at 35°C, what is its value of 10ºC ?

(a) 1.96×10^{-14} (b) 3.92×10^{-14}

(c) 2.95×10^{-15} (d) 1.96×10^{-13}

AP-EAMCET-2003

Ans. (c) : Given that, Initial temperature = 35°C

Ionic product of water (K_w) = 1.96×10^{-14}

Ionic product $\propto$ temperature

According to the question, as the temperature is decreasing (from 35°C to 10ºC) so, the ionic product of water also decreases. So the value of ionic product is 2.95×10^{-15} at 10°C.

23. Magnesium fluoride MgF_2 is a slightly soluble salt whose solubility product $K_{SP} = 3.7 \times 10^{-8}$ What is the approximate solubility of MgF_2 ?

(a) 9.2×10^{-8} M (b) 1.2×10^{-8} M

(c) 1.4×10^{-4} M (d) 2.1×10^{-3} M

SCRA-2012

Ans. (d) : Given that, $K_{sp} = 3.7 \times 10^{-8}$

The dissociation of MgF_2 is

$$MgF_2 \rightleftharpoons Mg^{2+} + 2F^-$$

Let, the solubility product is s.

$K_{sp} = [Mg^{+2}]\,[F^-]^2$

$\therefore \quad K_{sp} = s \times (2s)^2$

$3.7 \times 10^{-8} = 4s^3$

$$\text{or} \quad s^3 = \frac{3.7\times10^{-8}}{4} = 0.925 \times 10^{-8}$$

$s^3 = 9.25 \times 10^{-9}$

or $s = 2.1 \times 10^{-3}$ M

24. Among the following, which is water insoluble?

(a) Sodium fluoride

(b) Potassium fluoride

(c) Beryllium fluoride

(d) Magnesium fluoride

AP-EAMCET-2007

Ans. (d) : The solubility of the fluorides is based on the lattice energy released when there is more attraction and more is the charge density. Magnesium fluoride (MgF_2) is water insoluble because of the fluorides of alkaline earth metal are insoluble in water and beryllium fluoride is slightly soluble in water.

25. The solubility of A_2X_3 is 'y' M. Its solubility product is .... M.

(a) $6y^4$ (b) $64y^4$

(c) $36y^5$ (d) $108y^5$

AP EAMCET (Engg.) 17.09.2020, Shift-II

Ans. (d) : For a sparingly soluble salt of molecular formula A_2X_3, if solubility in pure water is y M at a given temperature,

$$\underset{}{A_2X_3} \rightleftharpoons \underset{2y}{2A^{3+}} + \underset{3y}{3X^{2-}}$$

Solubility product, $K_{sp} = \left[A^{3+}\right]^2\left[X^{2-}\right]^3$

$= (2y)^2 \times (3y)^3$

$= 4y^2 \times 27y^3 = 108\ y^5M$

26. When equal volumes of Ca^{2+} and F^- solutions are mixed, in which of the solutions precipitation will not occur ?

(K_{sp} of $CaF_2 = 1.6 \times 10^{-10}$)

(a) $10^{-2}MCa^{+2} + 10^{-5}MF^-$

(b) $10^{-3}MCa^{+2} + 10^{-3}MF^-$

(c) $10^{-4}MCa^{+2} + 10^{-2}MF^-$

(d) $10^{-2}MCa^{+2} + 10^{-3}MF^-$

AP EAMCET (Engg.) 17.09.2020, Shift-II

Ans. (a) : Ionic product of (CaF_2) = $[Ca^{2+}]$. $[F^-]^2$.

Concentration of ions will be halved after mixing.

Thus, ionic products will be

$$1.\ \frac{10^{-2}}{2}\times\left(\frac{10^{-5}}{2}\right)^2 = \frac{1}{8}\times10^{-12}$$

$$2.\ \frac{10^{-3}}{2}\times\left(\frac{10^{-3}}{2}\right)^2 = \frac{1}{8}\times10^{-9}$$

$$3.\ \frac{10^{-4}}{2}\times\left(\frac{10^{-2}}{2}\right)^2 = \frac{1}{8}\times10^{-8}$$

$$4.\ \frac{10^{-2}}{2}\times\left(\frac{10^{-3}}{2}\right)^2 = \frac{1}{8}\times10^{-8}$$

In option (2), (3) and (4), ionic product > K_{sp}. Hence option (1) of the solution precipitation will not occur.

27. If the solubility product of MgF_2 at a certain temperature is 1.08×10^{-10}, its solubility in mol L^{-1} is

(a) 1.04×10^{-5} (b) 7.3×10^{-4}

(c) 3.0×10^{-5} (d) 3.0×10^{-4}

AP EAMCET (Medical) - 2013

Ans. (d) : The dissociation of MgF_2 is given as -

$$MgF_2 \rightleftharpoons Mg^{2+} + 2F^-$$

Let, the solubility (S) of Mg^{+2} and F^- is then from the formula of solubility product we get–

$K_{sp} = [Mg^{2+}][F^-]^2$

$K_{sp} = S \times (2S)^2$

$$S^3 = \frac{K_{sp}}{4}$$

$$S^3 = \frac{1.08\times10^{-10}}{4}$$

$S = 3\times10^{-4}\ mol\ L^{-1}$

@apna_pdf

28. The ionic product of water .... with increase in temperature.

(a) remains constant
(b) increases
(c) decreases
(d) may increase or decrease

AP EAMCET (Engg.) 21.09.2020, Shift-I

Ans. (b) : With an increase in temperature, there is an increase in dissociation of H_2O which gives rise to an increase ion the concentration of H^+ and OH^- ions. Hence, the ionic product of water increases with an increase in temperature.

29. The solubility of AgBr with solubility product 5.0×10^{-13} at 298 K in 0.1 M NaBr solution would be

(a) 7×10^{-6} M
(b) 5×10^{-12} M
(c) 5×10^{-14} M
(d) 5×10^{-6} M

AP EAMCET (Engg.) 21.09.2020, Shift-I

Ans. (b) : Let, the solubility of AgBr be S mol/L.

$$AgBr \rightleftharpoons Ag^+ + Br^-$$

Hence, $[Ag^+]\,[Br^-] = 5 \times 10^{-13}$

Given that, $[Br^-] = 0.1$

$\because \quad K_{sp} = [Ag^+]\,[Br^-]$

$5.0 \times 10^{-13} = [Ag^+] \times 0.1$

or $\quad [Ag^+] = (5 \times 10^{-13}) / 0.1 = 5 \times 10^{-12}$M

It means solubility in NaBr is 5×10^{-12}.

30. If the molar solubility (in $mol.L^{-1}$) of a sparingly soluble salt AB_4 is 'S', and the corresponding solubility product is 'K_{sp}', then S in terms of K_{sp} is given by the relation ———

(a) $S = \left(\frac{K_{sp}}{256}\right)^{1/4}$
(b) $S = \left(\frac{K_{sp}}{256}\right)^{1/5}$
(c) $S = (256\,K_{sp})^{1/5}$
(d) $S = (128\,K_{sp})^{1/4}$

AP EAPCET 25.08.2021, Shift-II

Ans. (b) : $AB_4(aq) \rightleftharpoons \underset{S}{A^{+4}} + \underset{4S}{4B^-}$

The molar solubility (in mol/lit.) of a sparingly soluble salt AB_4 is 'S'. The corresponding solubility product is K_{sp}

$\because \quad K_{sp} = [A^{+4}]\,[B^-]^4$

$K_{sp} = S\,(4S)^4 = 256\,S^5$

Hence, the molar solubility is

$$S = \left(\frac{K_{sp}}{256}\right)^{1/5}$$

31. The solubility product of $Ni(OH)_2$ at 298 K is $2\times10^{-15} mol^3 dm^{-9}$. The pH value if, its aqueous and saturated solution is

(a) 5
(b) 7.5
(c) 9
(d) 13

AP EAMCET (Engg.) 17.09.2020 Shift-I

Ans. (c) : $Ni(OH)_2 \rightleftharpoons \underset{S}{Ni^{2+}} + \underset{2S}{2OH^-}$

$\because \quad K_{sp} = \left[Ni^{2+}\right]\left[OH^-\right]^2$

$= S \times (2S)^2 = 4S^3$

$2\times10^{-15}\,(mol/L)^3 = 4S^3$

$2\times10^{-15}\,mol^3 dm^{-9} = 4S^3$

or $\quad S = \left(\frac{2}{4}\times10^{-15}\right)^{1/3} \simeq 8\times10^{-6}\,mol/L$

$\left[OH^-\right] = 2S = 2\times8\times10^{-6}\,mol/L$

$= 16 \times 10^{-6}$

$pOH = -\log_{10}\left[OH^-\right]$

$pOH = -\log\left[16\times10^{-6}\right]$

$pOH = 6 - \log 16 = 4.983 \simeq 5$

$pH = 14 - pOH = 14 - 5 = 9$

32. The $[Ag^+]$ in a saturated solution of Ag_2CrO_4 is 1.5×10^{-4} M. What is the solubility product of Ag_2CrO_4 ?

(a) $3.375\times10^{-12}\ M^3$
(b) $1.6875\times10^{-10}\ M^3$
(c) $1.6875\times10^{-11}\ M^3$
(d) $1.6875\times10^{-12}\ M^3$

SCRA - 2009

Ans. (d) : Given that, $[Ag^+]=1.5\times10^{-4}M$

So, $\quad \left[CrO_4^{2-}\right] = \frac{1.5}{2}\times10^{-4}M$

Reaction : $Ag_2CrO_4 \rightleftharpoons 2Ag^+ + CrO_4^{2-}$

$\because \quad K_{sp} = \left[Ag^+\right]^2\left[CrO_4^{2-}\right]$

$K_{sp} = \left(1.5\times10^{-4}\right)^2 \times \frac{1.5}{2}\times10^{-4}$

$= 2.25\times10^{-8}\times0.75\times10^{-4}$

$= 1.6875\times10^{-12} M^3$

33. The Solubility of AgBr(s) having solubility product 5×10^{-10} in 0.2 M NaBr solution equals

(a) 5×10^{-10} M
(b) 25×10^{-10} M
(c) 0.5 M
(d) 0.002 M

AP EAPCET 20.08.2021 Shift-I

Ans. (b) : Given that,

Solubility product K_{sp} of AgBr(s) = 5×10^{-10}

Conc. of NaBr = 0.2 M

$AgBr(s) \rightleftharpoons Ag^+(s) + Br^-$

$\therefore \quad K_{sp} = 5 \times 10^{-10}$

$K_{sp} = [Ag^+]\,[Br^-]$

$S = \frac{5\times10^{-10}}{0.2}$

$S = 25 \times 10^{-10}$ M

34. If the concentration of Ag^+ ions in the saturated solution of Ag_2CO_3 is 1.20×10^{-4} mol. L^{-1}. then find the solubility product of Ag_2CO_3.

(a) 5.30×10^{-12}
(b) 4.50×10^{-11}
(c) 2.66×10^{-12}
(d) 6.90×10^{-12}

AP EAPCET 24.08.2021, Shift-I

Ans. (d) : Given that, $[Ag^+] = 1.20 \times 10^{-4}$ mol. L^{-1}

Silver carbonate dissociates as follows –

$$Ag_2CO_3 \rightarrow 2Ag^+ + CO_3^{2-}$$

Let the solubility is S. The solubility of silver will be 2s as two moles ion are dissociated –

$$K_{sp} = [Ag^+]^2\left[CO_3^{2-}\right]$$

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$$K_{sp} = (2S)^2 (S)$$
$$K_{sp} = 4S^3$$
$$K_{sp} = 4 \times (1.20 \times 10^{-4})^3$$
$$K_{sp} = 6.91 \times 10^{-12}$$

35. If the solubility of an electrolyte is S, then what is the solubility product of the electrolyte of the type A_3B_2?

(a) $6S^3$ (b) $27S^5$
(c) $108S^5$ (d) $36S^5$

COMEDK-2016

Ans. (c) : $A_3B_2 \rightleftharpoons \underset{3S}{3A^{2+}} + \underset{2S}{2B^{3-}}$

$\because$ $K_{sp}=[A^{2+}]^3 [B^{3-}]^2$ .....(i)

If, S = solubility of A_3B_2, then $[A^{2+}]=3S$; $[B^{3-}]=2S$

Putting the value of these in equation (i), we get–

Therefore, $K_{sp} = (3S)^3 \times (2S)^2$
$= 27S^3 \times 4S^2$
$= 108\ S^5$

36. The solubility of AgCl at 20°C is 1.435×10^{-5} gL^{-1}. The solubility product of AgCl is

(a) 2×10^{-16} (b) 108×10^{-3}
(c) 1.0×10^{-14} (d) 1.035×10^{-5}

COMEDK-2018

Ans. (c) : Solubility of AgCl = 1.435×10^{-5} gL^{-1}

[Molecular weight of AgCl=143.5]

We know that solubility of AgCl in moles

$$AgCl \rightleftharpoons Ag^+ + Cl^-$$
$$K_{sp} = [Ag^+][Cl^-]$$
$$K_{sp} = (s)^2$$
$$\because \quad S = \frac{(1.435 \times 10^{-5})}{143.5} = 1 \times 10^{-7}$$

Therefore solubility product of AgCl = S^2

$K_{sp} = (1 \times 10^{-7})^2 = 1 \times 10^{-14}$.

37. The solubility of AgCN in a buffer solution of pH = 3 is x. The value of x is :
[Assume : No cyano complex is found; K_{sp}(AgCN) = 2.2×10^{-16} and K_a (HCN) = 6.2×10^{-10}]

(a) 0.625×10^{-6} (b) 1.6×10^{-6}
(c) 2.2×10^{-16} (d) 1.9×10^{-5}

JEE Main 25-02-2021, Shift-I

Ans. (d) : Given : K_{sp} (AgCN) = 2.2×10^{-16}
K_a(HCN) = 6.2×10^{-10}

The solubility of AgCN in a buffer solution of pH = 3

Let, solubility is S then,

$$AgCN \rightleftharpoons Ag^+ + CN^-$$
$$K_{sp} = S \times S = S^2 \quad .....(i)$$
$$H^+ + CN^- \rightleftharpoons HCN, \quad K = \frac{1}{K_a} = \frac{1}{6.2 \times 10^{-10}}$$

Therefore, $K_{sp} \times \frac{1}{K_a} = [Ag^+][CN^-]\frac{[HCN]}{[H^+][CN^-]}$

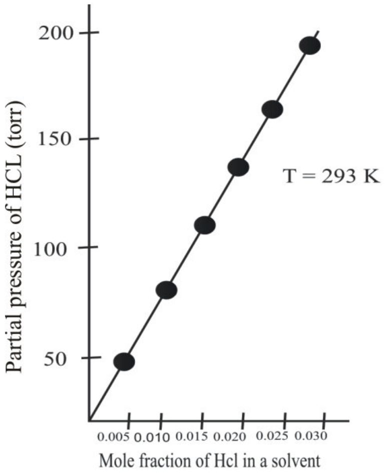
or $2.2 \times 10^{-16} \times \frac{1}{6.2 \times 10^{-10}} = \frac{S \times S}{10^{-3}}$

or $S^2 = \frac{2.2 \times 10^{-16} \times 10^{-3}}{6.2 \times 10^{-10}} = 0.354 \times 10^{-9}$

or $S^2 = 3.54 \times 10^{-10}$

or $S = 1.9 \times 10^{-5}$

38. From the graph, the value of Henry's constant for the solubility of HCl gas in cyclohexane is



(a) 10 k torr (b) 100 torr
(c) 50 torr (d) 2.4×10^2 torr

TS-EAMCET 09.08.2021, Shift-I

Ans. (a) : According to Henry's law, "The partial pressure of the gas in vapour phase (vapour pressure of the solute) is directly proportional to the mole fraction (X) of the gaseous solute in the solution at low concentration. This statement is known as Henry's law.

$P_{solute} \propto X_{solute}$ in solution

$P_{solute} = k_H X_{solute}$ in solution

Where, k_H = Henry's constant

The slope of the straight line gives the value of k_H.

$$\therefore \quad \tan\theta = k_H = \frac{50}{0.005}$$
$$= \frac{50000}{5} = 10000$$
$$\boxed{k_H = 10\text{k torr}}$$

39. Two salts A_2X and MX have the same value of solubility product of 4.0×10^{-12}. The ratio of their molar solubilities i.e. $\frac{S(A_2X)}{S(MX)}$ = ______
(Round off to the Nearest Integer).

JEE Main 16.03.2021, Shift-I

Ans. (50) : Given that, $K_{sp}(A_2X) = K_{sp}(MX) = 4 \times 10^{-12}$

For $A_2X \rightleftharpoons 2A^+ + X^{2-}$

$K_{sp} = (2S)^2 \times (S)$

or $S^3 = \frac{K_{sp}}{4} = \frac{4 \times 10^{-12}}{4} = 10^{-12}$

or $S(A_2X) = 10^{-4}$ .....(i)

Now, for $MX \rightleftharpoons M^+ + X^-$

$\because$ $K_{sp} = S \times S$

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or $S=\sqrt{4\times10^{-12}}=2\times10^{-6}$

Therefore, $\dfrac{S(A_2X)}{S(MX)}=\dfrac{10^{-4}}{2\times10^{-6}}$

or $\dfrac{S(A_2X)}{S(mX)}=50$

40. The solubility of $Ca(OH)_2$ in water is :
[Given : The solubility product of $Ca(OH)_2$ in water = 5.5×10^{-6}]

(a) 1.11×10^{-2} (b) 1.11×10^{-6}
(c) 1.77×10^{-2} (d) 1.77×10^{-6}

JEE Main 25.02.2021, Shift-II

Ans. (a) : Given: $K_{sp}=5.5\times10^{-6}$
Let, the solubility of $Ca(OH)_2$ in water is S,

$$\underset{}{Ca(OH)_2}\rightleftharpoons\underset{(S)}{Ca^{2+}}+\underset{(2S)}{2OH^-}$$

$$K_{sp}=[Ca^{2+}].[OH^-]^2$$
$$K_{sp}=(S)^1\times(2S)^2$$
$$5.5\times10^{-6}=4S^3$$
$$S=\left(\frac{5.5\times10^{-6}}{4}\right)^{1/3}$$
$$S=1.11\times10^{-2}$$

41. Which of the following has maximum solubility at low pH?

(a) NH_4Cl (b) $NaCl$
(c) Na_3PO_4 (d) $Sr(OH)_2$

AIIMS-25.05.2019 (Morning)

Ans. (d): Maximum solubility at low pH means in acidic solution get dissolve in high amount as OH^-get neutralize by H^+.

So, $Sr(OH)_2\longrightarrow Sr^{2+}+2OH^-$

Hence $Sr(OH)_2$ has maximum solubility at low pH.

42. At 25°C, the solubility product of $Mg(OH)_2$ is 1.0×10^{-11}. At which pH, will Mg^{2+} ions start precipitating in the form of $Mg(OH)_2$ from a solution of 0.001 M Mg^{2+} ions?

(a) 9 (b) 10
(c) 11 (d) 8

AIEEE-2014, 2010

Ans. (b): Given that, K_{sp} of $Mg(OH)_2$ = 1.0×10^{-11}
Solution molarity is = 0.001

$$Mg(OH)_2\longrightarrow Mg^{2+}+2OH^-$$

Moles of $Mg(OH)_2$= Moles of $[Mg^{2+}]$

$\because$ $K_{sp}=[Mg^{2+}]\times[OH^-]^2$

$$1.0\times10^{-11}=0.001\times[OH^{-1}]^2$$
$$[OH^-]^2=\frac{1.0\times10^{-11}}{0.001}=1.0\times10^{-8}\,M$$
$$[OH^-]=10^{-4}\,M$$
$$H^+=\frac{10^{-14}}{[OH^{-1}]}=\frac{10^{-14}}{10^{-4}}=10^{-10}\,M$$
$$pH=-\log[H]^+$$
$$pH=-\log[10]^{-10}$$
$$pH=10$$

43. The solubility product (K_{sp}) of the following compounds are given at 25°C.

Compound	**K_{sp}**
AgCl	**1.1×10^{-10}**
AgI	**1.0×10^{-16}**
$PbCrO_4$	**4.0×10^{-14}**
Ag_2CO_3	**8.0×10^{-12}**

The most soluble and least soluble compounds are respectively.

(a) AgCl and $PbCrO_4$ (b) AgI and Ag_2CO_3
(c) AgCl and Ag_2CO_3 (d) Ag_2CO_3 and AgI

KEAM-2011

Ans. (d): (i) $AgCl\longrightarrow Ag^+(aq)+Cl^-(aq)$

$$K_{Sp}=[Ag^+][Cl^-]$$
$$=S\times S$$

Given, $K_{sp}=1.1\times10^{-10}$

$$1.1\times10^{-10}=S^2$$
$$S=1.04\times10^{-5}\,mol\,L^{-1}$$

(ii) $AgI\longrightarrow Ag^++I^-$

$$K_{sp}=[Ag^+][I^-]$$
$$=S\times S$$
$$K_{sp}=S^2=1\times10^{-16}$$
$$S=1\times10^{-8}\,mol\,L^{-1}$$

(iii) $PbCrO_4\longrightarrow\underset{S}{Pb^{2+}}+\underset{S}{CrO_4^{2-}}$

$$K_{Sp}=[Pb^{2+}][CrO_4^{2-}]$$
$$=\;S\qquad S$$
$$K_{sp}=S^2$$
$$4\times10^{-14}=S^2$$
$$S=2\times10^{-7}\,mol\,L^{-1}$$

(iv) $Ag_2CO_3\longrightarrow2Ag^++CO_3^{2-}$

$$K_{sp}=[Ag^+][CO_3^{2-}]$$
$$=[2S]^2.[S]$$
$$K_{sp}=4S^5$$
$$8\times10^{-12}=4S^5$$
$$S=1.26\times10^{-4}\,mol\,L^{-1}$$

Hence, $Ag_2CO_3$are most soluble end AgI are least Soluble).

44. Why only As^{3+} gets precipitated as As_2S_3 and not Zn^{2+} as ZnS when H_2S is passed through an acidic solution containing $As^{3+}$and Zn^{2+} ?

(a) Solubility product of As_2S_3 is less than that of ZnS.
(b) Enough As^{3+} are present in acidic medium.
(c) Zinc salt does not ionise in acidic medium.
(d) Solubility product changes in presence of an acid.

JIPMER-2018

Ans. (a): Solubility product of As_2S_3 is less than that of ZnS because As^{3+} gets precipitated as As_2S_3 and not Zn^{2+} as ZnS. When H_2S is passed through an acidic solution containing As^{3+} and Zn^{2+} which means for As^{3+}. Solubility product is less than the ionic product. Therefore, only As^{3+} form a precipitate.

@apna_pdf

45. Solubility product of a salt AB is 1×10^{-8} M^2 in a solution in which the concentration of A^+ ions is 10^{-3} M. The salt will precipitate when the concentration of B^- ions is kept

(a) Between 10^{-8} M to 10^{-7} M
(b) Between 10^{-7} M to 10^{-8} M
(c) $> 10^{-5}$ M
(d) $< 10^{-8}$ M

KCET-2006

Ans. (c): Given that, K_{sp} of AB concentration of $A^+ = 10^{-3}$M

$$K_{sp} = 1\times10^{-8}$$

$$AB \rightleftharpoons [A^+][B^-]$$

$$[10^{-3}][B^-]$$

The salt will be precipitated, if ionic product > K_{sp}

$$10^{-3}\ [B^-] > 1\times10^{-8}$$

$$[B^-] > \frac{10^{-8}}{10^{-3}}$$

$$[B^-] > 10^{-5}M$$

46. The solubility of PbF_2 in water at 25°C is $\approx10^{-3}$ M. What is its solubility in 0.05 M NaF solution? Assume the later to be fully ionised.

(a) 1.6×10^{-6}M
(b) 1.2×10^{-6}M
(c) 1.2×10^{-5}M
(d) 1.6×10^{-4}M

AIPMT-2009

Ans. (a): Solubility of $PbF_2 \approx 10^{-3}$M

$$PbF_2 \rightleftharpoons Pb^{2+} + 2F^-$$

$$K_{sp} = [Pb]^{2+} . [F^-]^2$$

$$S \times 2S^2$$

$$K_{sp} = 4S^3$$

$$= 4 \times (10^{-3})^3$$

$$K_{sp} = 4 \times 10^{-9}$$

In 0.05 NaF We have 0.05 of F^- ion contributed by NaF

If the solubility of PbF_2 in this solution is S then total $[F^-] = [2S + 0.05]$M

$$K_{sp} = S[2S + 0.05]^2$$

Assuming 2S<< 0.05

$$4\times10^{-9} = S\times25\times10^{-4}$$

$$S = 0.16\times10^{-5}M = 1.6\times10^{-6}M$$

47. On adding 0.1 M solution each of $[Ag^+]$, $[Ba^{2+}]$, $[Ca^{2+}]$ in a Na_2SO_4 solution, species first precipitated is

$[K_{sp}BaSO_4 = 10^{-11}$, $K_{sp}CaSO_4 = 10^{-6}$, $K_{sp}Ag_2SO_4 = 10^{-5}]$

(a) Ag_2SO_4
(b) $BaSO_4$
(c) $CaSO_4$
(d) All of these

AIPMT-2008

Ans. (b): Given, K_{sp} of $BaSO_4 = 10^{-11}$

K_{sp} of $Ag_2SO_4 = 10^{-5}$

K_{sp} of $CaSO_4 = 10^{-6}$

$$\text{Solubility of } BaSO_4 = \sqrt{K_{sp}} = \sqrt{10^{-11}}$$

$$= 3.16 \times 10^{-6} \text{ mol/L}$$

$$\text{Solubility of } CaSO_4 = \sqrt{K_{sp}} = \sqrt{10^{-6}}$$

$$= 1.0 \times 10^{-3} \text{ mol/L}$$

Dissociation of Ag_2SO_4 occurs as follows :

$$Ag_2SO_4 \rightleftharpoons 2Ag + SO_4^{2-}$$

$$\therefore \quad K_{sp} = (2S)^2(S) = 4S^3$$

$$\therefore \text{ Solubility of } Ag_2SO_4 = \sqrt[3]{\frac{K_{sp}}{4}} = \sqrt[3]{\frac{10^{-5}}{4}}$$

$$= 1.4 \times 10^{-2} \text{ mol/L}$$

Least solubility is of $BaSO_4$, hence it will precipitate first.

48. The solubility of CuBr is 2×10^{-4} mol/L at 25°C. The K_{sp} value of CuBr is

(a) $4\times10^{-8}mol^2L^{-2}$
(b) $4\times10^{-4}mol^2L^{-2}$
(c) $4\times10^{-11}mol^2L^{-2}$
(d) $4\times10^{-15}mol^2L^{-2}$

AIPMT-2000

Ans. (a): $CuBr(S) \rightleftharpoons Cu^+ + Br^-$

t = 0	S	0	0
t' = t		S	S

$$\because \quad K_{sp} = [Cu^+] . [Br^-]$$

$$= [S] . [S]$$

$$K_{sp} = [S]^2$$

$$= (2 \times 10^{-4})^2$$

$$= 4 \times 10^{-8} \text{ mol}^2 \text{ L}^{-2}$$

49. At 80°C, distilled water has (H_3O^+) concentration equal to 1×10^{-6} mol/litre. The value of K_w, at this temperature will be

(a) 1×10^{-6}
(b) 1×10^{-12}
(c) 1×10^{-9}
(d) 1×10^{-15}

AIPMT-1994

Ans. (b): The distilled water is neutral with equal concentrations of hydrogen ion and hydroxide ion.

Whatever the temperature may be water will always dissociate to give equal concentration of H^+ ion and OH^- that it will be always be neutral

$$\text{Hence, } K_w = [H^+][OH^{-1}]$$

$$= [1\times10^{-6}][1\times10^{-6}]$$

$$K_w = 1\times10^{-12}$$

50. If the ionic product of $Ni(OH)_2$ is 1.9×10^{-15}, the molar solubility of $Ni(OH)_2$ in 1.0 M NaOH is

(a) 1.9×10^{-18}M
(b) 1.9×10^{-13}M
(c) 1.9×10^{-15}M
(d) 1.9×10^{-14}M

AP-EAMCET (Engg.) - 2014

Ans. (c) : Given, $[OH^-] = 1M$, $K_{sp} = 1.9 \times 10^{-15}$

Let the molar solubility of $Ni(OH)_2$ = S

$$[Ni(OH)_2] \rightleftharpoons Ni^{2+} + 2OH^-$$

$$\therefore K_{sp} = [Ni^{+2}][OH^-]^2$$

$$1.9\times10^{-15} = S\times(1.0)^2$$

$$S = 1.9\times10^{-15}M$$

51. A saturated solution of H_2S in 0.1 M HCl at 25°C contains S^{2-} ion concentration of 10^{-23} mol L^{-1}. The solubility product of some sulphides are CuS=10^{-44}, FeS = 10^{-14}, MnS = 10^{-15}, CdS = 10^{-25}. If 0.01 M solution of these salts in 1M HCl are saturated with H_2S, which of these will be precipitated?

(a) All
(b) All except MnS
(c) All except MnS and FeS
(d) Only-CuS

VITEEE-2015

@apna_pdf

Ans. (c) : Given $[S^{2-}] = 10^{-23}$ mol L^{-1}

$[M^{2+}] = 10^{-2} M$

Ionic product, $K_w = [M^{2+}][S^{2-}]$

$= 10^{-2} \times 10^{-23}$

$= 10^{-25}$

So, ionic product is greater than K_{sp} of CuS and CdS.

52. The solubility product of Ag_2CrO_4 is 32×10^{-12}. What is the concentration of CrO_4^{-2} ions in that solution?

(a) 2×10^{-4} M
(b) 16×10^{-4} M
(c) 8×10^{-4} M
(d) 8×10^{-8} M

VIEEE-2014

Ans. (a) : Given, K_{sp} of $Ag_2CrO_4 = 32 \times 10^{-12}$

$K_{sp} = [2Ag^{+}] . [CrO_4^{2-}]$

$= [2S]^2 . [S]$

$K_{sp} = 4S^3$

$$\therefore \quad S = \left(\frac{K_{sp}}{4}\right)^{1/3}$$

$$S = \left(\frac{32\times10^{-12}}{4}\right)^{1/3}$$

$$S = \left(8\times10^{-12}\right)^{1/3}$$

$$S = 2\times10^{-4}\ M.$$

53. What will be solubility of $KAl(SO_4)_2$ in water if solubility product (K_{sp}) for $KAl(SO_4)_2$ is 1.6×10^{-11} (unit)?

(a) 6×10^{-5} M
(b) 3×10^{-4} M
(c) 2×10^{-6} M
(d) 1.4×10^{-3} M

AMU-2019

Ans. (d) : Given that, $K_{sp} = 1.6 \times 10^{-11}$

$$KAl(SO_4)_2 \rightleftharpoons \underset{S}{K^+} + \underset{S}{Al^{3+}} + \underset{2S}{2SO_4^{2-}}$$

$$K_{sp} = [K^+][Al^{3+}][SO_4^{\ 2}]^2$$

$$= S \times S \times 2S^2$$

$$K_{sp} = 4S^4$$

$$S = \left(\frac{1.6\times10^{-11}}{4}\right)^{1/4}$$

$$= (4\times10^{-12})^{1/4}$$

$$S = 1.4\times10^{-3}$$

54. The K_{sp} of $PbCO_3$ and $MgCO_3$ are 1.5×10^{-15} and 1×10^{-15} respectively at 298 K. The concentration of Pb^{2+} ions in a saturated solution containing $MgCO_3$ and $PbCO_3$ is

(a) 1.5×10^{-8} M
(b) 3×10^{-8} M
(c) 2×10^{-8} M
(d) 2.5×10^{-8} M

AMU-2018

Ans. (b) :

$$\begin{array}{llll} & PbCO_3 \longrightarrow & Pb^{+2} & + CO_3^{\ -2} \\ t=0 & x & 0 & 0 \\ t'=t & 0 & x & x+y \end{array}$$

$$\begin{array}{llll} & MgCO_3 \longrightarrow & Mg^{2+} & + CO_3^{\ -2} \\ t=0 & y & 0 & 0 \\ t'=t & 0 & y & y+x \end{array}$$

$K_{sp}(PbCO_3) = (x)(x + y)$ .....(i)

$K_{sp}(MgCO_3) = (y)(x + y)$ .....(ii)

$$\frac{K_{sp}(PbCO_3)}{K_{sp}(MgCO_3)} = \frac{(x).(x+y)}{y(x+y)}$$

$$\frac{1.5\times10^{-15}}{1\times10^{-15}} = \frac{x}{y} \Rightarrow \boxed{x = 1.5y}$$

Putting the value of X in equation (i), we get–

$$1.5\times10^{-15} = 1.5y(1.5y + y)$$

$$= 1.5y(2.5y)$$

$$= 3.75y^2$$

$$y = \sqrt{\frac{1.5\times10^{-15}}{3.75}}$$

$$y = 2\times10^{-8}$$

Then, $x = 1.5y$

$$= 1.5\times2\times10^{-8},\ \boxed{x = 3\times10^{-8} m}$$

55. The solubility of pure oxygen in water at 20°C and 1.0 atmosphere pressure is 1.38×10^{-3} mole/litre. What will be the concentration of oxygen at 20°C and partial pressure of 0.21 atmosphere?

(a) 2.9×10^{-4} mole/litre
(b) 5.8×10^{-4} mole/litre
(c) 7.6×10^{-4} mole/litre
(d) 11.6×10^{-4} mole/litre

AMU-2018

Ans. (a) : The solubility of gas in liquid at particular temperature is given by Henrys law is –

$m_a = K_H P_a$ .....(i)

Where m_a = mass of gas dissolved in a unit volume of solvent.

Pa = pressure of the gas in equilibrium

K_H = Henry's Law constant

On putting the given values in above expression.

$$1.38\times10^{-3} \text{mol}/l = K_H \times 1\text{atm}$$

$$K_H = \frac{1.38\times10^{-3}\text{mol/L}}{1\text{atm}}$$

At 0.21 atm m_a will be calculated as

$$m_a = \frac{1.38\times10^{-3}\text{mol/L}}{1\text{atm}} \times 0.21\text{atm}$$

$$m_a = 2.9\times10^{-4}\text{mol/L}.$$

56. What is the value of K_{sp} for Bismuth sulphide (Bi_2S_3), Which has solubility of 1.0×10^{-15} mol/L at 25°C?

(a) 1.08×10^{-73}
(b) 1.08×10^{-74}
(c) 1.08×10^{-72}
(d) 1.08×10^{-75}

AMU-2016

Ans. (a) : Given that, $S = 1 \times 10^{-15}$

$$Bi_2S_3 \rightleftharpoons 2Bi^{3+}(aq) + 3S^{2-}(aq)$$

$$K_{sp} = \underset{2S}{[Bi^{3+}]^2}\ \underset{3S}{[S^{2-}]^3}$$

$$K_{sp} = 2\times(1\times10^{-15})\times3(1\times10^{-15})$$

$$K_{sp} = (2 \times 10^{-15})^2 \times (3 \times 10^{-15})^3$$

$$= (4\times10^{-30})\times\left(27\times10^{-45}\right)$$

$$= 108\times10^{-75}$$

$$K_{sp} = 1.08\times10^{-73}$$

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57. What is the minimum volume of water required to dissolve 1 g of calcium sulphate at 298 K? K_{sp} for $CaSO_4$ is 9.0×10^{-6} (Molar mass of $CaSO_4$ = 136 g mol^{-1})

(a) 2.45 L	(b) 4.08 L
(c) 4.90 L	(d) 3.00 L

AMU-2015

Ans. (a) : $CaSO_4 \rightarrow Ca^{2+} + SO_4^{2-}$

$$K_{sp} = \left[Ca^{2+}\right]\left[SO_4^{2-}\right]$$
$$K_{sp} = S^2$$
$$9.0 \times 10^{-6} = S^2$$
$$S = \sqrt{9.0 \times 10^{-6}}$$
$$= 3.0 \times 10^{-3} \text{ mol/L}$$

Given, molecular mass = 136 g mol^{-1}

Solubility of $CaSO_4$ = $3.0 \times 10^{-3} \times 136$ g/L = 0. 408 g/L

∴ To dissolve 0.408 of $CaSO_4$, water requires = 1L

∴ To dissolve 1 gm of $CaSO_4$, water requires = $\frac{1}{0.408}$L

= 2.45 L

58. What will be solubility product of $Ca(OH)_2$ if its solubility is $\sqrt{3}$?

(a) 3	(b) $3\sqrt{3}$
(c) $12\sqrt{3}$	(d) 27

AMU-2014

Ans. (c) : $Ca(OH)_2 \rightleftharpoons \underset{S}{Ca^{2+}} + \underset{2S}{2O\bar{H}}$

Given, solubility (S) = $\sqrt{3}$

$$K_{sp} = [Ca^{2+}] . [OH^-]^2$$
$$= [S] . [2S]^2$$
$$= 4S^3$$
$$K_{sp} = 4 \times \left(\sqrt{3}\right)^3$$
$$K_{sp} = 12\sqrt{3}$$

59. If K_{sp} of $Ni(OH)_2$ is 2.0×10^{-15} M, the molar solubility of $Ni(OH)_2$ in 0.10 M NaOH is

(a) 2.0×10^{-15} M	(b) 2.0×10^{-13} M
(c) 2.0×10^{-11} M	(d) 2.0×10^{-9} M

AMU-2013

Ans. (b) : $K_{sp} = 2.0 \times 10^{-15}$M

$$Ni(OH)_2 \rightleftharpoons \underset{S}{Ni^{2+}} + \underset{2S}{2OH^-}$$
$$K_{sp} = [Ni^{2+}]\,[OH^-]^2$$
$$= [s][0.10 + 2s]^2$$

(because total concentration of [OH^-] ions = [0.10 + 2s]

As K_{sp} is small 2s << 0.10

Thus, (0.10 + 2s) ≈ 0.10

Hence, $2.0 \times 10^{-15} = s\,(0.10)^2$

$S = 2.0 \times 10^{-13}$ M = [Ni^{2+}]

60. If the solubility of Pr_2 is S g-mole per litre, its solubility product, considering it to be 80% ionized, is

(a) 2.048 S^2	(b) 20.48 S^3
(c) 2.048 S^3	(d) 2.048 S^4

AMU-2012

Ans. (c) :

$$\begin{array}{llll} & Pr_2 & \rightleftharpoons P^{2+} + & 2r^- \\ \text{Initially} & & 1s & 0 \\ \text{After 80\%} & (1-0.80) & 0.80s & 2\times0.80S \\ \text{Ionization} & = 0.20s & & = 1.60s \end{array}$$

Solubility product,

$$K_{sp} = [P^{2+}]\,[r^-]^2$$
$$= [s] \quad [2s]^2$$
$$K_{sp} = [0.80s] \cdot [2 \times 0.80s]^2$$
$$K_{sp} = 2.048s^3$$

61. The precipitate of calcium fluoride (K_{sp}= 1.7×10^{-10}) is obtained when equal volume of the following are mixed.

(a) 0.001 M Ca^{2+} + 0.00001 M F^-

(b) 10^{-5} M Ca^{2+}+ 10^{-3} M F^-

(c) 10^{-2} M Ca^{2+}+ 10^{-3} M F^-

(d) 10^{-4} M Ca^{2+}+ 10^{-4} M F^-

AMU-2008

Ans. (c) : For precipitation to occur ionic product > solubility product.

$CaF_2 \rightleftharpoons Ca^{2+} + 2F^-$

for (a) $[Ca^{2+}] \times [F^-]^2 = 10^{-3}\ 4\times(10^{-5})^2$

$= 1/4[16 \times 10^{-13}] = 4 \times 10^{-13}$

(b) $[Ca^{2+}][F^-]^2 = 1/4[10^{-5}\times(2\times10^{-3})^2]$

$= 1/4[4\times10^{-11}] = 10^{-11}$

(c) $[Ca^{2+}][F^-]^2 = 1/4[10^{-2}\times(2\times10^{-3})^2]$

$= 1/4[4\times10^{-8}] = 10^{-8}$

(d) $[Ca^{2+}][F^-]^2 = 1/4[10^{-4}\times(2\times10^{-4})^2]$

$= 1/4[4\times10^{-12}] = 10^{-12}$

ionic product (10^{-8}) > Solubility product (1.7×10^{-10})

Hence, precipitation will occur.

62. The molar solubility (s) of the equilibrium, $A_x.B_y$ (solid) $\rightleftharpoons xA^{z+}_{(aq)} + yB^{z-}_{(aq)}$ in terms of the solubility product (K_{sp}) will be

(a) $s=\left(\frac{K_{sp}}{x^x y^y}\right)^{1/x+y}$	(b) $s=\left(\frac{K_{sp}}{x^x - y^y}\right)^{x+y}$
(c) $s=\left(\frac{K_{sp}}{x.y}\right)^{x+y}$	(d) $s=\left(\frac{K_{sp}}{x.y}\right)^{1/x+y}$

AMU-2007

Ans. (a) : Let us consider the molar solubility of a salt A_xB_x is s mol L^{-1}, then,

$$\begin{array}{lll} A_xB_x \text{ (solid)} & \rightleftharpoons xA^{z+}_{(aq)} & + yB^{z-}_{(aq)} \\ s & xs & ys \end{array}$$

$\therefore K_{sp} = (xs)^x.(ys)^y$

Hence, molar solubility can be given as :

$K_{sp} = [A^z]^x . [B^{z-}]$

$= [x.s]^x\ [y.s]^y$

$K_{sp} = x^x.\ s^x.\ y^y.\ s^y.$

$K_{sp} = x^x.\ y^y.\ s^x.\ s^y.$

$s^{x+y} = \frac{K_{sp}}{x^x.y^y}$ Thus $s = \left[\frac{K_{sp}}{x^x.y^y}\right]^{\frac{1}{x+y}}$

@apna_pdf

63. The solubility product of Ag_2CrO_4 in water at 298K is 3.2×10^{-11}. What will be concentration of CrO_4^{2-} ions in the saturated solution of Ag_2CrO_4

(a) $2\times10^{-4}M$ (b) $57\times10^{-5}M$

(c) $5.7\times10^{-6}M$ (d) $3.2\times10^{-11}M$

AMU-2005

Ans. (a) : $Ag_2CrO_4 \longrightarrow 2Ag^+ + CrO_4^{2-}$

S 2S S

$$K_{sp} = [Ag^+]^2[CrO_4^{2-}]$$
$$= (2S)^2.(S)$$
$$K_{sp} = 4S^3$$
$$S^3 = \frac{K_{sp}}{4}$$
$$S = \sqrt[3]{\frac{K_{sp}}{4}} = \sqrt[3]{\frac{3.2\times10^{-11}}{4}}$$
$$S = 2\times10^{-4}\ M$$

64. The solubility product of AgCl is 4.0 10^{-10} at 298 K. The solubility of AgCl in 0.04 M $CaCl_2$ will be

(a) 5.0×10^{-9} M (b) 20×10^{-5} M

(c) 2.2×10^{-4} M (d) 1.0×10^{-4} M

BITSAT-2008

AMU-2002

Ans. (a) : Given that,

$K_{sp}(AgCl) = 4.0 \times 10^{-10}$ 0.04M $CaCl_2$

$$AgCl \rightleftharpoons Ag^+ + Cl^-$$

$K_{sp} = [Ag^+]\ [Cl^-]$ ($\because [Cl]^- = 0.08$)

or $4.0 \times 10^{-10} = s \times 0.08$

or $S = \frac{4.0\times10^{-10}}{0.08}$

or $S = 5 \times 10^{-9}$

65. The solubility of AgCl is 1×10^{-5} mol/litre. Its solubility in 0.1 molar sodium chloride solution is

(a) 1×10^{-10} (b) 1×10^{-5}

(c) 1×10^{-9} (d) 1×10^{-4}

AMU–2001

Ans. (c) : $AgCl \rightleftharpoons [\ Ag^+]\ [\ Cl^-]$

[S] [S]

$$K_{sp}=[Ag^+][Cl^-]$$
$$=10^{-5}\times10^{-5}$$
$$K_{sp} =10^{-10}$$

In 0.1 M NaCl soln. $[Cl^-]=0.1$ M

$[Ag^+][0.1]=10^{-10}$ or $[Ag^+] = 10^{-9}$

66. Three sparingly soluble salts M_2X, MX and MX_3 have same value of solubility product. Their solubilities follow the order

(a) $MX_3 > MX > M_2X$ (b) $MX > MX_3 > M_2X$

(c) $MX > M_2X > MX_3$ (d) $MX_3 > M_2X > MX$

Assam CEE-2014

Ans. (d) : Let solubility of M_2X is S_1, MX is S_2 and MX_3 is S_3

$$S_1 = (K_{sp} / 4)^{-\frac{1}{3}}; S_2 = (K_{sp})^{1/2}$$
$$S_3 = (K_{sp} / 27)^{1/4}$$

As K_{sp} Let solubility of 10^{-12} (say) in that case

$$S_1 = \frac{1}{3}\sqrt{4}\ ,\ S_2 = 10^6 \text{ and } S_3 = \frac{1}{3\sqrt{3}}10^{-3}$$

The correct order of solubilities is $MX_3 > M_2X > MX$

67. If S is the solubility of $Zr_3\ (PO_4)_4$ in Pure water then.

(a) $K_{SP} = S^7$ (b) $K_{SP} = 12S^7$

(c) $K_{SP} = 5184S^7$ (d) $K_{SP} = 6912S^7$

Assam CEE-2021

Ans. (d) : $Zr_3(PO_4)_4 \rightleftharpoons 3Zr^{4+} + 4PO_4^{3-}$

t = 0 1 0 0

t = time 1-S 3S 4S

$$K_{sp} = [\ Zr^{4+}]^3.\ [PO_4^{3-}]^4$$
$$K_{SP} = (3S)^3 \times (4S)^4$$
$$= 27 \times 4^4 \times S^7$$
$$K_{sp} = 6912S^7$$

68. The solubility product of $BaCl_2$ is 4×10^{-9}. Its solubility in mol/L is–

(a) 4×10^{-3} (b) 4×10^{-9}

(c) 1×10^{-3} (d) 1×10^{-9}

BCECE-2007

Ans. (c) : K_{sp} of $BaCl_2$ is 4×10^{-9}

$$BaCl_2 \rightleftharpoons Ba^{2+} + 2Cl^{-1}$$
$$K_{sp} = [Ba^{2+}][Cl^-]^2$$
$$= [x][2x]^2$$
$$K_{sp} = 4x^3$$
$$x^3 = \frac{K_{sp}}{4}$$
$$x = \sqrt[3]{\frac{K_{sp}}{4}} = \sqrt[3]{\frac{4\times10^{-9}}{4}}$$
$$x = 1\times10^{-3}$$

69. The principle involved in the classification of basic radicals, is :

(a) common ion effect (b) solubility product

(c) valency of radicals (d) strength of salt

BCECE-2006

Ans. (b) : Basic radicals have been classified into 6 groups on the Basis of the solubility products of their salt with group reagent The radicals have been grouped in the order increasing solubility product.

70. Some chemists at ISRO wished to prepare a saturated solution of a silver compound and they wanted it to have the highest concentration of silver ion possible. Which of the following compounds, would they use?

$$\mathbf{K_{sp}(AgCl) = 1.8\times10^{-10}}$$
$$\mathbf{K_{sp}(AgBr) = 5.0\times10^{-13}}$$
$$\mathbf{K_{sp}(Ag_2CrO_4) = 2.4\times10^{-12}}$$

(a) AgCl (b) AgBr

(c) Ag_2CrO_4 (d) None of these

BCECE-2006

@apna_pdf

Ans. (c) : For binary salts (like AgCl, AgBr)

$$s = \sqrt{K_{sp}}$$

$$\therefore \text{ Solubility of AgCl} = \sqrt{1.8\times10^{-10}}$$
$$= 1.35 \times 10^{-7} \text{ mol / L}$$

$$\text{Solubility of AgBr} = \sqrt{5.0\times10^{-13}}$$
$$= 7.1 \times 10^{-7} \text{ mol / L}$$

For, Ag_2CrO_4, $K_{sp} = 4s^3$

$$= \sqrt[3]{\frac{2.4\times10^{-12}}{4}}$$
$$= \sqrt[3]{600\times10^{-15}}$$
$$= 8.44 \times 10^{-5} \text{ mol / L}$$

71. The value of Λ^{∞}_{eq} for NH_4Cl, NaOH and NaCl are respectively, 149.74, 248.1 and 126.4 ohm^{-1} cm^{2}eq^{-1}. The value of Λ^{∞}_{eq} of NH_4OH is... Ω cm^2 eq^{-1}.

(a) 371.44
(b) 271.44
(c) 71.44
(d) Cannot be predicted from given data

BCECE-2008

Ans. (b) : Given, $\Lambda^{\infty}_{eq}(NH_4Cl) = 149.74$

$$\Lambda^{\infty}_{eq}(NaOH) = 248.1$$
$$\Lambda^{\infty}_{eq}(NaCl) = 126.4$$

Hence,

$$\Lambda^{\infty}_{eq}(NH_4OH) = \Lambda^{\infty}_{eq}(NH_4Cl) + \Lambda^{\infty}_{eq}(NaOH) - \Lambda^{\infty}_{eq}(NaCL)$$
$$= (149.74 + 248.1 - 126.4)$$
$$\Lambda^{\infty}_{eq}(NH_4OH) = 271.44 \text{ ohm}^{-1} \text{ cm}^2 \text{ eq}^{-1}$$

72. If x mol L^{-1} is the solubility of KA*l* $(SO_4)_2$ then K_{sp} is equal to–

(a) x^3 (b) $4x^4$
(c) x^4 (d) $4x^3$

BCECE-2011

Ans. (b) : $KAl(SO_4)_2 \rightleftharpoons K^+ + Al^{3+} + 2SO_4{}^{2-}$

$$\quad x \qquad\qquad x \quad\; x \qquad 2x$$

$$K_{sp} = [K^+][Al^{3+}][SO_4 2^-]^2$$
$$= x \times x \times (2x)^2$$
$$= x^2 \times 4x^2$$
$$K_{sp} = 4x^4$$

73. A saturated solution of Ag_2SO_4 is 2.5 × 10^{-2} M. The value of its solubility product is–

(a) 62.5 × 10^{-6} (b) 6.25 × 10^{-4}
(c) 15.625 × 10^{-6} (d) 3.125 × 10^{-6}

BCECE-2010

Ans. (a) : $[Ag_2SO_4] = 2.5\times10^{-2}$ m

$$Ag_2SO_4(s) \rightleftharpoons 2Ag^+ + SO_4{}^{2-}$$
$$\qquad\qquad [2S] \qquad [S]$$

Given , S = 2.5 × 10^{-2}

$$K_{sp} = [Ag^+]^2.[SO4^{2-}]$$
$$= [2S]^2 \quad [S]$$
$$= 4S^3$$
$$= 4 \times (2.5 \times 10^{-2})^3$$
$$K_{sp} = 62.5\times10^{-6} \text{ m}$$

74. Ionic product of water at 310K is 2.7×10^{-14}. What is the pH of neutral water at this temperature?

(a) 7.00 (b) 5.98
(c) 6.78 (d) 4.58

BCECE-2017

Ans. (c) : $K_w = [H^+][OH]$

$$2.7\times10^{-14} = [H^+].[OH^-]$$

As in neutral $[H^+] = [OH^-]$

$$[H^+] = \sqrt{2.7\times10^{-14}}$$
$$= 1.6432\times10^{-7}$$
$$pH = -\log[H^+]$$
$$= -\log(1.643\times10^{-7})$$
$$pH = 6.78$$

The pH of Natural water is 6.78

75. When H_2S is passed in acidic medium in solution having CuS and ZnS, only CuS is precipitated because

(a) $K_{sp}ZnS = K_{sp}CuS$
(b) $K_{sp}CuS << K_{sp}ZnS$
(c) $K_{sp}CuS >> K_{sp}ZnS$
(d) ZnS has lower melting point than CuS

BITSAT-2005

Ans. (b) : Precipitation of salt AB will occur when.

$$K_{sp}<[A^+][B^-]$$

ZnS is not precipitated by passing H_2S in acidic medium but CuS precipitated because by analysing above equation it is clear that

$$K_{sp}CuS << K_{sp}\,ZnS.$$

76. The K_{sp} of CuS, Ag_2S and HgS are 10^{-31}, 10^{-44} and 10^{-54} respectively. The solubility of these sulphides are in the order :

(a) Ag_2S > CuS > HgS (b) AgS > HgS > CuS
(c) HgS > Ag_2S > CuS (d) CuS > Ag_2S > HgS

BITSAT-2010

Ans. (a) :

- CuS $\Rightarrow S^2 = 10^{-37}$

$$S = 3.16\times10^{-19}$$

- $Ag_2S \Rightarrow 4S^3 = 10^{-44}$

$$S = 1.357\times10^{-15}$$

- $H_gS \Rightarrow S^2 = 10^{-54}$

$$S = 1\times10^{-27}$$

So, order of solubility is-
Ag_2S > CuS > HgS

77. For a sparingly soluble salt A_pB_q, the relationship of its solubility product Ls → K_{sp} with its solubility (S) is

(a) $Ls \rightarrow K_{sp} = S_{pq}(pq)_{p+q}$
(b) $Ls = S_{p+q}.p_p q_q$
(c) $Ls \rightarrow K_{sp} = S_{p+q}.p_q q_p$
(d) $Ls \rightarrow K_{sp} = s_{pq}.p_p.q_q$

BITSAT-2016

@apna_pdf

Ans. (b) : The dissociation equilibrium of a sparingly soluble salt say ($A_p B_q$) can be represented as follow.

$$A_pB_q \rightleftharpoons \underset{[S]}{pA^{+q}} + \underset{[S]}{qB^{p-}}$$

Let S be the solubility in mol/liter the expression for the solubility product will be as given below.

$$K_{sp} = [A^{+q}]^p.[B^{p-}]^q$$
$$= [p.S]^p.[q.S]^q$$
$$Ls \rightarrow K_{sp} = p^p.q^q(S)^{p+q}$$

78. If K_{sp} of Ag_2S is 10^{-17}, the solubility of Ag_2S in 0.1 M solution of Na_2S will be

(a) 10^{-8} (b) 5×10^{-9}
(c) 10^{-15} (d) 10^{-16}

CG PET-2009

Ans. (b) : $Ag_2\underset{\downarrow}{S} + Na_2\underset{\downarrow}{S}$

$$S^{2-} \longrightarrow \text{common ion}$$

$$\begin{array}{ccc} Na_2S \rightleftharpoons & 2Na^+ & + S^{2-} \\ S & 2S & S \\ 0.1m & 2\times0.1m & 0.1m \end{array}$$

$$\begin{array}{ccc} Ag_2S \rightleftharpoons & 2Ag^+ & + S^{2-} \\ x & 2x & 0.1 \end{array}$$

$$K_{sp} = [Ag^+]^2.\left[S^{2-}\right]$$
$$K_{sp} = [2x]^2\left[x\right]$$
$$K_{sp} = [4x]^2\left[10^{-1}\right]$$
$$10^{-17} = [4x^2].[10^{-1}]$$
$$4x^2 = \frac{10^{-17}}{10^{-1}} = 10^{-16}$$
$$x = \sqrt{\frac{10^{-16}}{4}}$$
$$x = \frac{1}{2}\sqrt{10^{-16}}$$
$$x = \frac{1}{2}\times10^{-8}$$
$$x = 5\times10^{-9}\,m$$

79. If solubility of $M(OH)_3$ is S, its solubility product will be:

(a) $108S^5$ (b) $27S^3$
(c) $4S^4$ (d) $27S^4$

CG PET -2019, 2013

Ans. (d) : $M(OH)_3$ is AB_3 Type salt its solubility product will be-

$$\begin{array}{ccc} M(OH)_3 \rightleftharpoons & M^{3+} & + 3OH^- \\ & S & 3S \end{array}$$

$$K_{sp} = [M^{3+}].[OH^-]^3$$
$$K_{sp} = [S].[3S]^3$$
$$K_{sp} = 27S^4$$

80. The product of H^+ and OH^- of water will be

(a) $K_w = 10^{-12}$ (b) $K_w = 10^{-14}$
(c) $K_w = 10^{-11}$ (d) $K_w = 10^{-10}$

CG PET -2006

Ans. (b) : The product of the molar concentration of H^+ and OH^- ion pure water or an aqueous solution at constant temperature is constant which is called the ionic product of water.

At 298K, For pure water

$$[H^+].[OH^-] = 1\times10^{-7}\,mol/dm^{-3}$$
$$K_w = [H^+][OH^-]$$
$$= [1\times10^{-7}].[1\times10^{-7}]$$
$$K_w = 1\times10^{-14}$$

81. Solubility product of pure $PbC1_2$ will be

(a) $K_{sp} = S^2$ (b) $K_{sp} = 4S^3$
(c) $K_{sp} = 108S^5$ (d) $K_{sp} = S$

CG PET -2006, BCECE-2003

Ans. (b) : Solubility product of pure $pbcl_2$ is -

$$\begin{array}{ccc} PbCl_2 \rightleftharpoons & Pb^{2+} & + 2Cl^- \\ & S & 2S \end{array}$$

$$k_{sp} = [Pb^{2+}][Cl^-]^2$$
$$= [S].[2S]^2$$
$$K_{sp} = 4S^3$$

82. Which of the following inert gas is soluble in water?

(a) He (b) Ne
(c) Ar (d) Xe

CG PET -2006

Ans. (d) : As the molecular weight of Noble gas atoms increases down the group its polarity increases due to which Van der Waals force between then increases. due to increased polarity of havier inert gas, its solubility in water also increases. so most soluble gas will be Xe and least soluble will be He.

83. A metal halide has molar concentration of 0.000011 mol/L in saturated state. If its K_{sp} = 39.5×10^{-20}, then the halide is

(a) M_2X_4 (b) MX_4
(c) M_2X_6 (d) MX_3

CG PET -2018

Ans. (d) : molar concentration

ie solubility (s) =0.000011mol/L

K_{sp}= 39.5× 10^{-20}

(a)

$$M_2X_4 \rightleftharpoons \underset{[2S]}{[2M^+]} + \underset{[4S]}{4X^-}$$
$$K_{sp} = [M^+]^2.[X^-]^4$$
$$K_{sp} = (2S)^2.(4S)^4$$
$$= 1024S^6$$
$$K_{sp} = 18.14\times10^{-26}$$

(b)

$$MX_4 \rightleftharpoons \underset{[S]}{M^+} + \underset{[4S]}{4X^-}$$
$$K_{sp} = [M^+].[X^-]^4$$
$$K_{sp} = [S].[4S]^4$$
$$= 256[S]^5$$
$$= 42.68\times10^{-24}$$

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(c) $$M_2X_6 \rightleftharpoons \underset{[2S]}{2M^+} + \underset{[6S]}{6X^-}$$

$$K_{sp} = [M^+]^2.[X^-]^6$$

$$K_{sp} = [2S]^2.[6S]^6$$

$$= 106624[S]^8$$

$$= 40 \times 10^{-36}$$

(d) $$MX_3 \rightleftharpoons \underset{[S]}{M^+} + \underset{[3S]}{3X^-}$$

$$K_{sp} = [M^+].[X^-]^3$$

$$K_{sp} = [S].[3S]^3$$

$$= 27[S]^4$$

$$= 39.5 \times 10^{-20}$$

Correct formula of metal halide is MX_3.

84. In which of the following solvents, AgBr will have the highest solubility?

(a) 10^{-3} M NaBr (b) 10^{-3} M NH_4OH

(c) Purewater (d) 10^{-3} M HBr

CG PET- 2010

Ans. (b) : AgBr will form soluble complex with NH_4OH, i.e. $[Ag(NH_3)_2]$ Br.

The key to this problem is something called the " common ion effect" In essence, the solubility of ionic solute is much lower is a solvent that already contains one the ions of the solute.

85. Solubility produces of A1 $(OH)_3$ and Zn $(OH)_2$ are 8.5×10^{-23} and 1.8×10^{-4} respectively. If both $A1^{3+}$ and Zn^{2+} ions are present in a solution, which one will be precipitated first on addition of NH_4OH?

(a) $A1(OH)_3$ (b) Zn $(OH)_2$

(c) Both (a) and (b) (d) None of these

CG PET- 2010

Ans. (a) : The value of solubility product for

$Al(OH)_3$ is 8.5×10^{-23}.

It is much lower than the value of the solubility product for $Zn(OH)_2$ Which is 1.8×10^{-14}.

Hence, when both Al^{3+} and Zn^{2+} ion are present in the solution and as NH_4OH is added, $Al(OH)_3$ will precipitate first as the solubility product of $Al(OH)_3$ is quite low.

Hence, its ionic product will exceed its solubility product of $Al(OH)_3$ is quite low.

Hence, its ionic product will exceed its solubility product at a very low concentration of OH^- ions.

86. The molar solubility of $Cd(OH)_2$ is 1.84×10^{-5} M in water. The molar solubility of $Cd(OH)_2$ is a buffer solution of pH = 12 is

(a) 1.84×10^{-9} M (b) $\frac{2.49}{1.84} \times 10^{-9}$ M

(c) 6.23×10^{-11} M (d) 2.49×10^{-10} M

JEE MAIN-2019

Ans. (d) : $$Cd(OH)_2 \rightleftharpoons \underset{[S]}{Cd^{2+}} + \underset{[2S]}{2OH^-}$$

Now,

$$K_{sp} = [Cd^{2+}].[OH^-]^2$$

$$= [S].[2S]^2$$

$$K_{sp} = 4(S)^3$$

$$= 4 \times (1.84 \times 10^{-5})^3$$

$$Cd(OH)_2 \rightleftharpoons \underset{[S]}{Cd^{+2}} + \underset{[10^{-2}+S']}{2OH^-}$$

$$S'(10^{-2} + 5')$$

$$= 10^{-2}$$

$$S' \times \left(10^{-2}\right)^2 = 4 \times \left(1.84 \times 10^{-5}\right)^3$$

$S' = 4 \times (1.84)^3 \times 10^{-11}$

$S' = 2.491 \times 10^{-10}$m

87. The solubility product of Cr $(OH)_3$ at 298 k is 6.0×10^{-31}. The concentration of hydroxide ions in a saturated solution of Cr $(OH)_3$ will be

(a) $(2.22 \times 10^{-31})^{1/4}$ (b) $(18 \times 10^{-31})^{1/4}$

(c) $(4.86 \times 10^{-29})^{1/4}$ (d) $(18 \times 10^{-31})^{1/2}$

[JEE Main 2020, 9 Jan Shift-II]

Ans. (b) : $$Cr(OH)_3 \rightleftharpoons \underset{S}{Cr^{3+}} + \underset{3S}{3OH^-}$$

$K_{sp} = [Cr^{3+}].[OH^-]^3$

$= [S].[3S]^3$

$K_{sp} = 27S^4$

$6 \times 10^{-31} = 27S^4$

$$S^4 = \frac{6 \times 10^{-31}}{27}$$

$$S = \left(\frac{6 \times 10^{-31}}{27}\right)^{1/4}$$

$[OH^-] = 3S$

$$[OH^-] = 3 \times \left(\frac{6 \times 10^{-31}}{27}\right)^{1/4}$$

$$[OH^-] = \left(18 \times 10^{-31}\right)^{1/4}$$

88. If solubility product of $Zr_3(PO_4)_4$ is denoted by K_{sp} and its molar solubility is denoted by S, then which of the following relation between S and K_{sp} is correct?

(a) $S = \left(\frac{K_{sp}}{144}\right)^{1/6}$ (b) $S = \left(\frac{K_{sp}}{6912}\right)^{1/7}$

(c) $S = \left(\frac{K_{sp}}{929}\right)^{1/9}$ (d) $S = \left(\frac{K_{sp}}{216}\right)^{1/7}$

[JEE Main 2019, 8 April Shift-I]

Ans. (b) : $$Zr_3(PO_4)_4(s) \rightleftharpoons \underset{[3S]}{3Zr^{4+}} + \underset{[4S]}{4PO_4^{3-}}$$

$K_{sp} = [Zr^{4+}]^3[PO_4^{3-}]^4$

$= [3S]^3.[4S]^4$

$$S = \left(\frac{K_{sp}}{6912}\right)^{1/7}$$

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89. What is the molar solubility of $Al(OH)_3$ in 0.2 M NaOH solution? Given that, solubility product of $Al(OH)_3 = 2.4\times10^{-24}$

(a) 3×10^{-19} (b) 12×10^{-21}

(c) 3×10^{-22} (d) 12×10^{-23}

[JEE Main 2019, 12 April Shift-I]

Ans. (c) : $Al(OH)_3 \rightleftharpoons \underset{[S]}{Al^{+3}} + \underset{[3S]}{3OH^-}$

$K_{sp} = [Al^{3+}].[OH^-]^3$

Now let S be solubility

$[OH^-] = 3(S) + 0.2m \approx 0.2m$

$K_{sp} = S \times (0.2)^3$

$2.4 \times 10^{-24} = S \times [0.2]^3$

$$S = \frac{2.4\times10^{-24}}{0.2\times0.2\times0.2}$$

$S = 3 \times 10^{-22}$ mol/L.

90. If K_{sp} of Ag_2CO_3 is 8×10^{-12}, the molar solubility of Ag_2CO_3 in 0.1M $AgNO_3$ is

(a) 8×10^{-12} M (b) 8×10^{-13} M

(c) 8×10^{-10} M (d) 8×10^{-11} M

[JEE Main 2019, 12 Jan Shift-II]

Ans. (c) : $Ag_2CO_3 \rightleftharpoons \underset{[S]}{2Ag^+} + \underset{[S]}{CO_3^{2-}}$

$K_{sp} = [Ag^+].[CO_3^{2-}]$

$\underset{0.1\,M}{AgNO_3} \rightleftharpoons \underset{0.1\,M}{Ag^+} + \underset{0.1\,M}{NO_3^-}$

Hence, total Ag^+ ion = [0.1 M + S]

[0.1 M >> S]

S is negligible.

$K_{sp} = [Ag^+].[CO_3^{2-}]$

$= [0.1 + S]^2.[S]$

$8 \times 10^{-12} = [0.1]^2.[S]$

$$S = \frac{8\times10^{-12}}{0.1 \times 0.1}$$

$S = 8 \times 10^{-10}$ M

91. An aqueous solution contains 0.10 M H_2S and 0.20 M HCI. If the equilibrium constants for the formation of HS^- from H_2S is 1.0×10^{-7} and that of S^{2-} from HS^- ions is 1.2×10^{-13} then the concentration of s^{2-} ions in aqueous solution is

(a) 5×10^{-8} (b) 3×10^{-20}

(c) 6×10^{-21} (d) 5×10^{-19}

[JEE Main-2018]

Ans. (b) : Formation of $H\bar{S}$ from $H_2\bar{S}$

$H_2S \rightleftharpoons H^+(aq) + HS^-(aq) --- (i)$

from of S^{2-} from H^{S-}

$HS^-aq \rightleftharpoons H^+(aq) + S^{2-}(aq) --- (ii)$

Where in- $Ka_1 = \dfrac{[H^+][HS^-]}{[H_2S]}$

$Ka_2 = \dfrac{[H^+].[S^{2-}]}{[HS^{-1}]}$

Add eq^n (i) & (2), we get -

$H_2S(aq) \rightleftharpoons 2H^+(aq) + S^{2-}(aq), K = Ka_1 \times Ka_2$

$$K = \frac{[H^+][HS^-]}{[H_2S]} \times \frac{[H^+][S^{2-}]}{[HS^-]}$$

$$K = \frac{[H^+]^2[S^{2-}]}{[H_2S]}$$

$= 10^{-7} \times 1.2\times10^{-13}$

$K = 1.2\times10^{-20}$

at. t = 0 0.10m, 0.20m

$$K = \frac{(0.2)^2(x)}{0.1}$$

$$1.2\times10^{-20} = \frac{0.2\times0.2\times x}{0.1}$$

$x = 3 \times 10^{-20}$

92. An aqueous solution contains an unknown concentration of Ba^{2+} When 50 mL of a 1 M solution of Na_2SO_4 is added, $BaSO_4$ just begins to precipitate. The final volume is 500 mL. The solubility product of $BaSO_4$ is 1×10^{-10}. What is the original concentration of Ba^{2+}?

(a) 5×10^{-9} M (b) 2×10^{-9} M

(c) 1.1×10^{-9} M (d) 1.0×10^{-10} M

[JEE Main-2018]

Ans.(c): Final concentration of $[SO_4^-] = \dfrac{50\times1}{500} = 0.1M$

K_{sp} of B_aSO_4

$[Ba^{2+}][SO_4^{2-}] = 1\times10^{-10}$

$[Ba^{2+}][0.1] = 1\times10^{-10}$

$$[Ba^{2+}] = \frac{10^{-10}}{0.1} = 10^{-9}\,M$$

Concentration of Ba^{2+} in final solution = 10^{-9}M

concentration of Ba^{2+} in original

In solution, $M_1.V_1 = M_2.V_2$

$M_1(500 - 50) = 10^{-9}(500)$

$$M_1 = \frac{500\times10^{-9}}{450}$$

$M_1 = 1.11\times 10^{-9}$M

93. The K_{sp} for $Cr(OH)_3$ is 1.6×10^{-30}. The molar solubility of this compound in water is

(a) $\sqrt[2]{1.6\times10^{-30}}$ (b) $\sqrt[4]{1.6\times10^{-30}}$

(c) $\sqrt[4]{\dfrac{1.6\times10^{-30}}{27}}$ (d) $\dfrac{1.6\times10^{-30}}{27}$

[AIEEE-2011]

Ans. (c) : Let's be the molar solubility of $Cr(OH)_3$ then,

$Cr(OH)_3 \rightleftharpoons \underset{S}{Cr^{3+}} + \underset{3S}{3OH^-}$

$K_{sp} = [Cr^{3+}].[OH^-]$

$K_{sp} = S \times (3S)^3$

$= 27S^4$

$$S = \sqrt[4]{\frac{K_{sp}}{27}}$$

$$S = \sqrt[4]{\frac{1.6\times10^{-30}}{27}}$$

94. Solubility product of silver bromide is 5.0×10^{-13}. The quantity of potassium bromide (molar mass taken as 120 g mol^{-1}) to be added to 1 L of 0.05 M solution of silver nitrate of start the precipitation of AgBr is

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(a) 1.2×10^{-10} g (b) 1.2×10^{-9} g
(c) 6.2×10^{-5} g (d) 5.0×10^{-8} g

AIEEE-2010

Ans. (b) : Given (AgBr) = 5×10^{-13},$[Ag^+] = 0.05$m
Molar mass of KBr = 120gmol^{-1}

$$Ag^+(aq) + Br^-(aq) = AgBr$$

Precipitation starts when ionic product just exceeds solubility product.

$K_{sp} = [Ag^+][Br^-]$ putting the valves -

$$\Rightarrow \quad [Br^-] = \frac{K_{sp}}{[Ag^+]} = \frac{5\times10^{-13}}{0.05} = 10^{-11}$$

Precipitation starts when 10^{-11} moles of KBr is added to $AgNO_3$ of $AgNO_3$ solution.
No. of moles of KBr to be added = 10^{-11}
Weight of KBr = no. of moles × molar mass.
Putting the valves.

$$= 10^{-11}\times120 = 1.2\times10^{-9}\text{g}$$

95. Solid Ba(NO_3) is gradually dissolved in a 1.0×10^{-4} MNa_2CO_3 solution. At what concentration of Ba^{2+} will a precipitate begin to form?
(K_{sp} for $BaCO_3 = 5.1\times10^{-9}$)

(a) 4.1×10^{-5} M (b) 5.1×10^{-5} M
(c) 8.1×10^{-8} M (d) 8.1×10^{-7} M

[AIEEE-2009]

Ans. (b) : according to situation -

$$\underset{1\times10^{-4}\text{m}}{Na_2CO_3} \longrightarrow 2Na^+ + CO_3^{2-}$$

For

$$Ba\,CO_3 \rightarrow Ba^{2+} + CO_3^{2-}$$
$$K_{sp} = [Ba^{2+}].[CO_3^{2-}]$$

Hence. $5.1\times10^{-9} = [Ba^{2+}]\,[1\times10^{-4}]$

$$[Ba^{2+}] = \frac{5.1\times10^{-9}}{1\times10^{-4}}$$

$Ba^{2+} = 5.1\times10^{-5}$m

96. In a saturated solution of the spatingly soluble strong electrolyte $AgIO_3$ (molecular mass = 283) the equilibrium which sets in is

$$AgIO_3\,(s) \rightleftharpoons Ag+(aq) + IO_3^-(aq)$$

If the solubility product constant K_{sp} of $AgIO_3$ at a given temperature is 1.0×10^{-8}, what is the mass of $AgIO_3$ contained in 100 mL of its saturated solution?

(a) 28.3×10^{-2} g (b) 28.3×10^{-4} g
(c) 1.0×10^{-7}g (d) 1.0×10^{-4} g

[AIEEE-2007]

Ans. (b) :

$$\underset{(s)}{AgIO_3} \rightleftharpoons \underset{0}{Ag^+(aq)} + \underset{0}{IO_3^-(aq)}$$
$$0 \qquad s \qquad s$$

(s = Solubility)

$$K_{sp} = x^x \times y^y \times s^{x+y}$$

x = no. of Ag^+ ions and
y = no of IO_3^- ions

$$K_{sp} = S^2 \Rightarrow S = \sqrt{K_{sp}} = \sqrt{10^{-8}} = 10^{-4}\text{M}$$

$$1000\,\text{mL} \rightarrow 10^{-4}\,\text{mL} = 10^{-4}\times283\,\text{g}$$

$$100\,\text{mL} \rightarrow \frac{10^{-4}\times283\times100}{1000} = 28.3\times10^{-4}\,\text{g}$$

97. The solubility product of a salt having general formula MX_2, in water is 4×10^{-12}. The concentration of M^{2+} ions in the aqueous solution of the salt is

(a) 4.0×10^{-10} M (b) 1.6×10^{-4} M
(c) 1.0×10^{-4} M (d) 2.0×10^{-6} M

[AIEEE-2004]

Ans. (c) : Solubility produt = 4×10^{-12}

$$MX_2 \rightleftharpoons \underset{[S]}{M^{2+}} + \underset{[2S]}{2M^-}$$

$$K_{sp} = [M^{2+}]\times[M^-]^2$$
$$K_{sp} = [S].[2S]^2$$
$$K_{sp} = 4S^3$$

The solubility of M^{2+} ion = S

$$S = \left(\frac{K_{sp}}{4}\right)^{1/3} = \left(\frac{4\times10^{-12}}{4}\right)^{1/3}$$

$$S = 1\times10^{-4}\text{ M}$$

98. The molar solubility (in Mol L^{-1}) of a sparingly soluble salt MX_4 is S. The corresponding solubility product is K_{sp}. S is given in terms of K_{sp} by the relation.

(a) $S = (K_{sp}/128)^{1/4}$ (b) $S = (K_{sp}\times128)^{1/4}$
(c) $S = (K_{sp}/256)^{1/5}$ (d) $S = (K_{sp}\times256)^{1/5}$

[AIEEE-2004]

Ans. (c) : The expression for the dissociation of the salt is, $MX_4 \rightleftharpoons \underset{[S]}{M^{4+}} + \underset{[4S]}{4X^-}$

The expression for the solubility product is

$$K_{sp} = [M^{4+}][X^-]^4$$
$$= [S].[4S]^4$$
$$= 256S^5$$

thus, the expression for solubility becomes

$$S^5 = \frac{K_{sp}}{256}$$

$$S = \left(\frac{K_{sp}}{256}\right)^{1/5}$$

99. The solubility in water of a sparingly soluble salt AB_2 is 1.0×10^{-5} mol L^{-1}. Its solubility product will be

(a) 4×10^{-15} (b) 4×10^{-10}
(c) 1×10^{-15} (d) 1×10^{-10}

[AIEEE-2003]

Ans. (a) : Solubility process is :-

$$\underset{1}{AB_2} \longrightarrow \underset{S}{A^{2+}} + \underset{2S}{2B^-}$$

using the relation of solubility and solubility product as:

$$K_{sp} = [A^{2+}][B^-]^2$$
$$K_{sp} = [S.][2S]^2$$

Substituting . $S = 10^{-5}$

$$K_{sp} = 10^{-5}\times(2\times10^{-5})^2$$
$$K_{sp} = 4\times10^{-15}$$

100. Solubility of $Ca(OH)_2$ is S mol L^{-1}. The solubility product (K_{sp}) under the same condition is

(a) $4S^3$ (b) $3S^4$
(c) $4S^2$ (d) S^3

[AIEEE-2002]

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Ans. (a) : $Ca(OH)_2 \rightleftharpoons Ca^{2+} + 2OH^-$

$K_{sp} = [Ca^{2+}].[OH^-]^2$

$= [S].[2S]^2$

$K_{sp} = [S].4S^2$

$K_{sp} = 4S^3$

101. If the solubiity product of AB_2 is 3.20×10^{-11} M^3, then the solubility of AB_2 in pure water is.......$\times10^{-4}$ Mol L^{-1}

[Assuming that neither kind of ion reacts with water]

[JEE Main-2020, 6 Sept Shift-II]

Ans. (2) : $AB_2 \rightleftharpoons \underset{[S]}{A^{2+}} + \underset{[2S]}{2B^-}$

$K_{sp} = [A^{2+}].[B^-]^2$

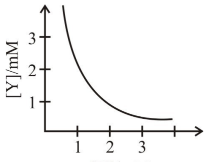
$= [S].[2S]^2$

$K_{sp} = 4S^3$

$$S = \left(\frac{K_{sp}}{4}\right)^{1/3} = \left(\frac{32\times10^{12}}{4}\right)^{1/3}$$

$K_{sp} = 2\times10^{-4}$Mol/liter

102. The stoichiometry and solubility product of a salt with the solubility curve given below is, respectively:



(a) X_2Y, 2×10^{-9} M^3
(b) XY, 2×10^{-6} M^3
(c) XY_2, 1×10^{-9} M^3
(d) XY_2, $4\times10^{-9}M^3$

[JEE Main 2020, 8 Jan Shift-I]

Ans. (d) : $[x] = 1\times10^{-3}$

$[y] = 2\times10^{-3}$

$XY_2 \rightleftharpoons \underset{10^{-3}}{X^{2+}} + \underset{2\times10^{-3}}{2Y^-}$

$K_{sp} = [X^{2+}][Y^-]^2$

$= [10^{-3}][2\times10^{-3}]^2$

$K_{sp} = 4\times10^{-9}$

Corresponding stoichiometry = $4\times10^{-9}M^3$

103. The molar solubility of $Zn(OH)_2$ in 0.1 M NaOH solution is x $\times10^{-18}$ M. The value of x is.......(Nearest integer)

(Given; The solubility product of Zn (OH), is 2 $\times 10^{-20}$)

[JEE Main 2021, 1 Sep Shift-II]

Ans. (2) : $Zn(OH)_2$ is dissolved in 0.1m of NaOH

$Zn(OH)_2(s) \rightleftharpoons \underset{(s)}{Zn^{2+}}(aq) + \underset{(0.1+2s)}{2OH^-}$

$Zn(OH)_2$ is less soluble, so, 2S is negligible compared to 0.1

$K_{sp} = [Zn^{2+}].[OH^-]^2$

$K_{sp} = [S].[0.1]^2$

$K_{sp} = [S].[10^{-2}]$

$2\times10^{-20} = S.10^{-2}$

$S = 2\times10^{-18}$ M

$= x\times10^{-18}$ M

So, x = 2

104. A_3B_2 is a sparingly soluble salt of molar mass M (g mol^{-1}) and solubility x g L^{-1}. The solubility product satisfies $K_{sp} = a\left(\frac{X}{M}\right)^5$. The value of a is ....(Integer answer)

[JEE Main 2021, 13 Aug Shift-I]

Ans. (a = 108) : $A_3B_2(s) \rightleftharpoons \underset{(3S)}{3A^{2+}} + \underset{(2S)}{2B^{-3}}$

$K_{sp} = [A^{2+}]^3[B^{-3}]^2$

$K_{sp} = (3S)^3(2S)^2$

$K_{sp} = 108S^5$ $S = \left(\frac{x}{m}\right)$

$$K_{sp} = 108\left(\frac{x}{m}\right)^5$$

given. $K_{sp} = a\left(\frac{x}{m}\right)^5$

a = 108

105. A solution is 0.1 M in Cl^- and 0.001 M in CrO_4^{2-}. Solid $AgNO_3$ is gradually added to it. Assuming that the addition does not change in volume and

K_{sp} (AgCl) = 1.7×10^{-10} M^2 and

K_{sp} (Ag_2CrO_4) = 1.9×10^{-12} M^3

Select correct statement from the following

(a) AgCl precipitates first because its K_{sp} is high.
(b) Ag_2CrO_4 precipitates first as its K_{sp} is low.
(c) Ag_2CrO_4 precipitates first because the amount of Ag^+ needed is low.
(d) AgCl will precipitate first as the amount of Ag^+ needed to precipitate is low

[JEE Main 2021, 20 July Shift-II]

Ans. (d) : Given data, $K_{sp} = 1.7\times10^{-10}$ M^2

$K_{sp}Ag_2CrO_4 = 1.9\times10^{-12}$ M^3

$[Cl^-] = 0.1$ M, $\left[CrO_4^{2-}\right] = 0.001M$

(i) $[Ag^+]$ required to precipitate AgCl(s)

$\therefore K_{sp} = I.P. = [Ag^+][Cl^-] = 1.7\times10^{-10}$

$$[Ag^+] = \frac{1.7\times10^{-10}}{0.1} = 1.7\times10^{-9}$$

(ii) $[Ag^+]$ required to precipitate $Ag_2CrO_4(s)$

$K_{sp} = I.P. = [Ag^+]^2[CrO_4^{-2}] = 1.9\times10^{-12}$

$[Ag^+] = 4.3\times10^{-5}$

$[Ag^+]$ required to precipitate AgCl is low. So, AgCl will precipitate 1st.

106. The solubility of $CdSO_4$ in water is 8.0×10^{-4} mol L^{-1}. Its solubility in 0.01M H_2SO_4 solution is.......$\times10^{-6}$ mol L^{-1}. (Round off to the nearest integer)

(Assume that, solubility is much less than 0.01 M)

[JEE Main 2021, 18 March Shift-II]

Ans. (64) : Given, Solubility of $CdSO_4$ = 8.0×10^{-4} mol/L^{-1}

Solubility of H_2SO_4 = ?

Solubility of $CdSO_4$ in pure water–

$CdSO_4 \rightleftharpoons \underset{S}{Cd^{2+}} + \underset{S}{SO_4^{2-}}$

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$$\therefore \quad K_{sp} = [Cd^{2+}][SO_4^{2-}]$$

$$K_{sp} = (S)^2$$

$$K_{sp} = (8 \times 10^{-4})^2$$

In H_2SO_4 solution,

$$\underset{0.01}{H_2SO_4} \rightleftharpoons \underset{2\times0.01}{2H^+} + \underset{0.01}{SO_4^{2-}}$$

$$CdSO_4 \rightleftharpoons \underset{S'}{Cd^{2+}} + \underset{S'+0.01\approx0.01}{SO_4^{2-}}$$

As, $S' << 0.01$

So, $S' + 0.01 \approx 0.01$

$$\therefore \quad K_{sp} = [Cd^{2+}][SO_4^{2-}]$$

$$64 \times 10^{-8} = S' \times 0.01$$

or $S' = 64 \times 10^{-6}$

Hence, the solubility of H_2SO_4 in 0.01 M solution is 64.

107. The oxygen dissolved in water exerts a partial pressure of 20 kPa in the vapour above water. The molar solubility of oxygen in water is ....×10^{-5} mol dm^{-3}.
(Round off the nearest integer). [Given, Henry's law constant (K_H) = 8.0 × 10^4 kPa for O_2, density of water with dissolved oxygen = 1.0 g dm^{-3}]

[JEE Main 2021, 17 March Shift-I]

Ans. (25) : Given, partial pressure = 20 kPa,
K_H = 8.0 × 10^4 kPa

As we know that partial pressure is directly proportional to the solubility.

Partial pressure = K_H × Solubility

Where, K_H = Henry constant

$$\therefore \quad 20 \times 10^3 = 8.0 \times 10^4 \times 10^3 \times \text{Solubility}$$

or $$\text{Solubility} = \frac{20}{8} \times 10^{-4}$$

$$\text{Solubility} = \frac{200}{8} \times 10^{-5}$$

Solubility = 25 × 10^{-5} mole dm^{-3}

108. Two Salts A_2X and MX have the same value of solubility product of 4.0 ×10^{-12}. The ratio of their molar solubilities i.e. $\frac{S(A_2X)}{S(MX)}$ = ...
(Round off to the nearest integer)

[JEE Main 2021, 16 March Shift-II]

Ans. (50) : Given,
Solubility product of A_2X = Solubility product of MX = 4.0 × 10^{-12}

For A_2X salt,

$$A_2X \rightleftharpoons \underset{2x}{2A^+(aq)} + \underset{x}{X^{2-}(aq)}$$

$$\therefore \quad K_{sp} = [A^+]^2[X^{-2}]$$

$$K_{sp} = (2x)^2(x)$$

$$K_{sp} = 4x^3$$

$$x = \left(\frac{K_{sp}}{4}\right)^{\frac{1}{3}}$$

$$x = \left(\frac{4\times10^{-12}}{4}\right)^{1/3}$$

$$x = 10^{-4}$$

or $S(A_2X) = 10^{-4}$

For MX Salt,

$$MX \rightleftharpoons \underset{y}{M^+} + \underset{y}{X^-}$$

$$K_{sp} = y^2$$

$$y = \sqrt{K_{sp}}$$

$$y = \sqrt{4\times10^{-12}}$$

$$y = 2\times10^{-6}$$

$$S(MX) = 2\times10^{-6}$$

Hence, $$\frac{S(A_2X)}{S(MX)} = \frac{10^{-4}}{2\times10^{-6}} = 50$$

109. The solubility of $Ca(OH)_2$ in water is [Given: The solubility product of $Ca(OH)_2$ in water = 5.5 ×10^{-6}]

(a) 1.11 ×10^{-2}
(b) 1.11×10^{-6}
(c) 1.77×10^{-2}
(d) 1.77×10^{-6}

[JEE Main 2021, 25 Feb Shift-II]

Ans. (a) : Given,
Solubility product of $Ca(OH)_2$ in water = 5.5 ×10^{-6}
Solubility of $Ca(OH)_2$ in water = ?

Now, $$Ca(OH)_2 \rightleftharpoons \underset{S}{Ca^{2+}} + \underset{2S}{2OH^-}$$

$$K_{sp} = [Ca^{2+}][OH^-]^2$$

$$5.5 \times10^{-6} = [S][2S]^2$$

$$5.5 \times10^{-6} = 4S^3$$

$$S^3 = \frac{5.5\times10^{-6}}{4}$$

$$S^3 = 1.375 \times10^{-6}$$

$$S = 1.11\times 10^{-2}$$

110. The solubility product of PbI_2 is 8.0×10^{-9}. The solubility of lead iodide in 0.1 molar solution of lead nitrate is x×10^{-6} mol/L. The value of x is........ (Rounded off to the nearest integer).
[Given, : $\sqrt{2} = 1.41$]

[JEE Main 2021, 24 Feb Shift-II]

Ans. (x = 141) : Given, K_{sp} of $PbCl_2$ = 8×10^{-9}

To calculate solubility of $PbCl_2$ in 0.1M solution of Pb $(NO_3)_2$.

(i) $$\underset{0.1m}{Pb(NO_3)(l)} \rightleftharpoons \underset{0.1m}{Pb^{2+}(aq)} + \underset{0.2m}{2NO_3\ (aq)}$$

(ii) $$PbI_2 \rightleftharpoons \underset{S}{Pb^{2+}}(aq) + \underset{2S}{2I^-}\ (aq)$$

total mole of $Pb^{2+} = S + 0.1 \approx 0.1$ ($\therefore S<<0.1$)

Now, $$K_{sp} = [Pb^{2+}] \times [I^-]^2$$

$$K_{sp} = [0.1]\,[2S]^2$$

$$K_{sp} = 0.1\times4S^2$$

$$S = \sqrt{\frac{K_{sp}}{0.1\times4}}$$

$$S = \sqrt{\frac{8\times10^{-9}}{0.1\times4}}$$

$$S = \sqrt{2}\times10^{-4}$$

$$S = 1.41\times10^{-4}$$

$$S = 141\times10^{-6}$$

Hence, the value of x is 141.

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111. The pH of a 0.1 molar solution of the acid HQ is 3. The value of the ionisation constant, K_a of the acid is

(a) 3×10^{-1} (b) 1×10^{-3}
(c) 1×10^{-5} (d) 1×10^{-7}

[AIEEE-2012]

Ans. (c) : Given, pH = 3

$\therefore$ $pH = -\log[H^+] \Rightarrow [H^+] = 10^{-3}$

Concentrastion of HQ = 0.1 molar, K_a = ?

Now, from ionzation of HQ - we get

$$\underset{\substack{0.1\\0.1-x}}{HQ} \rightleftharpoons \underset{\substack{0\\x}}{H^+} + \underset{\substack{0\\x}}{Q^-}$$

$$K_a = \frac{x \times x}{(0.1-x)}$$

$$K_a = \frac{x^2}{(0.1-x)} \qquad (\because 0.1 <<< x)$$

$$\therefore \quad K_a = \frac{(10^{-3})^2}{0.1}$$

$$K_a = \frac{10^{-6}}{0.1}$$

or $K_a = 1 \times 10^{-5}$

112. The first and second dissociation constants of an acid H_2A are 1.0×10^{-5} and 5.0×10^{-10}, respectively. The overall dissociation constant of the acid will be

(a) 5.0×10^{-5} (b) 5.0×10^{15}
(c) 5.0×10^{-15} (d) 0.2×10^{5}

[AIEEE-2007]

Ans. (c) : Given,

First dissociation constant of $H_2A(K_1) = 1.0 \times 10^{-5}$

Second dissociation constant of $H_2A(K_2) = 5 \times 10^{-10}$

Now, $H_2A \rightleftharpoons HA^- + H^+$

$$K_1 = \frac{[H^+][HA^-]}{[H_2A]} \qquad .....(i)$$

And, $HA^- \longrightarrow H^+ + A^{2-}$

$$K_2 = \frac{[H^+]^2[A^{-2}]}{[HA^-]} \qquad .....(ii)$$

Overall dissociation constant we get–

$K = K_1 \times K_2$

$K = 1 \times 10^{-5} \times 5 \times 10^{-10}$

$K = 5 \times 10^{-15}$

113. The correct equation relating solubility and solubility product for the sparingly soluble salt with the general molecular formula AB_2 is

(a) $S = [4K_{sp}]^{1/3}$ (b) $S = 2^{2/3}[K_{sp}]^{-1/3}$
(c) $S = [4K_{sp}]^{-1/3}$ (d) $S = 2^{-2/3}[K_{sp}]^{1/3}$

J & K CET-(2016)

Ans. (d) : The dissociation of AB_2 salt is–

$$AB_2 \rightleftharpoons \underset{S}{A^{2+}} + \underset{2S}{2B^-}$$

$$K_{sp} = [A^{2+}][B^-]^2$$

$$K_{sp} = (S)(2S)^2$$

$$K_{sp} = 4S^3$$

$$S = 1/2\sqrt{\frac{K_{sp}}{4}}$$

$$S = 2^{-2/3}\,(K_{sp})^{1/3}$$

114. The correct order of solubility of the sulphates of alkaline earth metals in water is

(a) Be > Ca > Mg > Ba > Sr
(b) Mg > Be > Ba > Ca > Sr
(c) Be > Mg > Ca > Sr > Ba
(d) Mg > Ca > Ba > Be > Sr

J & K CET-(2004)

Ans. (c) : Down the group the solutility of sulphates decreases So the sulphates of Be is more soluble and the sulphates of Ba is least soluble. So, the order of solubility of Sulfate is–

Be > Mg > Ca > Sr > Ba

115. If the solubility of a sparingly soluble salt AX_2 is s mol/lit., the solubility product is

(a) $4s^3$ (b) $8s^3$
(c) $4s^2$ (d) s^2

J & K CET-(2015)

Ans. (a) : The dissociation of AX_2 is given as–

$$AX_2 \rightleftharpoons \underset{s}{A^{2+}} + \underset{2s}{2X^-}$$

Now, $K_{sp} = [A^{2+}].[X^-]^2$

$= [s].[2s]^2$

$K_{sp} = 4s^3$

116. The solubility of $Fe(OH)_3$ is x mol L^{-1}. Its K_{sp} would be

(a) $9x^3$ (b) $3x^4$
(c) $27x^4$ (d) $9x^4$

J & K CET-(2013)

Ans. (c) : Given, solubility of $Fe(OH)_3$ = x mol L^{-1}

Now, $Fe(OH)_3 \rightleftharpoons Fe^{3+} + 3OH^-$

$$K_{sp} = \underset{[x]}{[Fe^{3+}]}.\underset{[3x]^3}{[OH^-]^3}$$

$K_{sp} = (x).(3x)^3$

$K_{sp} = 27x^4$

117. An aqueous solution contains Ni^{2+}, Co^{2+} and Pb^{2+} ions at equal concentrations. The solubility product of NiS, PbS and CoS in water at 25^0C are 1.4×10^{-24}, 3.4×10^{-28} and 3×10^{-26} respectively. Indicate which of these ions will be precipitated first and last when sulphide concentration is progressively increased from zero.

(a) NiS and PbS (b) NiS and CoS
(c) CoS and NiS (d) PbS and NiS

J & K CET-(2008)

Ans. (d) : For precipitation,

Ionic product > Solubility product

The metal sulfide with lowest K_{sp}(PbS) will precipitate out first because its ionic product will be exceed its K_{sp} and the metal sulfide with highest K_{sp}(NiS) will precipitate out at last.

118. Which of the following salts is most soluble?

(a) $Bi_2S_3(k_{sp} = 1 \times 10^{-17})$
(b) MnS $(K_{sp} = 7 \times 10^{-16})$
(c) CuS $(k_{sp} = 8 \times 10^{-37})$
(d) Ag_2S $(K_{sp} = 6 \times 10^{-51})$

J & K CET-(2003)

Ans. (b) : In all these compound the MnS is most soluble because its solubility product is maximum. The solubility product is a kind of equilibrium constant and

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its value depends on temperature. The solubility increases with an increase in K_{sp}. Solubility is stated as a property of a substance called solute to get dissolved in a solvent in order to form a solution.

119. Ostwald dilution law is applicable to
(a) strong electrolytes only
(b) weak electrolytes only
(c) non-electrolytes only
(d) strong as well as weak electrolytes

J & K CET-(2003)

Ans. (b) : Ostwald applied 'law of mass action' to ionic equilibrium. This is called as Ostwald's dilution law. This law is applicable only for weak electrolytes. According to Ostwald dilution law–

$$\underset{\substack{\text{Initially}\\ \text{At equi.}}}{}\ H_2O + \underset{\substack{C\\ C(1-\alpha)}}{HA} \rightleftharpoons \underset{\substack{0\\ C\alpha}}{A^-} + \underset{\substack{0\\ C\alpha}}{H_3O^+}$$

Where, α = degree of ionisation

$$\text{Dissociation constant } (K_a) = \frac{[A^-][H_3O^+]}{[HA]}$$

$$K_a = \frac{C^2\alpha^2}{C(1-\alpha)}$$

$$K_a = \frac{C\alpha^2}{(1-\alpha)} \quad (\because \text{ for weak electrolyte, } \alpha << 1)$$

$\therefore \quad K_a = C\alpha^2$

120. When HCl gas is passed through a saturated solution of NaCl (brine), then the solubility of NaCl
(a) increases (b) decreases
(c) remains same (d) none of these.

J & K CET-(2000)

Ans. (a) : If we take a saturated solution of sodium chloride and pass HCl gas through it, then sodium chloride is precipitated due to increased concentration of chloride ion available from the dissociation of HCl.
The common ion effect is also used for almost complete precipitation of a particular ion as its sparingly soluble salt, with very low value of solubility product for gravimetric estimation.

121. The solubility of CaF_2 in water is 1.30×10^{-5} mol L^{-1}. Its solubility product is
(a) 1.30×10^{-5} (b) 1.69×10^{-10}
(c) 2.20×10^{-15} (d) 8.80×10^{-15}

J & K CET-(1999)

Ans. (d) : Given, Solubility of $CaF_2(S) = 1.30 \times 10^{-5}$

$$\text{Now,} \quad CaF_2 \rightleftharpoons \underset{S}{Ca^{2+}} + \underset{2S}{2F^-}$$

$K_{sp} = [Ca^{2+}][F^-]^2$
$K_{sp} = (S).(2S)^2$
$K_{sp} = 4S^3$
$K_{sp} = 4 \times (1.3 \times 10^{-5})^3$
$K_{sp} = 8.8 \times 10^{-15}$

122. A solution contains 0.05 M NaCl and 0.05 M NaI. The concentration of iodied ion in solution when AgCl just starts precipitating is equal to (K_{sp} AgCl$=1\times10^{-10}$; K_{sp}AgI $= 4 \times 10^{-16}$)
(a) 4.0×10^{-8} M (b) 2.0×10^{-7} M
(c) 8.0×16^{-16} M (d) 2.0×10^{-8} M

J & K CET-(1999)

Ans. (b) : Given, K_{sp} AgCl$=1\times10^{-10}$, K_{sp}AgI $= 4 \times 10^{-16}$
The solution of AgI precipitated first because it has the less value of K_{sp} than the K_{sp} value of AgCl.

K_{sp}AgCl > K_{sp}AgI
$\therefore \quad K_{sp} = [Ag^+][Cl^-]$

$$\text{or} \quad [Ag^+] = \frac{1\times10^{-10}}{0.05} = 2\times10^{-9}\,M$$

And, $\quad K_{sp} = [Ag^+][I^-]$

$$\text{or} \quad [I^-] = \frac{4\times10^{-16}}{2\times10^{-9}} = 2\times10^{-7}\,M$$

123. The solubility product of $PbBr_2$ is 10.8×10^{-5}. It is 70% dissociated in saturated solution. The solubility of salt is:
(a) 4.18×10^{-2} (b) 6.76×10^{-3}
(c) 3.4×10^{-4} (d) 5.44×10^{-2}

JCECE - 2003

Ans. (a): Given, $K_{sp} = 10.8\times10^{-5}$

$$\text{Now,} \quad \underset{\substack{a\\ a-S}}{PbBr_2} \rightleftharpoons \underset{\substack{0\\ S}}{Pb^{2+}} + \underset{\substack{0\\ 2S}}{2Br^-}$$

$\therefore \quad K_{sp} = [Pb^{2+}][Br^-]^2$
$K_{sp} = (S)(2S)^2$
or $\quad 10.8 \times 10^{-5} = 4S^3$
or $\quad S = 3 \times 10^{-2}$

This is the solubility for the 100% dissociation. According to the question, we calculate for 70%.

$$\therefore \text{ For 70\% dissociation } (S) = \frac{100}{70} \times 3\times10^{-2}$$

$S \approx 4.28 \times 10^{-2}$

$$10\% \text{ dissociated} = \frac{70}{100} = .7$$

$$Pb\,Br_2 \rightleftharpoons \underset{.7S}{Pb^{2+}} + \underset{2\times.7S}{2Br^-}$$

$K_{sp} = [Pb^{2+}].[Br^-]^2$
$K_{sp} = [.7S].(2\times.7S)^2$
$10.8\times10^{-5} = (.7)^3.4S^3$
$S = 4.2 \times 10^{-2}$

124. A saturated solution of CaF_2 is 2×10^{-4} mol/L. Its solubility product constant is:
(a) 2.6×10^{-9} (b) 4×10^{-8}
(c) 8×10^{-12} (d) 3.2×10^{-11}

JCECE - 2005

Ans. (d) : Given, Saturated solution of $CaF_2(S) = 2\times10^{-4}$

$$\text{Now,} \quad CaF_2 \rightleftharpoons \underset{S}{Ca^{2+}} + \underset{2S}{2F^-}$$

$K_{sp} = [Ca^{2+}].[F^-]^2$
$= (S).(2S)^2$
$K_{sp} = 4S^3$
$K_{sp} = 4\times(2\times10^{-4})^3$
$K_{sp} = 3.2\times10^{-11}$

125. Solubility product of a salt AB is 1×10^{-8} M^2 in a solution in which the concentration of A^+ ions is 10^{-3} M. The salt will precipitate when the concentration of B^- ions is kept
(a) between 10^{-8} M to 10^{-7} M
(b) between 10^{-7} M to 10^{-8} M
(c) $> 10^{-5}$ M
(d) $< 10^{-8}$ M

JCECE - 2009

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Ans. (c) Given, $K_{sp}AB = 1\times 10^{-8}\ M^2$, $[A^+] = 10^{-3}$ M
The ionisation of AB salt is -

$$AB \rightleftharpoons A^+ + B^-$$
$$K_{sp} = [A^+][B^-]$$

Salt will precipitate if ionic concentration>K_{sp} therefore

$$[A^+][B^+] > 1\times10^{-8}$$
$$1\times10^{-3}[B^-] > 1\times10^{-8}$$
$$[B^-] > \frac{1\times10^{-8}}{1\times10^{-3}}$$
$$[B^-] > 1\times10^{-5}\ M$$

Hence, salt will precipitate when the concentration of B^- have the value greater than the 10^{-5}M.

126. The solubility product of Ag_2CrO_4 is 32×10^{-12}. What is the concentration of CrO_4^{2-} ions in that solution?
(a) 2×10^{-4} M (b) 16×10^{-4} M
(c) 8×10^{-4} M (d) 8×10^{-8} M

JCECE – 2015
MHT CET-2011

Ans. (a) : Given, $K_{sp} = 32\times10^{-12}$, $[CrO_4^{2-}] = ?$

Now, $\underset{S}{Ag_2CrO_4} \rightarrow \underset{2S}{2Ag^+} + \underset{S}{CrO_4^{2-}}$

$$K_{sp} = [Ag^+]^2.[CrO_4^{2-}]$$
$$K_{sp} = (2S)^2 \times S$$
$$\therefore \quad K_{sp} = 4S^3$$
$$\text{or} \quad S = \left(\frac{K_{sp}}{4}\right)^{1/3} = \left(\frac{32\times10^{-12}}{4}\right)^{1/3}$$
$$S = 2 \times 10^{-4}\ M$$

127. The solubility product of Hg_2I_2 is equal to
(a) $[Hg_2^{2+}]\ [I^-]$ (b) $[Hg^{2+}]\ [I^-]$
(c) $[Hg_2^{2+}]\ [I^-]^2$ (d) $[Hg^{2+}]\ [I^-]^2$

JIPMER-2012

Ans. (c) For Hg_2I_2,

$$Hg_2I_2 \rightleftharpoons Hg_2^{\ 2+} + 2I^-$$

Let, the solubility product be K_{sp}

$$\therefore \quad K_{sp} = [Hg_2^{2+}].[I^-]^2$$

128. The expression for the solubility product of Ag_2CO_3 will be
(a) $K_{sp}=s^2$ (b) $K_{sp}=4s^3$
(c) $K_{sp}=27s^4$ (d) $K_{sp}=s$

JIPMER-2011

Ans. (b) : Let, K_{sp} be the solubility product of Ag_2CO_3. the ionisation of Ag_2CO_3 is -

$$Ag_2CO_3 \rightleftharpoons \underset{2S}{2Ag^+} + \underset{S}{CO_3^{\ 2-}}$$
$$K_{sp} = [Ag^+]^2.[CO_3^{\ 2-}]$$
$$K_{sp} = (2s)^2\ (s)$$
$$K_{sp} = (4s^2).(s)$$
$$K_{sp} = 4s^3$$

129. The solubility of saturated solution of $Ag_2\ CrO_4$ is s mol L^{-1}. What is its solubility product?
(a) $4s^3$ (b) s^3
(c) $2s^3$ (d) $16s^2$

JIPMER-2010

Ans. (a): Given, solubility of Ag_2CrO_4 = s mol L^{-1}
K_{sp} = ?

Now, $Ag_2CrO_4 \rightleftharpoons \underset{2s}{2Ag^+} + \underset{s}{CrO_4^{2-}}$

$$K_{sp} = [Ag^+]^2.[CrO_4^{2-}]$$
$$K_{sp} = (2s)^2 \times s$$
$$K_{sp} = 4s^3$$

130. A 0.1 aqueous solution of a weak acid is 2% ionised. If the ionic product of water is 1×10^{-4}, the $[OH^-]$ is
(a) 5×10^{-12}M (b) 2×10^{-3}M
(c) 1×10^{-14}M (d) None of these

JIPMER-2009

Ans. (a) : Degree of dissociation of weak acid -

$$\alpha = \frac{2}{100} = 0.02$$

Concentration product of water = 1×10^{-14}

$$[H^+].[OH^-] = 1\times10^{-14}$$
$$[OH^-] = \frac{1\times10^{-14}}{0.002}$$
$$[OH^-] = 5\times10^{-12}$$

131. Solubility product of $PbCl_2$ at 298 K is 1×10^{-6}, at this temperature solubility of $PbCl_2$ in mol/L is
(a) $(1 \times 10^{-6})^{1/2}$ (b) $(1 \times 10^{-6})^{1/3}$
(c) $(0.25 \times 10^{-6})^{1/3}$ (d) $(2.5 \times 10^{-6})^{1/2}$

JIPMER-2008
JCECE - 2007

Ans. (c) : Given, Solubility product of $PbCl_2 = 1\times10^{-6}$
S = ?

$$PbCl_2 \rightleftharpoons \underset{S}{Pb^{2+}} + \underset{2S}{2Cl^-}$$
$$K_{sp} = [Pb^{2+}][Cl^-]^2$$
$$K_{sp} = [S]\ [2S]^2$$
$$K_{sp} = 4S^3$$
$$1\times10^{-6} = 4S^3$$
$$S^3 = \frac{1\times10^{-6}}{4}$$
$$S = (.25\times10^{-6})^{1/3}$$
$$S = (0.25\times 10^{-6})^{1/3}$$

132. Solubility of AgCl is least in
(a) 0.1 M NaCl (b) pure water
(c) 0.1 M $BaCl_2$ (d) 0.1 M $AlCl_3$

Karnataka-CET-2019

Ans. (d) : The common ion effect of the chloride ion supresses the dissociation and hence, the solubility of AgCl is least.
This effect is the most pronounced in 0.1M $AlCl_3$ as it has the most Cl^- ion.

133. Conductivity of a saturated solution of a sparingly soluble salt AB at 298 K is 1.85×10^{-6} Sm^{-1}. Solubility product of the salt AB at 298 K is
Given, $\Lambda^o_m(AB) = 140\times10^{-4}\ Sm^2mol^{-1}$

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(a) 5.7×10^{-12} (b) 1.32×10^{-12}
(c) 7.5×10^{-12} (d) 1.74×10^{-12}

Karnataka-CET-2014

Ans. (d) :
Given, Conductivity of a saturated solution (κ) = 1.85×10^{-6}

$$\Lambda_m^o = 14 \times 10^{-3}\ \text{Sm}^2\text{mol}^{-1}$$

Now, $K_{sp} = ?$

$$K_{sp} = \left(\frac{K\times10^3}{\Lambda_m^o}\right)^2$$

$$K_{sp} = \left(\frac{1.85\times10^{-5}\times10^{-3}}{14\times10^{-3}}\right)^2$$

$$K_{sp} = (0.1321\times10^{-5})^2$$
$$K_{sp} = 0.01745 \times 10^{-10}$$
$$K_{sp} = 1.745 \times 10^{-12}$$

134. H_2S is passed into one nm^3 of a solution containing 0.1 mole of Zn^{2+} and 0.01 mole of Cu^{2+} till the sulphide ion concentration reaches to 8.1×10^{-19} moles. Which one of the following statements is true?
[K_{sp} of ZnS and CuS are 3×10^{-22} and 8×10^{-36} respectively.]

(a) Only ZnS precipitates
(b) Both CuS and ZnS precipitate
(c) Only CuS precipitates
(d) No precipitation occurs

Karnataka-CET-2011

Ans. (b) : The ionic product for ZnS ($0.1 \times 8.1 \times 10^{-19}$) and for CuS ($0.01 \times 8.1 \times 10^{-19}$) exceeds their K_{sp} values. Precipitation of occurs only when ionic product exceeds the value of solubility product. Hence, both CuS and ZnS precipitated.

135. 1 dm^3 solution containing 10^{-5} moles each of Cl^- ions and CrO_4^{2-} ions is treated with 10^{-4} moles of silver nitrate. Which one of the following observations is made?
[K_{sp} of $Ag_2CrO_4 = 4 \times 10^{-12}$]
[K_{sp} of AgCl = 1×10^{-10}]

(a) Precipitation does not occur
(b) Silver chromate gets precipitated first
(c) Silver chloride gets precipitated first
(d) Both silver chromate and silver chloride start precipitating simultaneously

Karnataka-CET, 2009

Ans. (c) : It is very well to know that when the value of ionic product is greater then the compounds precipitated first.
For precipitation–
Ionic product > Solubility product (K_{sp})
For, Ag_2CrO_4

$$\text{Ionic product} = [Ag^+]^2[CrO_4^{2-}]$$
$$= (10^{-4})^2(10^{-5}) = 10^{-13}$$

K_{sp} of $Ag_2CrO_4 = 4 \times 10^{-12}$
Hence, K_{sp} > I.P.
Thus, no precipitate is obtained.
For, AgCl,

$$\text{Ionic product} = [Ag^+][Cl^-]$$
$$= [10^{-4}][10^{-5}]$$
$$= 10^{-9}$$

$K_{sp}AgCl = 1 \times 10^{-10}$
Here, I.P. > K_{sp}
So, precipitate will form.
Thus, silver chloride gets precipitated first.

136. Choose the correct statement.

(a) K_H value is same for a gas in any solution.
(b) Higher the K_H value more the solubility of gas.
(c) K_H value increases on increasing the temperature of the solution.
(d) Easily liquefiable gases usually has lesser K_H values.

Karnataka-CET-2021

Ans. (c) : According to the mathematical expression of Henry's law–

$$p \propto x$$
$$p = K_H.x$$

Where, p = Partial pressure of the gas
K_H = Henry's law constant of the gas
x = Mole fraction of gas.

K_H depends only on the nature of gas, nature of liquid and temperature. As temperature increases, K_H increases.

137. The K_H value (K bar) of Argon (I). carbondioxide (II), formaldehyde (III) and methane (IV) are respectively 40.3, 167, 1.83 $\times10^{-5}$ and 0.413 at 298 K. The increasing order of solubility of gas in liquid is

(a) I<II<IV<III (b) III<IV<II<I
(c) I<III<II<IV (d) I<IV<II<III

Karnataka-CET-2021

Ans. (a) : Higher the value of the K_H, the lower is the solubility of gas in liquid. Hence, the order of increasing solubility will be–

$$Ar < CO_2 < CH_4 < HCHO$$

138. Henry's law constant for the solubility of N_2 gas in water at 298K is 1.0×10^5 atm. The mole fraction of N_2 in air is 0.8. The number of moles of N_2 from air dissolved in 10 moles of water at 298 K and 5 atm pressure is

(a) 4.0×10^{-4} (b) 4.0×10^{-5}
(c) 5.0×10^{-4} (d) 4.0×10^{-6}

Karnataka-CET-2021

Ans. (a) : Given,
Henry's law of constant (K_H) = 1.0×10^5 atm, $X_{N_2} = 0.8$

$$p_{N_2} = \text{Total pressure} \times \text{Mole fraction}$$
$$= 5\times 0.8 = 4\ \text{atm}$$

From Henry's law-

$$p_{N_2} = K_H . X_{N_2}$$

$$X_{N_2} = \frac{4}{1\times10^5} = 4\times10^{-5}$$

$\because$ 1 mole of X_{N_2} contains = 4×10^{-5}
$\therefore$ 10 mole of X_{N_2} contains = $4 \times 10^{-5} \times 10 = 4 \times 10^{-4}$

139. For which of the following sparingly soluble salt, the solubility (s) and solubility product (K_{sp}) are related by the expression s = $(K_{sp}/4)^{1/3}$?

@apna_pdf

(a) $BaSO_4$ (b) $Ca_3(PO_4)_2$
(c) Hg_2Cl_2 (d) Ag_3PO_4
(e) CuS

Kerala-CEE-2006

Ans. (c) : (3) $Hg_2Cl_2 \rightleftharpoons \underset{S}{Hg_2^{2+}} + \underset{2S}{2Cl^-}$

$$K_{sp} = [Hg_2^{2-}].[Cl^-]^2$$
$$K_{sp} = (S).(2S)^2$$
$$K_{sp} = 4S^3$$
$$S = \sqrt[3]{\frac{K_{sp}}{4}}$$

(2) $Ca_3(PO_4)_2$

$$Ca_3(PO_4)_2 \rightleftharpoons \underset{3S}{3Ca^{2+}} + \underset{2S}{2PO_4^{3-}}$$
$$K_{sp} = [Ca^{2+}]^3.[PO_4^{3-}]^2$$
$$K_{sp} = (3S)^3\,(2S)^3$$
$$K_{sp} = 108S^5$$
$$S = \left(\frac{K_{sp}}{108}\right)^{1/5}$$

(1) $BaSO_4$

The ionisation of $BaSO_4$ is–

$$BaSO_4 \rightleftharpoons \underset{S}{Ba^{2+}} + \underset{S}{SO_4^{2-}}$$
$$K_{sp} = [Ba^{2+}]\,.\,[SO_4^{-2}]$$
$$K_{sp} = S.S$$
$$K_{sp} = S^2$$
$$S = \sqrt{K_{sp}}$$

(4) $Ag_3PO_4 \rightleftharpoons 3Ag^+ + PO_4^{3-}$

$$K_{sp} = [Ag^+]^3.[PO_4^{3-}]$$
$$K_{sp} = (3S)^3(S)$$
$$K_{sp} = 27S^4$$
$$S = \sqrt[4]{\frac{K_{sp}}{27}}$$

(5) $CuS \rightleftharpoons \underset{S}{Cu^{2+}} + \underset{S}{S^{2-}}$

$$K_{sp} = [Cu^{2+}]\,[S^{2-}]$$
$$K_{sp} = (S)(S)$$
$$K_{sp} = S^2$$
$$S = \sqrt{K_{sp}}$$

The solubility product and solubility of Hg_2Cl_2 has the relation :

$$S = \left(\frac{K_{sp}}{4}\right)^{1/3}$$

140. The solubility product (K_{sp}) of the following compounds are given at 25°C

Compounds	**K_{sp}**
AgCl	**1.1×10^{-10}**
AgI	**1.0×10^{-16}**
$PbCrO_4$	**4.0×10^{-14}**
Ag_2CO_3	**8.0×10^{-12}**

The most soluble and least soluble compounds are

(a) AgCl and $PbCrO_4$
(b) AgI and Ag_2CO_3
(c) AgCl and Ag_2CO_3
(d) Ag_2CO_3 and AgI
(e) Ag_2CO_3 and $PbCrO_4$

Kerala-CEE-2011

Ans. (d) : The salt AgCl, AgI, $PbCrO_4$ are of example of AB type salt.

Now, $AB \rightarrow \underset{S}{A^+} + \underset{S}{B^-}$

$\therefore$ $K_{sp} = [A^+]\,[B^-]$

$K_{sp} = S \times S$

or $S^2 = K_{sp}$

$S = \sqrt{K_{sp}}$

Solubility of AgCl $= \sqrt{K_{sp}}$

$= \sqrt{1\times10^{-10}} = 1\times10^{-5}$

Solubility of AgI $= \sqrt{K_{sp}}$

$= \sqrt{1\times10^{-16}} = 1\times10^{-8}$

Solubility of $PbCrO_4$ $= \sqrt{K_{sp}}$

$= \sqrt{4\times10^{-4}} = 2\times10^{-7}$

For Ag_2CO_3 –

$Ag_2CO_3 \rightarrow 2Ag^+ + CO_3^{2-}$

$\therefore$ $K_{sp} = [Ag^+]^2\,[CO_3^{2-}]$

$K_{sp} = (2S)^2\,(S)$

or $K_{sp} = 4S^3$

or $S^3 = \frac{K_{sp}}{4}$

$S^3 = \frac{8\times10^{-12}}{4}$

$S^3 = 2 \times 10^{-12}$

Hence, the most soluble salt are Ag_2CO_3 and least soluble salt are AgI because K_{sp} of Ag_2CO_3 is highest and K_{sp} of AgI is lowest.

141. The pH of a saturated solution of a metal hydroxide of formula $X(OH)_2$ is 12.0 at 298 K. What is the solubility product of a metal hydroxide at 298 K (in mol^3 L^{-3})?

(a) 2×10^{-6} (b) 1×10^{-7}
(c) 5×10^{-5} (d) 2×10^{-5}
(e) 5×10^{-7}

Kerala-CEE-2014

Ans. (e) : Give pH = 12

$[H^+] = 1\times10^{-pH} = 1\times10^{-12}$

$= 1 \times 10^{-12}$

We know that

$[H^+][OH^-] = k_w = 1\times10^{-14}$

$$[OH^-] = \frac{1\times10^{-14}}{[H^+]}$$
$$= \frac{1\times10^{-14}}{1\times10^{-12}} = 1\times10^{-2}$$
$$X(OH)_2 \longrightarrow \underset{x}{X^{2+}} + \underset{2x}{2OH^-}$$

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$$X^{2+} = \frac{[OH^-]}{2} = \frac{1\times10^{-2}}{2} = 5\times10^{-3}$$

$K_{sp} = [X^{2+}].[2OH^-]^2$
$= (5\times10^{-3}).(1\times10^{-2})^2$
$= (5\times10^{-3}).(1\times10^{-4})$
$= 5\times10^{-7} mol^3L^{-3}$

142. If the ionic product of $M(OH)_2$ is 5×10^{-10} then the molar solubility of $M(OH)_2$ in 0.1 M NaOH is

(a) 5×10^{-12} M (b) 5×10^{-8} M
(c) 5×10^{-10} M (d) 5×10^{-9} M
(e) 5×10^{-16} M

Kerala-CEE-2015

Ans. (b) :

K_{sp} of $M(OH)_2$ is $= 5\times10^{-10}$M
$[OH^-] = 10^{-1}$

$$M(OH)_2 \rightleftharpoons [M^{2+}].\ [OH^-]^2$$
$$5\times10^{-10} \qquad [S] \qquad [10^{-1}]^2$$

$$S = \frac{5\times10^{-10}}{10^{-2}}$$

$$S = 5\times10^{-8}$$

Hence, molar solubility = 5×10^{-8} M

143. Solubility product (k_{sp}) of saturated $PbCl_2$ in water is 1.8×10^{-4} mol^3 dm^{-9}. What is the concentration of Pb^{2+} in the solution?

(a) $(0.45\times10^{-4})^{1/3}$ mol dm^{-3}
(b) $(1.8\times10^{-4})^{1/3}$mol dm^{-3}
(c) $(0.9\times10^{-4})^{1/3}$mol dm^{-3}
(d) $(2.0\times10^{-4})^{1/3}$ mol dm^{-3}
(e) $(2.45\times10^{-4})^{1/3}$ mol dm^{-3}

Kerala-CEE-2017

Ans. (a) : Given - $K_{sp}=1.8\times10^{-4}mol^3dm^{-9}$
For the reaction of the AB_2 ie ($PbCl_2$)

$K_{sp} = [Pb^{2+}][Cl^-]^2$
$= [S] \quad [2S]^2$
$K_{sp} = 4S^3$

$$S = \left(\frac{K_{sp}}{4}\right)^{1/3}$$

Solubility of Pb^{2+} ion will be

$$\therefore\ S = \left[\frac{1.8\times10^{-4}}{4}\right]^{1/3}$$

$S = (0.45\times10^{-4})^{1/3}$ mol.dm^{-3}

144. Consider the electrochemical reaction between Ag (s) and Cl_2 (g) electrodes in 1 L of 0.1 M KCl aqueous solution. Solubility product of AgCl is 1.8×10^{-10} and F = 96500 C/mol. At $1 \geq 10^{-6}$ A current, calculate the time required to start observing the AgCl precipitation in the galvanic cell

(a) 173 s (b) 346 s
(c) 125×10^6 s (d) 1.25×10^5 s
(e) 101 s

Kerala-CEE-2018

Ans. (a) : Given, $K_{sp} = 1.8\times10^{-10}$,$[Cl^-]$=0.1M
The electrochemical reaction between.

Ag(S) and Cl_2 (g) is as fallows-

$$AgCl \rightleftharpoons Ag^+ + Cl^-$$

$$\because K_{sp} = [Ag^+].[Cl^-]$$
$$1.8\times10^{-10} = [Ag^+]\times0.1$$
$$\because [Ag^+] = \frac{1.8\times10^{-10}}{0.1}$$

$\because$ 1L of solution contain's
1.8×10^{-9}moles of Ag^+
Quantity of electricity required
$= 1.8\times10^{-9}\times96500$
$= 1.73\times10^{-4}$C

$$\text{time requried (t)} = \left(\frac{1.73\times10^{-4}}{1\times10^{-6}}\right)$$

t = 173s

145. The solubility CaF_2 is s moles/litre. Then solubility product is :

(a) s^2 (b) $4s^3$
(c) $3s^2$ (d) s^3

Manipal-2019

Ans. (b) : $CaF_2 \rightleftharpoons \underset{[s]}{Ca^{2+}} + \underset{[2s]}{2F^-}$

$$K_{sp}\text{for } CaF_2 = [Ca^{2+}].[F^-]^2$$

$K_{sp} = [s].[2s]^2$
$K_{sp} = 4s^3$

146. The solubility product of $Al_2(SO_4)_3$ is given by the expression :

(a) $[Al^{3+}]\ [SO_4^{2-}]$ (b) $[Al^{3+}]^2\ [SO_4^{2-}]$
(c) $[Al^{3+}]^3\ [SO_4^{2-}]^2$ (d) $[Al^{3+}]^2\ [SO_4^{2-}]^3$

Manipal-2018

Ans. (d) : Find K_{sp} of.

$Al_2(SO_4)_3$ -

$$Al_2(SO4)_3 \rightleftharpoons 2Al^{3+} + 3SO_4^{2-}$$
$$K_{sp} = [Al^{3+}]^2[SO_4^{2-}]^3$$

147. Which among the following salts, solubility decreases with increase in temperature?

(a) Na_2SO_4 (b) NaBr
(c) NaCl (d) KCl

MHT CET-03.05.2019, SHIFT-I

Ans. (a) : For Na_2SO_4 salt, Solubility decreases with Increase in temperature because reaction of Na_2SO_4 with water is an exothermic reaction.
As a result solubility decreases.
For NaBr, NaCl, KCl the dissolution process i.e. endothermic

148. Solubility of which among the following solids in water changes slightly with temperature?

(a) KNO_3 (b) $NaNO_3$
(c) KBr (d) NaBr

MHT CET-2017

Ans. (d) : The solubility of NaBr changes slightly with temperature.

149. Solubility of $Ca(OH)_2$ is s mol L^{-1} . The solubility product (K_{sp}) under the same condition is

(a) $4s^3$ (b) $3s^4$
(c) $4s^2$ (d) s^3

MHT CET-2008

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Ans. (a) : $Ca(OH)_2 \rightleftharpoons \underset{[s]}{Ca^{2+}} + \underset{[2s]}{2OH^-}$

So, solubility product $(K_{sp}) = [Ca^{2+}]\,[OH^-]^2$

$= (s)\,(2s)^2$

$= 4s^3$

150. The solubility of AgCl is 1×10^{-5} mol/L. Its solubility in 0.1 molar sodium chloride solution is

(a) 1×10^{-10} (b) 1×10^{-5}

(c) 1×10^{-9} (d) 1×10^{-4}

MHT CET-2007

Ans. (c) : $AgCl \rightleftharpoons \underset{[S]}{Ag^+} + \underset{[S]}{Cl^-}$

$K_{sp} = [Ag^+][Cl^-]$

$K_{sp} = S^2$

$S = 1\times10^{-5}$

$K_{sp} = (1\times10^{-5})^2 = 1\times10^{-10}$

suppose its solubility in 0.1m NaCl is x mol/L

$AgCl \rightleftharpoons \underset{x}{Ag^+} + \underset{x}{Cl^-}$

$NaCl \rightleftharpoons \underset{0.1m}{Na^+} + \underset{0.1m}{Cl^-}$

K_{sp} of AgCl $= [Ag^+][Cl^-]$

$= [x].\,[x+0.1]$

$1\times10^{-10} = x^2 + 0.1x$

higher power of x are neglected

$0.1x = 1\times10^{-10}$

$$x = \frac{1\times10^{-10}}{0.1}$$

$x = 1\times10^{-9}$

151. In qualitative analysis the metals of group 1 can be separated from other ions by precipitating them as chloride salts. A solutions initially contains Ag^+ and Pb^{2+} at a concentration of 0.10 M. Aqueous HCl is added to this solution until the Cl^- concentrations of Ag^+ and Pb^{2+} be at equilibrium ?

(K_{sp} for AgCl $= 1.8\times10^{-10}$, K_{sp} for $PbCl_2$ $=1.7\times10^{-5}$)

(a) $[Ag^+] = 1.8\times10^{-7}$ M, $[Pb^{2+}] = 1.7\times10^{-6}$ M

(b) $[Ag^+] = 1.8\times10^{-11}$ M, $[Pb^{2+}] = 8.5\times10^{-5}$ M

(c) $[Ag^+] = 1.8\times10^{-9}$ M, $[Pb^{2+}] = 1.7\times10^{-3}$ M

(d) $[Ag^+] = 1.8\times10^{-11}$ M, $[Pb^{2+}] = 1.7\times10^{-4}$ M

NEET-Mains 2011

Ans. (c) : $[Ag^+][Cl^-] = 1.8\times10^{-10}$

$$[Ag^+] = \frac{1.8\times10^{-10}}{0.1} = 1.8\times10^{-9}$$

$Ag^+ = 1.8\times10^{-9}$ M

$[Pb^{2+}].\,[Cl^-]^2 = 1.7\times10^{-5}$

$$Pb^{2+} = \frac{1.7\times10^{-5}}{0.1\times0.1}$$

$Pb^{2+} = 1.7\times10^{-3}$ M

152. H_2S gas when passed through a solutions if cations containing HCl precipitates the cations of second group of qualitative analysis but not those belonging to the fourth group. It is because

(a) Presence of HCl decreases the sulphate ion concentration

(b) Solubility product of group II sulphate is more than that of group IV sulphate

(c) Presence of HCl increase the suphate ion concentration

(d) Sulphate of group IV cations are unstable in HCl

NEET-2005

Ans. (a) : H_2S gas is passed in presence of HCl, in qualitative analysis of cation of second group, Therefor, due to common ion effect, lower concentration of sulphide ion is obtained which is sufficient for the precipitation of second group cation in form of their sulphides due to lower value of their solubility product (K_{sp}).

in presence of HCl decreases the sulphate ion concentration.

153. The solubility product of a sparingly soluble salt AX_2 is 3.2×10^{-11}. Its solubility (in moles L) is

(a) 5.6×10^{-6} (b) 3.1×10^{-4}

(c) 2×10^{-4} (d) 4×10^{-4}

NEET-2004

Ans. (c) : AX_2 is ionised as follow -

$AX_2 \rightleftharpoons A^{2+} + 2X^-$

[S] [2S]

Solubility product of AX_2 is -

$K_{sp} = [A^{2+}][X^-]^2$

$= [S][2S]^2$

$K_{sp} = 4S^3$

$3.2\times10^{-11} = 4S^3$

$S^3 = 0.8\times10^{-11}$

$S^3 = 8\times10^{-12}$

$S = \left(8\times10^{-12}\right)^{1/3}$

Solubility $= 2\times10^{-4}$ mol/L

154. The solubility product of AgI at 25ºC is 1.0×10^{-16} mol^{-1}L^{-1}. The solubility of AgI in 10^{-4} N solution of KI at 25ºC is approximately (in mol L^{-1})

(a) 1.0×10^{-16} (b) 1.0×10^{-12}

(c) 1.0×10^{-10} (d) 1.0×10^{-8}

NEET-2003

Ans. (b) : $AgI \rightleftharpoons Ag^+ + I^-$

$KI \rightleftharpoons \underset{[10^{-4}]}{K^+} + \underset{[10^{-4}]}{I^-}$

$AgI \rightleftharpoons \underset{[x]}{Ag^+} + \underset{[x+10^{-4}]}{I^-}$

K_{sp} of AgI-

$K_{sp} = [Ag^+]\ \ [I^-]$

$= [x]\ \ [x+10^{-4}]$ $(x << 10^{-4})$

Hence, x=neglect

$K_{sp} = [x]\,[10]^{-4}$

$$x = \frac{K_{sp}}{10^{-4}} = \frac{10^{-16}}{10^{-4}} = 1\times10^{-12}$$

Solubility of AgI is 1×10^{-12} mol L^{-1}

155. Solubility of MX_2 type electrolytes is 0.5×10^{-4} mol/lit, then find out K_{sp} of electrolytes.

(a) 5×10^{-12} (b) 25×10^{-10}

(c) 1×10^{-13} (d) 5×10^{-13}

NEET-2002

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Ans. (d): An electrolyte MX_2 undergoes dissocitation as follows:–

Concentration	MX_2	M^{+2}	X^-
Initial concentration	1	0	0
Concentration at Equilibrium	1-s	s	2s

Thus from the above condition we can say that, $K_{sp}= s\times(2s)^2= 4\times(s)^3$

Here, s (the solubility) is 0.5×10^{-4} mole/lit.

$\therefore K_{sp}=4\times(0.5\times10^{-4})^3$

$K_{sp}=5\times10^{-13}$

156. Solubility of M_2S salt is 3.5×10^{-6} then find out solubility product,

(a) 1.7×10^{-6} (b) 1.7×10^{-16}

(c) 1.7×10^{-18} (d) 1.7×10^{-12}

NEET-2001

Ans. (b) : Let's be the solubility of salt M_2S which undergoes dissociation as fallow:-

	$M_2S \rightleftharpoons$	$2M^+$	$+S^{-2}$
Initial concentration	1	0	0
Concentration at aqulibrium	1-S	2S	S

$K_{sp}=[M^+]^2[S^{-2}]$

$K_{sp} = (2S)^2 (S)$

$K_{sp} = 4S^3$

$K_{sp} = 4 \times (3.5\times10^{-6})^3$

$K_{sp} = 1.7\times10^{-16}$

157. The solubility of a saturated solution of calcium fluoride is 2×10^{-4} moles per litre. Its solubility product is

(a) 22×10^{-11} (b) 14×10^{-14}

(c) 2×10^{-2} (d) 32×10^{-12}

NEET-1999

Ans. (d) : $CaF_2 \rightleftharpoons \underset{[S]}{Ca^{2+}} + \underset{[2S]}{2F^-}$

$K_{sp} = [Ca^{2+}][F^-]^2$

$= [S]\,[2S]^2$

$K_{sp}= 4S^3$

Given, $S=2\times10^{-4}$

$K_{sp}=4\times(2\times10^{-4})^3$

$K_{sp} = 32\times10^{-12}$

158. The solubility product of CuS, Ag_2S and HgS are 10^{-31}, 10^{-44} and 10^{-54} respectively. The solubilities of these sulphides are in the order

(a) HgS > Ag_2S > CuS (b) CuS > Ag_2S > HgS

(c) Ag_2S > CuS > HgS (d) Ag_2S > HgS > CuS

NEET-1997

Ans. (c) : Solubility product (K_{sp}) of CuS = 10^{-31}

$CuS \rightleftharpoons \underset{S}{Cu^{++}} + \underset{S}{S^{--}}$

$\therefore$ Solubility of CuS -

$K_{sp} = S^2$

$S = \sqrt{K_{sp}}$

$= \sqrt{10^{-31}}$

$= 3.16\times10^{-16}$ mol/L

Similarly solubility of Ag_2S-

$Ag_2S \rightleftharpoons \underset{2S}{2Ag} + \underset{2S}{S^{--}}$

$K_{sp} = (2S)^2 \times S$

$K_{sp} = 4S^3$

$$S = \left(\frac{K_{sp}}{4}\right)^{1/3}$$

$$= \left(\frac{10^{-42}}{4}\right)^{1/3} = 10^{-27}\ \text{mol/L}$$

$\therefore$(for Ag_2S, $4S^3=K_{sp}$)

$$\sqrt{\frac{10^{-42}}{4}} = 6\times10^{-15}\text{mol/liter}$$

Solubility of HgS-

$HgS \rightleftharpoons \underset{S}{Hg^{++}} + \underset{S}{S^{--}}$

$K_{sp} = S^2$

$S = \sqrt{K_{sp}}$

$= \sqrt{10^{-54}}$

$= 10^{-27}$ mol/L

Hence, the correct order of solubility is

Ag_2S >CuS >HgS.

159. pH of a saturated solution if $Ba(OH)_2$ is 12. The value of solubility product (K_{sp}) of $Ba(OH)_2$ is

(a) 3.3×10^{-7} (b) 5.0×10^{-7}

(c) 4.0×10^{-6} (d) 5.0×10^{-6}

NEET-2012, 2010

Ans. (b) : $Ba(OH)_2 \rightleftharpoons \underset{S}{Ba^{2+}} + \underset{2S}{2OH^-}$

Given,

pH = 12

p(OH) = 14 – pH

p(OH) = 14 – 12 = 2

$[OH^-] = 10^{-pOH} = 10^{-2}$ or 1×10^{-2}

As conc. of Ba^{2+} is half of OH^-

$Ba^{2+} = 0.5 \times 10^{-2}$

$K_{sp} = (0.5 \times 10^{-2})\,(1 \times 10^{-2})^2$

$K_{sp} = 0.5 \times 10^{-6}$

$K_{sp} = 5 \times 10^{-7}$

160. pH of a saturated solution of $Ca(OH)_2$ is 9. The solubility product (K_{sp}) of $Ca(OH)_2$ is

(a) 0.5×10^{-10} (b) 0.5×10^{-15}

(c) 0.25×10^{-10} (d) 0.125×10^{-15}

NEET-2019

Ans. (b) : $CO(OH)_2 \rightleftharpoons Ca^{2+} + 2OH^-$

pH=9 and pOH = 14 –9=5

$$\text{Hence}[Ca^{2+}] = \frac{10^{-5}}{2}$$

$$\text{Thus}, K_{sp} = [Ca^{2+}][OH^-]^2$$

$$= \left(\frac{10^{-5}}{2}\right)(10^{-5})^2$$

$= 0.5\times10^{-15}$

Solubility product (K_{sp}) of $Ca(OH)_2$ is 0.5×10^{-15}.

@apna_pdf

161. The molar solubility of CaF_2 ($K_{sp} = 5.3\times10^{-11}$) in 0.1 M solution of NaF will be

(a) 5.3×10^{-11} mol L^{-1}
(b) 5.3×10^{-8} mol L^{-1}
(c) 5.3×10^{-9} mol L^{-1}
(d) 5.3×10^{-10} mol L^{-1}

Odisha NEET-2019

Ans. (c) : $CaF_2(s) \rightleftharpoons Ca^{2+}(aq)+2F^-(aq)$

$NaF(aq) \rightarrow Na^+(aq) + F^-(aq)$

In solution –[F]= (2s'+C)

$[F^-] \approx C$ (due to common ion effect)

$K_{sp}(CaF_2)=[Ca+2].[F^-]^2$

$K_{sp}(CaF_2)=s'.C^2$

$$s' = \frac{5.3\times10^{-11}}{(10^{-1})^2}$$

s'= 5.3×10^{-9} mol L^{-1}

162. The solubility of $BaSO_4$ in water is 2.42×10^{-3}g L^{-1} at 298 K. The value of its solubility product (K_{sp}) will be (Given molar mass of $BaSO_4$ = 233 g mol^{-1})

(a) 1.08×10^{-10} mol^2 L^{-2}
(b) 1.08×10^{-12} mol^2 L^{-2}
(c) 1.08×10^{-14} mol^2 L^{-2}
(d) 1.08×10^{-8} mol^2 L^{-2}

NEET-2018

Ans. (a) : The solubility S= $2.42\times10^{-3}gL^{-1}$

$$S = \frac{2.42\times10^{-3}gL\text{-}1}{233g\ mol^{-1}} = 1.04\times10^{-5}molL^{-1}$$

$K_{sp}=[B^{2+}].[SO_4^{2-}]$

$K_{sp}=[S].[S]= S^2$

$K_{sp}= (1.04\times 10^{-5})^2$

Hence, $K_{sp} = 1.08 \times 10^{-10}$ mol^2 L^{-2}

163. Concentration of the Ag^+ ions in a saturated solution of $Ag_2C_2O_4$ is 2.2×10^{-4} mol L^{-1}. Solubility product of $Ag_2C_2O_4$ is

(a) 2.66×10^{-12}
(b) 4.5×10^{-11}
(c) 5.3×10^{-12}
(d) 2.42×10^{-8}

NEET-2017

Ans. (c) :

$$Ag_2C_2O_4(s) \rightleftharpoons \underset{[2S]}{2Ag^+}(aq) + \underset{[S]}{(C_2O_4^{2-})}(aq)$$

$K_{sp} = [Ag]^+ [C_2O_4^{2-}]$

$$Ag^+ = \frac{2.2\times10^{-4}}{2}M = 1.1 \times 10^{-4}M$$

$K_{sp} = (2.2 \times 10^{-4})^2 (1.1 \times 10^{-4})$

$K_{sp} = 5.324 \times 10^{-12}$

164. The solubility of $AgCl_{(s)}$ with solubility product 1.6×10^{-10} in 0.1 M NaCl would be

(a) 1.26×10^{-5} M
(b) 1.6×10^{-9} M
(c) 1.6×10^{-11} M
(d) zero

NEET-2016

Ans. (b) : $AgCl \rightleftharpoons Ag^+ + Cl^-$

a	0	0
a – S	S	S + 0.1

$K_{sp} = [Ag^+].[Cl^-]$

$= [S]. [0.1 + S]$

K_{sp} is value seems to very small so S value can be neglected, with to 0.1m

$K_{sp} = S[0.1]$

$$S = \frac{K_{sp}}{0.1}$$

$$S = \frac{1.6\times10^{-10}}{0.1}$$

$S = 1.6\times10^{-9}M$

165. MY and NY_3 two nearly insoluble salts, have the same K_{sp} values of 6.2×10^{-13} at room temperature. Which statement would be true in regard to MY and NY_3?

(a) The salts MY and NY_3 are more soluble in 0.5 M KY than pure water
(b) The addition of the salt of KY to solution of MY and NY_3 will have no effect on their solubilities
(c) The molar solubilities of MY and NY_3 in water are identical
(d) The molar solubility of MY in water is less than that of NY_3

NEET-I 2016

Ans. (d) : Molar solubility of MY in water is less than that of NY_3

$MY \longrightarrow M^+ + Y^-$

$NY_3 \longrightarrow N^{3+} + 3Y^-$

For MY the molar solubility $= \sqrt{K_{sp}}$

$= \sqrt{6.2\times10^{-13}}$

$= 7.88 \times 10^{-7}$ m.

For NY_3 the molar solubility-

$$S = \left(\frac{K_{sp}}{27}\right)^{1/4} = \left(\frac{1.2\times10^{-13}}{27}\right)^{1/4}$$

$S = 3.9 \times 10^{-4}$ M

Hence molar solubility of MY water is less than that of NY_3.

166. The ionic product of water at 25°C is 10^{-14}. Its product at 90° C will be

(a) 1×10^{-14}
(b) 1×10^{-16}
(c) 1×10^{-20}
(d) 1×10^{-12}

NEET-1996

Ans. (d) : The ionic product of water increases with increases in temperature. This is because of the fact that with increase of temperature the degree of ionization of water increases.

the only one option has a value greater than 10^{-14} ie 10^{-2}

Hence ionic product of water at 90°C = 1×10^{-12}.

167. Find out the solubility of $Ni(OH)_2$ in 0.1 M NaOH. Given that the ionic product if $Ni(OH)_2$ is 2×10^{-15}

(a) 2×10^{-13} M
(b) 2×10^{-8} M
(c) 1×10^{-13} M
(d) 1×10^{8} M

NEET-2020

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Ans. (a) : α = 1 for NaOH

$$NaOH \rightarrow Na^+ + OH^-(aq)$$

$$\begin{array}{c} (aq) \\ 0.1M \quad 0.1M \end{array}$$

$$Ni(OH)_2 \rightleftharpoons Ni^{2+}(aq) + 2OH^-(aq)$$

$$S \qquad (0.1+2S)$$

ionic product = $[Ni^{+2}][OH^-]^2$

$2 \times 10^{-15} = [Ni^{+2}][10^{-1}]^2$

$2 \times 10^{-13} = [Ni^{2+}]$

$[Ni^{2+}] = 2 \times 10^{-13}$

168. Aqueous solutions of acetic acid contains

(a) CH_3COO^- and H^+

(b) CH_3COO^- and CH_3COOH

(c) CH_3COO^- H_3O^+ and H^+

(d) CH_3COOH, CH_3COO^- and H^+

NEET-1991

Ans. (b) : The aqueous solution fo acetic acid ionize as follows–

$H_2O + CH_3COOH(Base) \Leftrightarrow CH_3COO^-(Acid) + H_3O^+$

So, the aqueous solution of acetic acid contains CH_3COO–, H_3O+ and CH_3COOH.

169. K_{sp} for $Mg(OH)_2$ is 0.4×10^{-11}, then the pH value of the solution is

(a) 5	(b) 8.5
(c) 10.3	(d) 12

UP CPMT-2014

Ans. (c) : $Mg(OH)_2$ dissolves in the following manner.

$$\underset{S\,mol/L}{Mg(OH)_2} \longrightarrow \underset{S\,mol/L}{Mg^{2+}} + \underset{2s\,mol/L\,(s=solubility)}{2OH^-}$$

$$K_{sp} = [Mg^{2+}][OH^-]^2$$

$$= (S)(2S)^2$$

$$= 4S^3$$

$$4S^3 = 0.4 \times 10^{-11}$$

$$S^3 = 10^{-12}$$

$$S = \left(10^{-12}\right)^{1/3}$$

$$S = 10^{-4}$$

Since 1 mol Mg $(OH)_2$ provides 2 moles of $[OH^-]$,

So $[OH^-] = 2 \times 10^{-4}$

pOH = – log $[OH^-]$

= –log (2×10^{-4}) = 3.7

pH = 14 – pOH

= 14 – 3.7

= 10.3

170. K_{sp} and solubility of MX_4 (mol/litre) are related by

(a) $s = [K_{sp}/256]^{1/5}$	(b) $s = [128\ K_{sp}]^{1/4}$
(c) $s = [256\ K_{sp}]^{1/3}$	(d) $s = -[K_{sp}/128]^{1/4}$

UP CPMT-2013

Ans. (a) : MX_4 ionises in the solution as

$$MX_4 \rightleftharpoons M_s^{4+} + 4X_{4s}^-$$

$$K_{sp} = [M^{4+}][X^-]^4 = (s) \times (4s)^4$$

$$= 256\ s^5$$

Or $\quad s = \left(\dfrac{K_{sp}}{256}\right)^{1/5}$

171. The solubility of Sb_2S_3 in water is 10×10^{-5} mol/L at 298K. What will be its solubility product?

(a) 108×10^{-25}	(b) 10×10^{-25}
(c) 144×10^{-25}	(d) 126×10^{-24}

UP CPMT-2004

Ans. (a) : Key Idea Write the equation for dissociation of Sb_2S_3 and find relationship between K_{sp} and solubility. From this relationship, calculate K_{sp}.

Let solubility of Sb_2S_3=x mol/L

$$Sb_2S_3 \rightleftharpoons 2Sb^{3+} + 3S^{2-}$$

∴ solubility $\quad$ x mol/L $\qquad$ 2x $\quad$ 3x

$K_{sp} = [Sb^{3+}]^2 [S^{2-}]^3$

$= (2x)^2 (3x)^3$

$K_{sp} = 108x^5$

Given, $x = 10 \times 10^{-5}$ mol/L

$K_{sp} = 108 \times (10 \times 10^{-5})^5$

$= 108 \times 10^{-25}$

172. If the solubility of $BaSO_4$ (mol. wt. 233) is 2.33 × 10^{-4}g/100 ml, then the solubility product of $BaSO_4$ is

(a) 1×10^{-5} mol/L	(b) 1×10^{-10} mol/L
(c) 1×10^{-4} mol/L	(d) 1×10^{-8} mol/L

UP CPMT-2001

Ans. (b) : Given, solubility of $BaSO_4$

$= 2.33 \times 10^{-4}$ g/100 mL

$= 2.33 \times 10^{-3}$ g/L $= \dfrac{2.33 \times 10^{-3}}{233}$

(∵ mol. wt. of $BaSO_4$ = 233)

∴ Solubility of $BaSO_4 = 1 \times 10^{-5}$ mol/L

$$BaSO_4 \rightleftharpoons Ba^{2+} + SO_4^{2-}$$

$K_{sp} = [Ba^{2+}][SO_4^{2-}]$

$= (1 \times 10^{-5})(1 \times 10^{-5})$

$= 1 \times 10^{-10}$ mol/L

173. The solubility product of calcium fluoride is 3.2 × 10^{-11} M^3. Its solubility in saturated solution is

(a) 8×10^{-12} ML^{-1}	(b) 2×10^{-4} ML^{-1}
(c) 4×10^{-12} ML^{-1}	(d) 1×10^{-4} ML^{-1}

UP CPMT-2001

Ans. (b) : Given, $K_{sp} = 3.2 \times 10^{-11}$

Let the solubility of CaF_2 = x mol/L

$$\underset{\text{moles after dissolution}}{CaF_2} \longrightarrow \underset{x}{Ca^{2+}} + \underset{2x}{2F^-}$$

$K_{sp} = [Ca^{2+}][F^-]^2$

$= x \times (2x)^2$

$= 4x^3$

∴ $\qquad 3.2 \times 10^{-11} = 4x^3$

or $\qquad x = \sqrt[3]{\dfrac{3.2 \times 10^{-11}}{4}}$

$x = \sqrt[3]{8 \times 10^{-12}}$

$x = 2 \times 10^{-4}$ mol/L

174. If the solubility of lithium sodium hexafluoroaluminate is 'a' mol/L, its solubility product is

(a) a^8	(b) $10\ a^3$
(c) $180\ a^3$	(d) $2916\ a^8$

UP CPMT-2001

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Ans. (d) : Lithium sodium hexafluoro aluminate is chemically $Li_3Na_3(AlF_6)_2$. Write its dissociation reaction and then find K_{sp}

$$Li_3Na_3(AlF_6)_2 \rightleftharpoons 3Li^+ + 3Na^+ + 2AlF_6^{3-}$$

initial conc. a mol/L	0	0	0
conc. at equilibrium	3a	3a	2a

$\therefore$ $K_{sp} = [Li^+]^3\,[Na^+]^3\,[AlF_6{}^{3-}]^2$
$= (3a)^3 \times (3a)^3 \times (2a)^2$
$= 27a^3 \times 27a^3 \times 4a^2$
$= 2916a^8$

175. The solubility in water of a sparingly soluble salt AB_2 is 1.0×10^{-5} mol L^{-1}. Its solubility Product number will be

(a) 4×10^{-15}
(b) 4×10^{-10}
(c) 1×10^{-15}
(d) 1×10^{-10}

UPTU/UPSEE-2007

Ans. (a) :

$$AB_2 \rightleftharpoons A^{2+} + 2B^-$$
$$\quad S \qquad 2S$$

Using the relation of solubility and solubility.

$$AB_2 \rightleftharpoons \left[A^{+2}\right].\left[B^-\right]^2$$

$K_{sp} = [S].[2S]^2$
$K_{sp} = 4s^3$
$= 4\,(1\times 10^{-5})^3$
$K_{sp} = 4 \times 10^{-15}$

176. The value of the ionic product of water depends:

(a) on volume of water
(b) on temperature
(c) changes by adding acid or alkali
(d) always remain constant

UPTU/UPSEE-2006

Ans. (b) : The value of the ionic product of water depends on temperature

177. The solubility of CaF_2in pure water is 2.3×10-^{4} mol dm^{-3} Its solubility product will be:

(a) 4.6×10^{-4}
(b) 4.6×10^{-8}
(c) 6.9×10^{-12}
(d) 4.9×10^{-11}

UPTU/UPSEE-2006, 2005

Ans. (d) : Solubility of CaF_2 in pure water is : 2.3×10^{-4} mol dm^{-3}

$$CaF_2 \rightleftharpoons Ca^{2+} + 2F^-$$
$$[S] \quad [2S]$$
$$K_{sp} = \left[Ca^{2+}\right].\left[F^-\right]^2$$
$$[S] \quad [2S]^2$$

$K_{sp} = 4s^3$
$= 4 \times (2.3 \times 10^{-4})^3$
$K_{sp} = 4.9 \times 10^{-11}$

178. The solubility product of Barium sulphate is 1.5×10^{-9} at 18°C. Its solubility in water at 18°C is:

(a) 1.5×10^{-9}
(b) 1.5×10^{-5}
(c) 3.9×10^{-9}
(d) 3.9×10^{-5}

UPTU/UPSEE-2004

Ans. (d) : K_{sp} of Barium sulphate is = 1.5×10^{-9}

$$BaSO_4 \rightleftharpoons Ba^{2+} + SO_4^{2-}$$
$$[s] \qquad [s]$$

$K_{sp} = [\,Ba^{2+}].\,[SO_4^{2-}\,]$
$K_{sp} = S^2$
$S = \sqrt{K_{SP}}$
$S = \sqrt{1.5\times10^{-9}} = 3.9\times10^{-5}$

179. K_{sp} of $CaSO_4$ is 4×10^{-12}. $CaSO_4$ is precipitated on mixing equal volumes of the following solutions.

(a) 3×10^{-10}M $CaCl_2$ and 3×10^{-6}M $(NH_4)_2SO_4$
(b) 4×10^{-6} M $CaCl_2$ and 3×10^{-6}M $(NH_4)_2SO_4$
(c) 6×10^{-6}M $CaCl_2$ and 3×10^{-16}M $(NH_4)_2SO_4$
(d) In all the above cases

UPTU/UPSEE-2015

Ans. (c) : Super Saturated Solution– It is defined as precipitate, which form by the mixture of two solution, if the product of ions is greater than product of solubility, then it is called super saturated solution.

$$[Ca^{2+}].[SO_4{}^{2-}] > K_{sp}$$

180. The solubility of AgI in NaI solution is less than that in pure water because

(a) AgI forms complex with NaI
(b) Of common ion effect
(c) Solubility product of AgI is less then that of NaI
(d) The temperature of the solution decreases

UPTU/UPSEE-2014
JCECE - 2014

Ans. (b) : The solubility of AgI in NaI Solution is less than in pure water because of common ion effect.

$$AgI \rightleftharpoons Ag^+ + I^-$$
$$NaI \rightleftharpoons Na^+ + I^-$$

181. At a certain temperature, the solubility of the salt, M_mA_n in water is s mol/L. The solubility product of the salt is

(a) M^mA^n
(b) $(m+n)s^{m+n}$
(c) $m^mn^ns^{m+n}$
(d) m^mA^ns

UPTU/UPSEE-2010

Ans. (c) : let us consider solubility of any general salt $M_m\,A_n$.

$$M_mA_n \rightleftharpoons \left[mM^{n+}\right]\left[nA^{m-}\right]$$

The solution which contains maximam possible amount of solute in it are called saturated solution for saturated solution, at equilibrium.

$K_{sp} = [M^{n+}]^m[A^{m+}]^n$
$= [ms]^m[ns]^n$
$K_{sp} = m^m\,n^n\,[S]^{m+n}$

182. Solubility product of $Mg(OH)_2$ at ordinary temp 1.96×10^{-11}. pH of a saturated soln. of Mg $(OH)_2$ will be

(a) 10.53
(b) 8.47
(c) 6.94
(d) 3.47

WB-JEE-2008

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Ans. (a) :

$$Mg(OH)_2 \rightleftharpoons Mg^{2+} + 2OH^-$$
$$[s] \qquad [2s]$$
$$K_{sp} = [Mg^{2+}].[OH^-]^2$$
$$= [s] \qquad [2s]^2$$
$$1.69 \times 10^{-11} = 4S^3$$
$$S = \left[\frac{1.96\times10^{-11}}{4}\right]^{1/3}$$
$$S = (4.9 \times 10^{-12})^{1/3}$$
$$S = 1.69 \times 10^{-4}$$

So, concentration of $[OH^-] = 2s$

$$[OH^-] = 3.38 \times 10^{-4}$$
$$pOH = -\log[OH^-]$$
$$= -\log[3.38 \times 10^{-4}]$$
$$pOH = 3.471$$
$$pH = 14 - pOH$$
$$= 14 - 3.471$$
$$pH = 10.529.$$

183. The solubility of $Ca_3(PO_4)_2$ in water is y moles/litre. its solubility product is

(a) $6y^4$ (b) $36y^4$

(c) $64y^5$ (d) $108y^5$

WB-JEE-2011

Ans. (d) : $Ca_3(PO_4)_2 \rightleftharpoons 3Ca^{2+} + 2PO_4^{3-}$

$$K_{sp} = [Ca^{2+}]^3[PO_4^{3-}]^2$$
$$= [3y]^3 \qquad [2y]^2$$
$$K_{SP} = 27y^3.\ 4y^2$$
$$K_{SP} = 108y^5$$

184. At 25°C, the solubility product of salt of MX_2 type is 3.2×10^{-8} in water. The solubility (in mol/L) of MX_2 in water at the same temperature will be

(a) 1.2×10^{-3} (b) 2×10^{-3}

(c) 3.2×10^{-3} (d) 1.75×10^{-3}

WB-JEE-2013

Ans. (b): For MX_2 type salt,

$$MX_2 \rightleftharpoons [M^{2+}] + [2X^-]$$
$$[s] \qquad [2s]$$
$$K_{sp} = [M^{2+}][X^-]^2$$
$$= [S] \qquad [2S]^2$$
$$= 4S^3$$
$$3.2 \times 10^{-8} = 4s^3$$
$$S = \sqrt[3]{\frac{3.2\times10^{-8}}{3}}$$
$$S = 2 \times 10^{-3}\ \text{mol/L}$$

185. The molar solubility (in mol L^{-1}) of a sparingly soluble salt MX_4 is 'S'. The corresponding solubility product is K_{sp}. S in terms of 'K_{sp}' is given by the relation

(a) $S = \left(\frac{K_{sp}}{128}\right)^{1/4}$ (b) $S = \left(\frac{K_{sp}}{256}\right)^{1/5}$

(c) $S = (256\ K_{sp})^{1/5}$ (d) $S = (128\ K_{sp})^{1/4}$

WB-JEE-2016

Ans. (b) : For MX_4 type salt -

$$MX_4 \rightleftharpoons [M^{4+}] + [4X^-]$$
$$[S] \qquad [4S]$$
$$K_{sp} = [M^{4+}][4X^-]$$
$$K_{sp} = [S] \qquad [4S]^4$$
$$K_{sp} = [S][256\ S^4]$$
$$K_{sp} = [256\ S^5]$$
$$S = \left(\frac{K_{sp}}{256}\right)^{1/5}$$

186. Which of the following arrangements correct in respect of solubility in water?

(a) $CaSO_4 > BaSO_4 > BeSO_4 > MgSO_4 > SrSO_4$

(b) $BeSO_4 > MgSO_4 > CaSO_4 > SrSO_4 > BaSO_4$

(c) $BaSO_4 > SrSO_4 > CaSO_4 > MgSO_4 > BeSO_4$

(d) $BeSO_4 > CaSO_4 > MgSO_4 > SrSO_4 > BaSO_4$

WB-JEE-2016

Ans. (b) : The solubility of sulphates in water decreases down the group. The magnitude of the lattic enthalpy remains almost constant as the sulphate ion is so big that small increases in size of cation from Be to Ba does not make any difference. The hydration enthalpy decreases from Be^{2+} to Ba^{2+} as the size of the cation increases down the group.

Hence, the solubility of sulphates of alkaline earth metal decreases down the group mainly due to decreasing hydration enthalpy from Be^{2+} to Ba^{2+}. The decreasing order of solubility would be⁻

$BeSO_4 > MgSO_4 > CaSO_4 > SrSO_4 > BaSO_4$

3. Acid, Bases and Salts

187. Given below are the oxides:

Na_2O, As_2O_3, N_2O, NO and Cl_2O_7

Number of amphoteric oxides is:

(a) 0 (b) 1

(c) 2 (d) 3

JEE Main-24.06.2022, Shift-I

Ans. (b) : An amphoteric oxide is an oxide that can act either as an acid or as a base to create oxides and hydroxides are formed when metals have several oxidation states.

$Na_2O \rightarrow$ Basic

$As_2O_3 \rightarrow$ Amphoteric

$N_2O \rightarrow$ Neutral

$Cl_2O_7 \rightarrow$ Acidic

$NO \rightarrow$ Neutral

So, only As_2O_3 shows amphoteric oxides.

188. When 10 ml of 10 M solution of H_2SO_4 and 100 ml of 1 M solution of NaOH are mixed, the resulting solution will be?

(a) Acidic (b) Neutral

(c) Alkaline (d) Can not be predicted

CG PET-22.05.2022

Ans. (a) : For, NaOH:–

$$N_1V_1 = 100\ \text{ml} \times 1N = 100\ \text{ml (N)}$$

For H_2SO_4:–

$$N_2V_2 = 10\ \text{ml} \times 10N = 100\ \text{ml (N)}$$

Hence, The resulting solution will be acidic.

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189. In case of following Bronsted base, the correct order of basic strength is

(a) $ClO_4^- > ClO_3^- > ClO_2^- > ClO^-$

(b) $ClO^- > ClO_2^- > ClO_3^- > ClO_4^-$

(c) $ClO_3^- > ClO_2^- > ClO_4^- > ClO^-$

(d) $ClO_2^- > ClO_3^- > ClO^- > ClO_4^-$

CG PET-22.05.2022

Ans. (b) : As we know,
More the number of oxygen atoms attached, more is the acidity of the molecule.
So, Order of acidity is:–
$HClO < HClO_2 < HClO_3 < HClO_4$
So, the conjugate base order will be just the reverse:–
$ClO^- > ClO_2^- > ClO_3^- > ClO_4^-$

190. Match List-I with List-II

	List-I(Oxide)	**List-II(Nature**
(A)	**Cl_2O_7**	**(I) Amphoteric**
(B)	**Na_2O**	**(II) Basic**
(C)	**Al_2O_3**	**(III) Neutral**
(D)	**N_2O**	**(IV) Acidic**

Choose the correct answer from the given below:

(a) A-IV, B-III, C-I, D-II
(b) A-IV, B-II, C-I, D-III
(c) A-II, B-IV, C-III, D-I
(d) A-I, B-II, C-III, D-IV

JEE Main-28.06.2022, Shift-II

Ans. (b) :

Oxide		**Nature**
Cl_2O_7	→	Acidic
Na_2O	→	Basic
Al_2O_3	→	Amphoteric
N_2O	→	Neutral

191. Amphoteric oxide among the following:

(a) Ag_2O (b) SnO_2
(c) BeO (d) CO_2

Karnataka CET-17.06.2022, Shift-II

Ans. (b & c) : Amphoteric oxides can be defined that can behave as an acid and a base to produce salt and water. Thus, SnO_2 and BeO both reacts with acid as well as the base. So it is and amphoteric oxide.

192. The conjugate acid of N_3^- (azide ion) is:

(a) NH_3 (b) HN_3
(c) NH_2^- (d) N_2^-

AP-EAMCET (Med.)-1999

Ans. (b) : The species formed by the addition of proton in a base is called conjugate acid.

$$\underset{\text{Base}}{N_3^-} + \underset{\text{Proton}}{H^+} \rightarrow \underset{\text{Conjugate acid}}{HN_3}$$

193. Aqueous solution of $FeCl_3$ is acidic because of

(a) hydrolysis (b) anionic hydrolysis
(c) cationic hydrolysis (d) dissociation

AP-EAMCET-1991

Ans. (c) : Aqueous solution of $FeCl_3$ is acidic because of cationic hydrolysis $FeCl_3$ is a salt of weak base and strong acid.

$$FeCl_3 + 3H_2O \rightarrow Fe(OH)_3 + 3HCl$$
$$Fe^{3+} + 3H_2O \rightarrow Fe(OH)_3 + 3H^+$$

194. The conjugate base of HSO_4^- ion is ....

(a) H_2SO_4 (b) $H_3SO_4^+$
(c) SO_4^{2-} (d) O^{2-}

AP-EAMCET-1991

Ans. (c) : Although it has a negative charge, it will never accept a H^+ to form H_2SO_4(sulfuric acid). That is because sulfuric acid is a strong acid and completely disassociates in water.
Therefore, the sulfate ion (SO_4^{2-}) is the conjugate base of HSO_4^-

$$\underset{\text{Acid}}{HSO_4^-} \xrightarrow{-H^+} \underset{\text{Conjugate base}}{SO_4^{2-}}$$

195. The nature of 0.1 M solution of sodium bisulphate is

(a) acidic (b) basic
(c) neutral (d) can't predict

AP-EAMCET-1993

Ans. (a) : The sodiumbisulphate is the sodium salt of the bisulfate ion with the molecular formula $NaHSO_4$. In aqueous solutions. H releases H^+ ion
The question is shown in fig.

$$NaHSO_4 \rightleftharpoons Na^+ + HSO_4^-$$
$$HSO_3^- \rightleftharpoons \underset{\text{Release } H^+ \text{ion}}{\underset{\downarrow}{H^+}} + SO_4^{2-}$$

So the nature of 0.1 M solutions of Sodiumbisulphate is acidic in Nature.

196. Which one of the following is least likely to act as a Lewis base?

(a) PCl_3 (b) SCl_2
(c) I^- (d) I^+

AP-EAMCET-1995

Ans. (d) : Lewis base are the electron donating species. I^+ being to electron deficient is least likely acts as a lewis base.

197. Which one of the following is not a Lewis acid?

(a) BF_3 (b) $AlCl_3$
(c) $BeCl_2$ (d) $SnCl_2$

AP-EAMCET-1995

Ans. (c) : Lewis Acids are the chemical species that have empty orbital and are able to accept electron pairs from Lewis bases. e.g. boron trifluoride (BF_3) $AlCl_3$, Beryllium chloride ($BeCl_2$).

198. Which of the following can act both as Bronsted acid and Bronsted base?

(i) HCO_3^- (ii) NH_3 (iii) O^{2-} (iv) HCl

(a) (i) and (ii) (b) (ii) and (iii)
(c) None of the above (d) All of the above

AP-EAMCET-1995

Ans. (a) : Those substance which accept the proton are called Bronsted base and which is donate the proton are called Bronsted acid.

$HCO_3^- + H^+ \rightleftharpoons H_2CO_3$ Bronsted base.

$HCO_3^- \rightleftharpoons H^+ + CO_3^{2-}$ Bronsted acid.

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199. Which of the following is the strongest Lewis acid?

(a) BI_3 (b) BBr_3
(c) BCl_3 (d) BF_3

AP-EAMCET-1998

Ans. (a) : A molecule is said to be a lewis acid if it can accept a loan pair. BI_3 is a strong lewis acid. Due to back bonding in I_3^-, conjugate base of BI_3 is very stable. So, it is most acidic. Lewis acidity increases from fluoride to iodide. The lewis acidity is ameliorated by a π-bonding contribution through overlap of the halogen lone pair and the vacant orbital on boron.

200. The conjugate base of NH_2^- is

(a) NH_3 (b) NH^{2-}
(c) NH_4^+ (d) N_3^-

AP-EAMCET-1998

Ans. (b) : Conjugate base is defined by a substance formed when an acid losses a hydrogen ion. The conjugate base of NH_2^-.

$$NH_2^- \xrightarrow{-H^+} NH^{2-}$$

201. Which one of the following salts gives an acidic solution in water?

(a) CH_3COONa (b) NH_4Cl
(c) $NaCl$ (d) CH_3COONH_4

AP-EAMCET-2007

Ans. (b) : Ammonium chloride when dissolved in water gives hydrochloric acid which makes the solution acidic in nature as HCl is a strong acid.

$$NH_4Cl \rightleftharpoons NH_4^+ + Cl^-$$

$$2H_2O \rightleftharpoons OH^- + H_3O^+$$

$$NH_4^+ + OH^- \rightleftharpoons \underset{\text{Weekly ionised}}{NH_4OH}$$

$$H_3O^+ + Cl^- \rightleftharpoons \underset{\substack{\text{Strongly}\\ \text{ionized}}}{HCl} + H_2O$$

202. Which one of the following is not a conjugate acid base pair?

(a) HPO_3^{2-}, PO_3^{2-} (b) $H_2PO_4^-, HPO_4^{2-}$
(c) $H_2PO_4^-, H_3PO_4$ (d) $H_2PO_4^-, PO_3^{3-}$

AP EAMCET (Engg.) -2007

Ans. (d) : The acid and base which differ by a proton are said to form a conjugate acid–base pair.

$$\text{Acid}_1 + \text{Base}_2 \rightleftharpoons \text{Acid}_2 + \text{Base}_1$$

$$HPO_3^{2-} + H_2O \rightleftharpoons H_3O^+ + PO_3^{2-}$$

$$H_2PO_4^- + H_2O \rightleftharpoons H_3O^+ + HPO_4^{2-}$$

$$H_3PO_4 + H_2O \rightleftharpoons H_3O^+ + H_2PO_4^-$$

In $H_2PO_4^-, PO_3^{3-}$ difference of 2 proton. So, it is not a conjugate base pair.

203. Molten sodium chloride conducts electricity through the following:

(a) free electrons (b) free ions
(c) free molecules (d) free atoms

MPPET - 2012

Ans. (b) : Molten sodium chloride conducts electricity due to presence of free ions. Electrons are bound in bonds by strong electrostatic forces. So sodium chloride does not conduct electricity in a solid-state.

204. The conjugate acid of NH_3 is:

(a) NH_2^- (b) NH_2OH
(c) N_2H_4 (d) NH_4^+

MPPET-2012

Ans. (d) : $\underset{\text{Base}}{NH_3} \xrightarrow{H^+} \underset{\text{Conjugate acid}}{NH_4^+}$

Specie	Conjugate Acid	Conjugate Base
H_2O	H_3O^+	OH^-
HCO_3^-	H_2CO_3	CO_3^{2-}
HSO_4^-	H_2SO_4	SO_4^{2-}
NH_3	NH_4^+	NH_2^-

205. When a particular aqueous solution is diluted by a factor of ten with K_2O, the pH increases by one unit. the solution most likely contains a

(a) Weak acid (b) Strong base
(c) Strong acid (d) Buffer

SCRA-2014

Ans. (c) : The increasing of pH by one unit, that means the solution is more acidic because the pH scale show the acidic character from 1 to 7. Less the value in pH scale, higher acidity of the solution will be.

Weak acid → Acid that don't completely dissociated in solution.

Strong acid → Completely dissociated in solution Exa- Chloric acid hydrobromic acid.

Buffer → A buffer Solution are resist a change in pH when small acid or alkali are added.

206. Consider the following regarding potash alum:

1. It has 24 water molecules.
2. It swells on heating.
3. Its aqueous solution is basic.
4. It is white in colour.

Which of the above statements are correct?

(a) 1 and 2 only (b) 1, 3 and 4
(c) 2, 3 and 4 (d) 1, 2 and 4

SCRA 2010

Ans. (d) : The formula of potash alum is $K_2SO_4Al_2(SO_4)_3.24H_2O$.
It is white in colour.
It has 24 water molecules and it swells on heating.

207. The aqueous solution of which one of the following is not basic?

(a) $Na_2B_4O_7.\ 10H_2O$ (b) HOCl
(c) $NaHCO_3$ (d) CH_3COONa

SCRA 2010

Ans. (d) : CH_3COONa – Na is the most electronegative atom and it is also metal. So, Na react with acetic acid to form sodium acetate. Therefore, CH_3COONa is acidic is nature (Removal of H^+ atom to place Na metal).

208. In the reaction $H_2O + HCl \rightarrow H_3O^+ + Cl^-$, the species that acts as Bronsted base is :

(a) H_2O (b) HCl
(c) H_3O^+ (d) Cl^-

MPPET-2013

@apna_pdf

Ans. (a) : A Bronsted-Lowry base is any species that is capable of accepting a proton, which requires a lone pair of electrons to bond to the H^+. **Ex.** H_2O.

$$\underset{\text{Acid}}{HCl} + \underset{\text{Base}}{H_2O} \rightarrow \underset{\text{Conjugate base}}{Cl^-} + \underset{\text{Conjugate acid}}{H_3O^+}$$

- Bronsted-Lowry acids are proton/H^+ doners (Lose H^+).

209. Which of the following species acts as both Bronsted acid and base?

(a) OH^- (b) NH_3

(c) NaCl (d) HSO_4^-

AP-EAMCET 25-08-2021 Shift - I

Ans. (d) : HSO_4^- acts as both Bronsted acid and base because it receive and also donate H^+ ion.

210. How many compound given below are amphoteric oxides ?

P_2O_5, P_4O_6, As_2O_5, As_4O_6, Sb_2O_5, Sb_4O_6, Bi_2O_3

(a) 2 (b) 3

(c) 4 (d) 6

AP EAMCET (Engg.) 17.09.2020, Shift-II

Ans. (a) : The oxides of the type $\overset{+3}{E}_2O_3$ of N and P, P_2O_3 (P_4O_6, dimer of P_2O_3) are purely acidic, that of As (As_4O_6, dimer of As_2O_3) and Sb (Sb_4O_6, dimer of Sb_2O_3) amphoteric and that of Bi (Bi_2O_3) is predominantly basic.

The oxides of the type $\overset{+3}{E}_2O_3$ are more acidic, e.g. N_2O_3, P_2O_5, As_2O_5, Sb_2O_5

So, in the given set of oxides of group- 15 elements, two oxides are amphoteric, As_4O_6 and Sb_4O_6.

211. Which acid among the following has the highest pK_a value ?

(a) HCℓ (b) HF

(c) Hℓ (d) HBr

AP EAMCET (Engg.) 21.09.2020, Shift-I

Ans. (b) : HF ($pK_a = 3.1$)

HCl ($pK_a = -6.0$)

HBr ($pK_a = -9.0$)

HI ($pK_a = -9.5$)

Therefore, HF has highest pK_a value. Hence, the correct option is (b).

212. Match the following

Acid	**Ionizationconstant, K_a**
A) Formic acid	**I) 4.9×10^{-10}**
B) Niacin	**II) 1.5×10^{-5}**
C) Hypochlorus acid	**III) 1.8×10^{-4}**
D) Hydrocyanic acid	**IV) 3.0×10^{-8}**

The correct match is

	A	**B**	**C**	**D**
(a)	II	III	IV	I
	A	B	C	D
(b)	I	II	III	IV
	A	B	C	D
(c)	III	II	IV	I
	A	B	C	D
(d)	III	IV	I	II

TS EAMCET 10.08.2021, Shift-II

Ans. (c) :

Acid	Ionization Constant – K_a
Formic acid –	1.8×10^{-4}
Niacin –	1.5×10^{-5}
Hypochlorous acid –	3.0×10^{-8}
Hydrocyanic acid –	4.9×10^{-10}

213. Iron sulphide is heated in air to form A, an oxide of sulphur. A is dissolved in water to give an acid. The basicity of this acid is

(a) 2 (b) 3

(c) 1 (d) Zero

AP EAMCET-2002

Ans. (a) : $4FeS + 7O_2 \rightarrow 2Fe_2O_3 + 4SO_2\uparrow$

$SO_2 + H_2O \rightarrow H_2SO_3$

$H_2SO_3 \rightarrow 2H^+ + SO_3^{2-}$

Basicity of sulphrous acid H_2SO_3 is 2.

214. Which of the following is a Lewis acid?

(a) Cl^- (b) H_3O^+

(c) PF_3 (d) C_2H_5OH

MPPET-2008

Ans. (c) : A Lewis acid is a substance that accepts a pair of electrons to form a covalent bond. PF_3 is a lewis acid.

215. Which one of the following salts will produce an alkaline solution on dissolving in water?

(a) NH_4Cl (b) Na_2CO_3

(c) $NaNO_3$ (d) Na_2SO_4

MPPET-2008

Ans. (b) : Na_2CO_3 salt will produce an alkaline solution on dissolving in water.

216. Which is the strongest Bronsted base among the following

(a) ClO_4^- (b) ClO_3^-

(c) ClO_2^- (d) ClO^-

MPPET-2008

Ans. (d) :

$$ClO_4^- \xrightarrow{H^+} HClO_4$$

$$ClO_3^- \xrightarrow{H^+} HClO_3$$

$$ClO_2^- \xrightarrow{H^+} HClO_2$$

$$ClO^- \xrightarrow{H^+} HClO$$

The strength of acid is $HClO_4 > HClO_3 > HClO_2 > HClO$ and strength of conjugate base is

$$ClO_4^- < ClO_3^- < ClO_2^- < ClO^-$$

Hence ClO^- is strongest bronsted base.

217. Using the Lewis concept, which one of the following has the strongest acidic strength ?

(a) H_3PO_4

(b) H_3PO_3

(c) H_3PO_2

(d) All are of equal strength

SCRA-2009

@apna_pdf

Ans. (a) : H_3PO_4 has the strongest acid strength as the no. of O atom is more in case of H_3PO_4. As the no. of O atom increases the strength of the acid increases. Oxygen is highly electronegative element, and so if there are more O atoms present, more will be the electron pulling tendency.
So, O–H bond weakening results more acidic character.

218. $SiCl_4$ on hydrolysis forms 'X' and HCl, compound 'X' losses water at 1000°C and gives 'Y'. Compounds 'X' and 'Y' respectively are

(a) H_2SiCl_6, SiO_2 (b) H_4SiO_4, Si
(c) SiO_2, Si (d) H_4SiO_4, SiO_2

AP EAMCET (Engg.)-2009

Ans. (d): $SiCl_4$ on hydrolysis give H_2SiO_4
$SiCl_4 + 4H_2O \rightarrow H_2SiO_3 + 4HCl$
H_4SiO_4 loses the water at 1000 degree centigrade and produces SiO_2
$H_4SiO_4 \rightarrow SiO_2 + 2H_2O$
So, X and Y are H_4SiO_4 and SiO_2 respectively.

219. Which of the following does not form double salts?

(a) Li_2SO_4 (b) Na_2SO_4
(c) K_2SO_4 (d) Rb_2SO_4

AP EAPCET 20.08.2021 Shift-I

Ans. (a) : Double salt is salt that contains more than one different contains or anion it completely dissociate into simple ions.
Lithium is an electropositive element. It has vary small size. It cannot form double salt.

220. The pk_a of a weak acid is 4.8. What should be the ratio of $\frac{[acid]}{[salt]}$, if a buffer of pH=5.8 is required?

(a) 0.1 (b) 10
(c) 1 (d) 2

AP EAMCET (Engg.) 2001

Ans. (a) : Given the expression for the pH of the acidic buffer solution is as given below

$$pH = Pk_a + \log\frac{[salt]}{[acid]}$$

$$Pk_a = 4.8$$

Substitute value in the above equation

$$5.8 = 4.8 + \log\frac{[salt]}{[acid]}$$

Hence, $\frac{[salt]}{[acid]} = \frac{10}{1} = 10:1$

i.e. $\frac{[acid]}{[salt]} = \frac{1}{10} = 0.1$

221. Which one of the following salts give an acidic solution in water?

(a) CH_3COONa (b) NH_4Cl
(c) NaCl (d) CH_3COONH_4

AP EAMCET (Engg.) -2007

Ans. (b) : $NH_4Cl \rightleftharpoons NH_4 + Cl^-$
$H_2O + H_2O \rightleftharpoons OH^- + H_3O^-$

$$\begin{tikzcd} H_2O+H_2O \arrow[r, shift left] & OH^- \arrow[l, shift left] \arrow[d, shift left] & +H_3O^- \arrow[d, shift left] \\ & NH_4OH \arrow[u, shift left] & HCl+H_2O \arrow[u, shift left] \end{tikzcd}$$

Weakly ionized Strongly ionized

222. Match the following?

Species	Conjugate acid
(a) NH_3	(i) H_2C0_3
(b) HCO_3^-	(ii) H_30^+
(c) H_20	(iii) NH_4^+
(d) HSO_4^-	(iv) H_2SO_4

(a) $(a\rightarrow iii),(b\rightarrow i),(c\rightarrow ii),(d\rightarrow iv)$
(b) $(a\rightarrow i),(b\rightarrow iii),(c\rightarrow ii),(d\rightarrow iv)$
(c) $(a\rightarrow iii),(b\rightarrow ii),(c\rightarrow i),(d\rightarrow iv)$
(d) $(a\rightarrow iii),(b\rightarrow ii),(c\rightarrow iv),(d\rightarrow i)$

AP EAPCET 20.08.2021 Shift-II

Ans. (a): A conjugate acid is formed when a proton is added to a base.

$$NH_3 + H^+ \longrightarrow NH_4^+$$
$$HCO_3^- + H^+ \longrightarrow H_2CO_3$$
$$H_2O + H^+ \longrightarrow H_2O^+$$
$$HSO_4^- + H^+ \longrightarrow H_2SO_4$$

223. Rochelle's salt is

(a) sodium citrate
(b) sodium potassium citrate
(c) potassium tartarate
(d) sodium potassium tartarate.

COMEDK-2011

Ans. (d) : Fehling reagent comprises of two solutions Fehling solution A and Fehling solution B. Fehling solution A is aqueous copper sulptate and Fehling solution B is alkaline sodium potassium tartarate (Rochelle's salt)

224. In the titration of oxalic acid against sodium hydroxide the indicator used is

(a) diphenylamine (b) methyl orange
(c) menthyl red (d) phenolphthalein.

COMEDK-2011

Ans. (d) : Phenolphthalein is used as indicator in the titration of weak acid against strong alkali.

225. The conjugate acid of HCO_3^- is

(a) H_2CO_3 (b) CO_3
(c) CO_2 (d) CO

COMEDK-2011

Ans. (a) : $\underset{\text{Base}}{HCO_3^-} \xrightarrow{H^+} \underset{\text{Conjugate acid}}{H_2CO_3}$

Specie	Conjugate Acid	Conjugate Base
H_2O	H_3O^+	OH^-
HCO_3^-	H_2CO_3	CO_3^{2-}
HSO_4^-	H_2SO_4	SO_4^{2-}
NH_3	NH_4^+	NH_2^-

@apna_pdf

226. According to the Lewis theory an acid is a

(a) proton donor (b) proton acceptor
(c) electron pair donor (d) electron pair acceptor.

COMEDK-2011

Ans. (d) : According to the Lewis theory an acid is a electron pair acceptor.
lewis acids accept an electron pair. Lewis acids are electrophilic meaning that they are electron attracting when bonding with a base the acid uses its lowest unoccupied molecular orbital.

227. The dissociation constant of a weak acid is 1×10^{-4} . In order to prepare a buffer solution with a pH=5, the [Salt]/[Acid] ratio should be

(a) 4 : 5 (b) 10 : 1
(c) 5 : 4 (d) 1 : 10

Karnataka NEET-2013

Ans. (b) : $\text{pH} = \text{pK}_a + \log\dfrac{[\text{Salt}]}{[\text{Acid}]}$ .....(i)

$K_a = 1 \times 10^{-4}$

$[\because \text{pK}_a = -\log K_a]$

$= -20g\,(1 \times 10^{-4})$

$= 4$

From equation (i)–

$$5 = -\log K_a + \log\frac{[\text{Salt}]}{[\text{Acid}]}$$

$$5 = 4 + \log\frac{[\text{Salt}]}{[\text{Acid}]}$$

$$5-4 = \log\frac{[\text{Salt}]}{[\text{Acid}]}$$

$$1 = \log\frac{[\text{Salt}]}{[\text{Acid}]}$$

$$\frac{[\text{Salt}]}{[\text{Acid}]} = 10 = 10:1$$

228. What is the conjugate base of HSO_4^- ?

(a) H_2SO_4 (b) HSO_4^{2-}
(c) SO_4^{2-} (d) H^+

AP-EAMCET (Medical), 2006

Ans. (c) : The acid base reaction can be written as:-

$$\underset{\text{Acid}}{HSO_4^-} + \underset{\text{Base}}{H_2O} \rightarrow \underset{\substack{\text{Conjugate}\\ \text{acid of } H_2O}}{H_3O^+} + \underset{\substack{\text{Conjugate}\\ \text{base of } H_2SO_4}}{SO_4^{2-}}$$

Although it has a negative charge, it will never accept ah$^+$ to form H_2SO_4. That is because H_2SO_4 is a strong acid and completely dissociates in water.

Therefore, the sulfate ion $\left(SO_4^{-2}\right)$ is the conjugate base of HSO_4^-.

229. Identify Bronsted-Lowry acids in the reaction given.

$$\underset{(\mathbf{A})}{[Al(H_2O)_6]^{3+}} + \underset{(\mathbf{B})}{HCO_3^-} \rightleftharpoons \underset{(\mathbf{C})}{[Al(H_2O)_5(OH^-)]^{2+}} + \underset{(\mathbf{D})}{H_2CO_3}$$

The correct answer is

(a) (A), (C) (b) (B), (D)
(c) (A), (D) (d) (B), (C)

AP-EAMCET (Medical), 2008

Ans. (c) : The given reversible reaction is :

$$\underset{\substack{(A)\\ \text{acid}}}{\left[Al(H_2O)_6\right]^{3+}} + \underset{\substack{(B)\\ \text{base}}}{HCO_3^-} \rightleftharpoons \underset{\substack{(C)\\ \text{conjugate base}}}{\left[Al(H_2O)_5(OH^-)\right]^{2+}} + \underset{\substack{(D)\\ \text{conjugate acid}}}{H_2CO_3}$$

A base after gaining a proton (H$^+$) gives conjugate acid. Hence, in the above reaction A and D are the acids.

230. The elements 'X' , 'Y' and 'Z' form oxides which are acidic, basic and amphoteric respectively. The correct order of their electro negativity is

(a) $X > Y > Z$ (b) $Z > Y > X$
(c) $X > Z > Y$ (d) $Y > X > Z$

AP-EAMCET (Medical), 2008

Ans. (c) : As we know , electronegativity is directly proportional to non-metallic character and inversely proportional to metallic character. The element (X) form acidic oxide, so it is a non-metal, while the element (Y) form basic oxide, So (Y) is a metal. Hence the order of electronegativity will be X> Z > Y.

231. Which one of the following salts form is micelle?

(a) Sodium formate (b) Sodium acetate
(c) Sodium stearate (d) Sodium chloride

AP-EAMCET (Medical), 2001

Ans. (c) : A colloidal sized sodium stearate formed in water by association of these molecule each having a hydrophilic and hydrophobic end is known as micelle.

232. Which one of the following statements is not correct.

(a) Cl^- is a Lewis acid
(b) The pH of 10^{-8} molar HCl solution is less than 7
(c) the ionic product of water at 25°C is 10^{-14} mol^{2}L^{-2}
(d) Bronsted-Lowry theory could not explain the acidic character of $AlCl_3$

AP-EAMCET (Medical), 2002

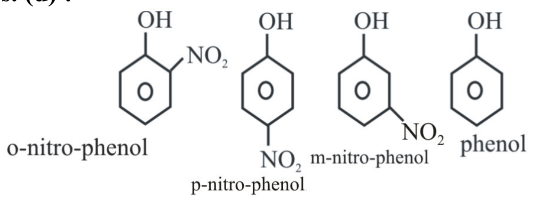
Ans. (a) : Cl^- is not a Lewis acid. It is a Lewis base. Lewis acid is a chemical species that reacts with a Lewis base to form a Lewis adduct. A Lewis base, then, is any species that donates a pair of electrons to a Lewis acid to form a Lewis adduct.
Therefore, Cl^- is a Lewis acid statement is not correct.

233. Which compound having maximum value of pK_a from following?

(a) $O-O_2N-C_6H_4-OH$
(b) $P-O_2N-C_6H_4-OH$
(c) $m-O_2N-C_6H_4-OH$
(d) C_6H_5OH

GUJCET-2021

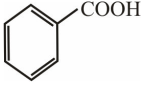
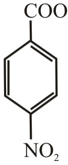
Ans. (d) :



@apna_pdf

Phenol (C_6H_5OH) has the maximum value of pK_a from the following. The pK_a value is inversely proportional to the acidity of compound. Phenol is least acidic in nature because it has the more pK_a value.
The pK_a order is-
Phenol > m-nitrophenol > p-nitrophenol > o-nitrophenol.

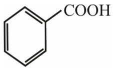
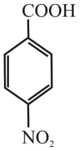
234. Match the following

Column-I **Acid**	**Column-II** **pKa value**
(A) CH_3COOH	**(I) 0.23**
(B) F_3CCOOH	**(II) 3.41**
(C) 	**(III) 4.19**
(D) 	**(IV) 4.76**

	A	**B**	**C**	**D**
(a)	IV	I	III	II
(b)	I	IV	II	III
(c)	IV	I	II	III
(d)	IV	III	II	I

TS EAMCET 04.08.2021, Shift-I

Ans. (a) : Correctly matched :

Acid	**pK_a value**
CH_3COOH	4.76
F_3CCOOH	0.23
	4.19
	3.413

235. If the molar concentrations of base and its conjugate acid are same, the pOH of the buffer solution is

(a) same as pK_b of base (b) same as pK_a of base
(c) same as pK_a of acid (d) same as pK_b of acid

TS EAMCET 04.08.2021, Shift-I

Ans. (a) : If the molar concentration of base and its conjugate acid are same the pOH of the buffer solution is same as pK_b of base.

236. The set of amphoteric oxides among the given oxides are Ga_2O_3, As_4O_{10}, Sb_4O_{10}, B_2O_3, Tl_2O

(a) Tl_2O, B_2O_3
(b) Sb_4O_{10}, B_2O_3, Ga_2O_3
(c) Ga_2O_3, Tl_2O, As_4O_{10}
(d) Ga_2O_3, As_4O_{10}, Sb_4O_{10}

TS EAMCET 04.08.2021, Shift-I

Ans. (d) : Amphoteric oxides–Metaloxide which react with both basic and acidic oxides to produces salt and water.
Ex-Ga_2O_3, As_4O_{10}, Sb_4O_{10} and Al_2O_3, all are amphoteric oxides because they react as acid with base and vice-versa.

237. The conductivity of a 0.05 M solution of a weak monobasic acid is 10^{-3}S cm^{-1}. If λ_m^∞ for weak acid is 500 S cm^2 mol^{-1}, calculate K_a of weak monobasic acid:

(a) 8×10^{-5} (b) 4×10^{-6}
(c) 16×10^{-7} (d) 14×10^{-8}

AIIMS 26 May 2019 (Evening)

Ans. (a): Given that, C = 0.05 M, k = 10^{-3} S cm^{-1}

$$\lambda_m^\infty = 500\,\text{S}\,\text{cm}^2\text{mol}^{-1}$$

$$K_a = C\alpha^2$$

We have to find α.

$$\alpha = \frac{\lambda_m^c}{\lambda_m^\infty}$$

$$\because \quad \lambda_m^c = \frac{1000 \times k}{C}$$

$$= \frac{1000 \times 10^{-3}}{0.05}$$

$$\lambda_m^c = 20 \text{ S cm}^2 \text{ mol}^{-1}$$

$$\alpha = \frac{20\,\text{S}\,\text{cm}^2\text{mol}^{-1}}{500\,\text{S}\,\text{cm}^2\text{mol}^{-1}} = 0.04$$

$K_a = C\alpha^2$
$K_a = 0.05 \times (0.04)^2$
$= 0.00008$
$K_a = 8 \times 10^{-5}$

238. Which of the following is incorrect about $K_2Cr_2O_7$?

(a) It can be prepared from K_2CrO_4.
(b) It is used in redox titrations.
(c) It is stable in both acid & base.
(d) It is orange in colour.

AIIMS 26 May 2019 (Evening)

Ans. (c):
- Colour of $K_2Cr_2O_7$ is orange
- $$\underset{\text{(Chromate ion)}}{2Cr_4^{-2}} \xrightarrow[\text{H+}]{\text{In acidic medium}} \underset{\text{(Dichromate ion)}}{Cr_2O_7^{2-}} + H_2O$$
- $K_2Cr_2O_7$ is used in redox titrations.
- It is stable in both acid & base this statement is incorrect about $K_2Cr_2O_7$.

239. Which of the following is a Lewis-acid?

(a) Br^- (b) Cl^-
(c) S^- (d) Ag^+

AIIMS-1994

Ans. (d): Ag^+ can accept electron pair so it act as Lewis acid and Br^-, Cl^-, S^- are Lewis base because these are donate e^- pair (lone pair).

240. Which of the following is the strongest base?

(a) H_2^+ (b) H
(c) HCO_3^- (d) H^-

AIIMS-1996

Ans. (c) : HCO_3^- is a strongest base.
A stronger base liberates more OH^- when dissolved in an aqueous solution and has a pH value of more than 7. So, HCO_3^- acts as a base when reacting with the compound that is more acidic than it i.e. HCl. This is because a stronge acid has more ability to donate the proton.

@apna_pdf

241. The strongest bronsted base among the following anions is

(a) ClO_3^- (b) ClO^-

(c) ClO_4^- (d) ClO_2^-

AIIMS-1996

Ans. (b): Bronsted base is the substance that can accept H+ ion. With the increase in the number of oxygen atoms in the given conjugate base, the delocalization of the π bond becomes more extended. This results in decrease in electron density. Consequently also decreases in the order $ClO^- > ClO_2^- > ClO_3^- > ClO_4^-$

Hence strongest & bronsted base is ClO^-.

242. Assertion: H_2O shows amphoteric nature.

Reason: According to Bronsted theory, it acts as acid with NH_3 and a base with H_2S.

(a) If both Assertion and Reason are correct and Reason is the correct explanation of Assertion.

(b) If both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.

(c) If Assertion is correct but Reason is incorrect.

(d) If both the Assertion and Reason are incorrect.

AIIMS 26 May 2019 (Morning)

Ans. (a): Water has the ability to act as an acid as well as a base i.e. It behaves as an amphoteric substance.

In Bronsted sense it act as an acid with NH_3 and base with H_2S.

$$H_2O(l) + NH_3(aq) \rightleftharpoons OH^-(aq) + NH_4^+(aq)$$

$$H_2O(l) + H_2S(aq) \rightleftharpoons H_3O^+(aq) + HS^-(aq)$$

243. Assertion : KOH is more soluble in water than NaOH.

Reason : NaOH is a stronger base than KOH.

(a) If both Assertion and Reason are correct and the Reason is the correct explanation of Assertion.

(b) If both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.

(c) If Assertion if correct but Reason is incorrect.

(d) If both the Assertion and Reason are incorrect.

AIIMS-(2011)

Ans. (c): KOH is more soluble in water than NaOH. The ionic size of Na^+ is smaller than K^+. Hence attractive force between Na^+ and OH^- is relatively strong and so ionisation of NaOH is lower than KOH which makes NaOH a weaker base than KOH.

244. Assertion : Addition of silver ions to a mixture of aqueous sodium chloride and sodium bromide solution will first precipitate AgBr rather than AgCl.

Reason: K_{sp} of AgCl > K_{sp} of AgBr.

(a) If both Assertion and Reason are correct and the Reason is the correct explanation of Assertion.

(b) If both assertion and Reason are correct, but Reason is not the correct explanation of assertion.

(c) If Assertion is correct but Reason is incorrect.

(d) If both the Assertion and Reason are incorrect.

AIIMS-(2016, 2004)

Ans. (c): We know that,

The solubility product of AgBr = 5×10^{-13} and AgCl = 5×10^{-10}

Hence, K_{sp} of AgCl < K_{sp} of AgBr

Hence, when we add silver ion to a mixture of aqueous sodium chloride and sodium bromide solution, AgBr will percipitate first.

245. Assertion : $[Al(H_2O)_6]^{3+}$ is a stronger acid than $[Mg(H_2O)_6]^{2+}$.

Reason : Size of $[Al(H_2O)_6]^{3+}$ is smaller than $[Mg(H_2O)_6]^{3+}$ and possesses more effective nuclear charge.

(a) If both Assertion and Reason are correct and the Reason is the correct explanation of Assertion.

(b) If both assertion and Reason are correct, but Reason is not the correct explanation of assertion.

(c) If Assertion is correct but Reason is incorrect.

(d) If both the Assertion and Reason are incorrect.

AIIMS-(2010, 2008)

Ans. (a): $[Al(H_2O)_6]^{3+}$ is a stronger Lewis acid than $[Mg(H_2O)_6]^{2+}$ because along the period, size decreases and oxidation no. of metal increases. So, size of $[Al(H_2O)_6]^{3+}$ is smaller than $[Mg(H_2O)_6]^{2+}$ and possesses more effective nuclear charge which stabilizes the conjugate base.

246. In which of the following acid-base titration, pH is greater than 8 at equivalence point.

(a) Acetic acid versus ammonia.

(b) Acetic acid versus sodium hydroxide.

(c) Hydrochloric acid versus ammonia.

(d) Hydrochloric acid versus sodium hydroxide.

AIIMS-(2003)

Ans. (b): Acetic acid is a weak acid and sodium hydroxide is strong base. Salts of the two will Hydrolyse to give basic solution. So at neutral point, pH of the solution will be greater than 8.

247. pK_a value of four acids are given below. The strongest acid is:

(a) 4.0 (b) 3.5

(c) 2.5 (d) 2

BCECE-2004

AIIMS-(2000)

Ans. (d): We know that

$$\text{acidic strength} \propto K_a \propto \frac{1}{pK_a}$$

Hence acid with lowest pKa value will be strongest acid.

In this question minimum pKa value is 2.

Hence, It is a strongest acid.

248. Which is Lewis acid?

(a) C_2H_5OH (b) BF_3

(c) Cl^- (d) NH_3

AIIMS-(1998)

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Ans. (b) : Lewis acids are those which can accept a pair of non-bonding electron pair. Hence BF_3 is accept electron pair it is Lewis acid.
Lewis base are those which can donate a pair of e^- pair C_2H_5OH, Cl^-, NH_3 all are donate e^- pair. Hence, It is a Lewis base.

249. In the reaction $I_2 + I^- \rightarrow I_3^-$, the Lewis base is:

(a) I_3^- (b) I_2
(c) I^- (d) non of these

BCECE-2005, AIIMS-(1997)

Ans. (c) : I^- ion can act as Lewis base i.e. It can denote electron pair to some species.
Here, I^- is giving electron pair to I_2 molecule. Therefore I_2 is a lewis acid and I^- is a lewis base.

250. Which among the following pairs is not an acidic buffer?

(a) HCOOH & HCOOK
(b) $HClO_4$ & $NaClO_4$
(c) C_6H_5COOH & C_6H_5COONa
(d) HCN & KCN

AP EAPCET 19-08-2021, Shift-II

Ans. (b) : Acidic buffer are solution that have a pH below 7 and contain a weak acid and one of its salts. So, the $HClO_4$ is the strong acid which means that it's conjugate base is extremly weak. As such, the solution of $HClO_4$ and $NaClO_4$ is not a buffer solution.

251. The pK_a values of four carboxylic acids are 4.76, 4.19, 0.23 and 3.41 respectively. The pK_a value of strongest carboxylic acid among them is

(a) 4.19 (b) 3.41
(c) 0.23 (d) 4.76

AP-EAMCET- (Engg.)-2011

Ans. (c) : The value K_a is increase then acid is stronger but smaller pKa value. Hence among the given carboxylic acid the pKa value of strongest acid is 0.23.

252. Which one of the following is correct with respect to basic character?

(a) $P(CH_3)_3 > PH_3$ (b) $PH_3 > P(CH_3)_3$
(c) $PH_3 > NH_3$ (d) $PH_3 = NH_3$

AP-EAMCET (Engg.) 2015

Ans. (a) : $P(CH_3)_3$ is more basic than PH_3 because there is three methyl group attached to phosphorous due to +I effect.

253. Assertion (A) According to Lowry-Bronsted theory, a substance can function as an acid as well as a base.
Reason (R) Acid reacts with a base to produce a salt.
The correct answer is

(a) Both (A) and (R) are true and (R) is the correct explanation of (A)
(b) Both (A) and (R) are true but (R) is not the correct explanation of (A)
(c) (A) is true but (R) is not true
(d) (A) is not true but (R) is true

AP- EAMCET(Medical) -2010

Ans. (b): According to Lowry Bronsted theory, a species can function as an acid as well as a base. e.g.:- H_2O. Water loss his proton and act as a lewis acid if they accept proton then act as a lewis base. Acid reacts with base to produce a salt.

$$\text{Acid} + \text{Base} \longrightarrow \text{Salt}$$

Hence, both (A) and (R) are true but (R) is not the correct explanation of (A).

254. Which one of the following compounds is Lewis acid?

(a) PCl_3 (b) BCl_3
(c) NCl_3 (d) $CHCl_3$

AP – EAMCET - (Medical)-1997

Ans. (b) : In BCl_3, Boron has 6 electrons in it outermost orbital and has a vacant p-orbital. Thus, it is an electron-deficient compound.
Hence, it acts as Lewis acid and accepts a loan pair of electrons.

255. The conjugate acid of NH_2^- ion is:

(a) NH_3 (b) NH_4^+
(c) N_2H_4 (d) NH_2OH

COMEDK 2012
AP-EAMCET 1997
AP-EAMCET - (Medical)-1997

Ans. (a) : According to Bronsted–Lowery theory of acid and base, the species which accepting a proton is called conjugate acid of the base.

$$\underset{\text{Base}}{NH_2^-} + H^+ \longrightarrow \underset{\text{Conjugate acid}}{NH_3}$$

256. Which one of the following is not a base?

(a) N_2H_4 (b) NH_2OH
(c) $(CH_3)_3N$ (d) HN_3

AP – EAMCET - (Medical)-1997

Ans. (d) : Hydrazoic acid or azoimide is a colorless acid whose chemical formula is HN_3. Hydrazoic acid is an important hydride of nitrogen but unlike ammonia and hydrazine, it is acidic in nature.

257. The strongest conjugate base results from':

(a) Formic acid (b) Benzoic acid
(c) Acetic acid (d) Acetylene

AP-EAMCET-1998
AP – EAMCET - (Medical)-1997

Ans. (d) : The compounds which donates a proton are called acid and compounds which accept proton are called base. When an acid donate a proton is called conjugate base of that acid.
The strongest conjugate base results from acetylene since it is the weakest acid among formic acid, benzoic acid, acetic acid and acetylene.
The order of strength of acids is given below–
Acetylene < Acetic acid < Formic acid < Benzoic acid
Weaker an acid, stronger will be its conjugate base. Hence, the order of strength of conjugate bases will be as follows–
Acetylene > Acetic acid > Formic acid > Benzoic acid

258. Which of the following oxide is amphoteric?

(a) SnO_2 (b) CaO
(c) SiO_2 (d) CO_2

VITEEE- 2012

@apna_pdf

Ans. (a) : Amphoteric oxides reacts with both acids and alkalis to form salts and water. Examples of amphoteric oxides are zinc oxide aluminium oxide and tin oxide. Generally in group 14 SiO_2 and CO_2 are acidic where as in second group due to alkali nature of elements it oxide are basic.

Amphoteric → Acidic/Basic

Metals → Basic, Amphoteric

Amphoteric Metals→ Be, Sc, Ti, V, Cr, Fe, Co, Cu, Zn, Al, Ge, Sn, Zn, Ag, Ga, Au, In, Tl, Pb, Sb, Bi

259. The conjugate acid of O^{2-} is

(a) O_2 (b) O_2^-

(c) H_2O (d) OH^-

AMU-2019

Ans. (d) : Adding one H^+ to anything gives you is conjugate acid.

Removing one H^+ gives you its conjugate base.

conjugate acid of O^{2-}

$O^{2-} + H^+ \rightarrow OH^-$

260. Which one of the following acids is used as an oxidizer in rocket fuel?

(a) $HClO_4$ (b) HNO_2

(c) H_3PO_4 (d) HNO_3

AMU-2014

Ans. (d) : Rocket fuels generally contain two substance, one the fuel and other the oxidiser.

Oxidizer is an oxygen rich substance and used to provide oxygen for burning process. Common oxidizers used for this purpose are nitric acid (HNO_3).

261. Pick out the electrophiles from the following species:

BF_3, NH_3, Me_3C^+, HCl

(a) BF_3 and NH_3 (b) Me_3C^+ and HCl

(c) BF_3 and Me_3C^+ (d) NH_3 and HCl

AMU-2013

Ans. (c) : The neutral or positively charged species with deficiency of electron and capable of accepting a pair of electron (Lewis acid) are called electrophiles ex. BF_3 and Me_3C^+ are electrophiles.

262. For a diprotic acid, which of the following is true for 1st and 2nd ionization constants (K_{a_1} and K_{a_2})?

(a) $K_{a_1} = K_{a_2}$ (b) $K_{a_1} > K_{a_2}$

(c) $K_{a_2} > K_{a_1}$ (d) $K_{a_2} \geq K_{a_1}$

AMU-2012

Ans. (b) : K_{a_1} and K_{a_2} are acid constant for polyprotic acids, which may consist of diprotic acids, triprotic acid etc. The first dissociation constant is necessarily greater than the second (i.e. $K_{a_1} > K_{a_2}$); this is because the first proton to dissociate is always the most strongly acidic, followed in order by next most strongly acidic proton.

So, $K_{a_1} > K_{a_2}$

263. The strongest base of the following is

(a) NaOH (b) KOH

(c) LiOH (d) CsOH

AMU-2012

Ans. (d) : The order of basic character of hydroxide of alkali metal is–

CsOH > RbOH > KOH > NaOH > LiOH

The order of basicity appears to be inversely related to the electropositivity. Thus the more electropositive, the more the cation may associate with the OH^-, making it less available to act as a base.

264. Which of the following acids is stronger than benzoic acid (K_a=6.3×10^{-5})?

(a) A (K_a=1.67×10^{-8}) (b) B (pK_a=6.0)

(c) C (pK_a=4.0) (d) D (K_a=1.0×10^{-5})

AMU-2012

Ans. (c) : $pK_a = -\log K_a$

pK_a for bezoic acid $= -\log(6.3 \times 10^{-5})$

$= -\log 6.3 - \log 10^{-5}$

$= -0.799 + 5$

$= 4.201$

(a) pK_a for A $= -\log(1.67 \times 10^{-8})$

$= -0.222 + 8 = 7.778$

(b) pK_a for B = 6.0

(c) pK_a for C = 4.0

(d) pK_a for D $= -\log(1.0 \times 10^{-5})$

$= 0 + 5 = 5$

For a stronger acids, pK_a must be less.

Therefore, acid C will be stronger than benzoic acid.

265. If the salt M_2X,$QY_2$and PZ_3 have the same solubilities, their K_{sp} values are related as

(a) $K_{sp}(M_2X)$=$K_{sp}(QY_2)$< $K_{sp}(PZ_3)$

(b) $K_{sp}(M_2X)$>$K_{sp}(QY_2)$= $K_{sp}(PZ_3)$

(c) $K_{sp}(M_2X)$<$K_{sp}(QY_2)$= $K_{sp}(PZ_3)$

(d) $K_{sp}(M_2X)$>$K_{sp}(QY_2)$> $K_{sp}(PZ_3)$

AMU-2011

Ans. (a) : For M_2X Salt⁻

$M_2X \rightleftharpoons 2M^+ + X^{2-}$

$K_{sp} = (2S)^2\ (S)$

$= 4S^3$

For QY_2 Salt⁻

$QY_2 \rightleftharpoons \underset{(S)}{Q^{2+}} + \underset{(2S)}{2Y^-}$

$K_{sp} = (Q^{2+}) + (Y^-)^2$

$= (S)\ (2S)^2$

$K_{sp} = 4S^3$

For PZ_3 Salt⁻

$PZ_3 \rightleftharpoons \underset{(S)}{P^{3+}} + \underset{(2S)}{3Z^-}$

$K_{sp} = \underset{(S)}{(P^{3+})} + \underset{(3S)^3}{(Z^-)^3}$

$K_{sp} = (S)\ (27S^3)$

$K_{sp} = 27S^4$

Thus K_{sp} in order–

$K_{sp}(M_2X)$=$K_{sp}(QY_2)$< $K_{sp}(PZ_3)$

266. Which of the following conjugate bases will be the most acidic in nature?

(a) NO_3^- (b) Cl^-

(c) HSO_4^- (d) SO_4^{2-}

AMU – 2008

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Ans. (c) : The strength of an acid depend upon its tendency to lose its proton and the strength of the base depends upon its tendency to gain the proton.

$H_2SO_4 > HCl > HNO_3 > HSO_4^-$ (acidic strength)

$HSO_4^- > Cl^- > NO_3^- > SO_4^{2-}$ (conjugate base strength)

Conjugate base of H_2SO_4 i.e., HSO_4^- is most acidic in nature.

267. A solution of $FeCl_3$ in water acts as acidic solution due to :

(a) hydrolysis of Fe^{3+} (b) acidic impurities

(c) dissociation (d) ionisation

BCECE-2006

Ans. (a) : $FeCl_3 + 3H_2O \rightleftharpoons Fe(OH)_3 + 3HCl$

This is strong acid and weak base.

On hydrolysis $FeCl_3$ gives an acidic solution due to presence of strong acid and weak base in the solution.

268. Arrange NH_4^+, H_2O, H_3O^+, HF and OH^- in increasing order of acidic nature :

(a) $H_3O < NH_4^+ < HF < OH^- < H_2O$

(b) $NH_4^+ < HF < H_3O^+ < H_2O < OH^-$

(c) $OH^- < H_2O < NH_4^+ < HF < H_3O^+$

(d) $H_3O^+ > HF > H_2O > NH_4^+ > OH^-$

BCECE-2006

Ans. (c) : Acid are the species who have tendency to give H^+ ion.

The strongest giving tandency of H^+ ion is H_3O^+. Hence it is strongest acid and Base are the species who have tendency to accept H^+ ion. The strongest accepting H^+ ion is OH^-. Hence it is a base.

So order of acidity is–

$$\underset{\text{base}}{OH^-} < \underset{\text{neutral}}{H_2O} < \underset{\text{weak acid}}{NH_4^+} < \underset{\text{strong acid}}{HF} < \underset{\text{strong acid}}{H_3O^+}$$

269. What amount of water is added in 40 mL of NaOH (0.1N) which is neutralized by 50 mL of HCl (0.2N) ?

(a) 80 mL (b) 60 mL

(c) 40 mL (d) 90 mL

BCECE-2004

Ans. (b) : $N_1V_1 = N_2V_2$

Amount of water to be added= total volume – volume of NaOH.

Given normality of NaOH (N_1) = 0.1N

Volume of NaOH = V_1

Normality of HCl (N_2) = 0.2 N

Volume of HCl V_2 = 50 mL

$$N_1V_1 = N_2V_2$$

$$0.1 \times V_1 = 0.2 \times 50$$

$$V_1 = \frac{0.2 \times 50}{0.1} = 100$$

V of NaOH = 40mL

Amount of water to be added = 100 – 40 = 60mL

270. An acid has pH = 5 and its concentration is 1M. What is the value of K_a for the acid ?

(a) 10^{-7} (b) 10^{-5}

(c) 10^{-10} (d) 10^{-8}

BCECE-2003

Ans. (c) : Given, pH = 5

Concentration (C) = 1M

K_a = ?

By using $pH = -\log\sqrt{K_a.C}$

$$5 = -\log\sqrt{K_a.1}$$

$$5 = -\frac{1}{2}\log K_a$$

$$\log K_a = -10$$

$$K_a = 10^{-10}$$

271. CH_3COO^- ion is a

(a) weak conjugate base

(b) strong conjugate base

(c) weak conjugate acid

(d) strong conjugate acid

BCECE-2011

Ans. (b) : Acetic acid (CH_3COOH) is a weak acid.

In water it dissociates partially into hydrogen ion H^+ and the acetate ion CH_3COO^-. Thus, the acetate ion thus formed is a conjugate base of acetic acid.

Strong acids have a weaker conjugate base whereas weak acid have a strongest conjugate base.

Since acetic acid is weak acid, its conjugate base is strong in nature.

272. Nature of nitride ion is–

(a) acidic (b) basic

(c) amphiprotic (d) cannot predict

BCECE-2013

Ans. (b) : Nitride ion with H_2O it accepts protons from water molecules to form NH_3 and OH^- are released in the solution.

$$N_3 + 3H_2O(l) \xrightarrow{+} NH_3 + 3OH^-(aq)$$

Since nitride ion accepts protons and releases OH^-. It is strong Bronsted Lowry base,

Hence, the nature of nitride ions is basic.

273. 0.45 g of acid molecular weight 90 is neutralized by 20 ml of 0.5N caustic potash. The basicity of acid is

(a) 1 (b) 2

(c) 3 (d) 4

[BITSAT-2012]

Ans. (b) : Acid Base

0.45 g 20 mL of 0.5 N

Mass = 90 g/mole

no. of eq. of acid = gm eq. of base

Moles × basicity = N × V(L)

$$\frac{0.45}{90} \times \text{basicity} = 0.5 \times \frac{20}{1000}$$

$$0.005 \times \text{basicity} = 0.5 \times 0.02$$

$$\text{Basicity} = \frac{0.5 \times 0.02}{0.005}$$

∴ Basicity = 2

274. Which equilibrium can be described as an acid-base reaction using the Lewis acid-base definition but not using the Bronsted-Lowry definition?

(a) $2NH_3 + H_2SO_4 \rightleftharpoons 2NH_4^+ + SO_4^{2-}$

(b) $NH_3 + H_3COOH \rightleftharpoons NH_4^+ + CH_3COO^-$

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(c) $H_2O + CH_3COOH \rightleftharpoons H_3O^+ + CH_3COO^-$

(d) $[Cu(H_2O)_4]^{2+} + 4NH_3 \rightleftharpoons [Cu(NH_3)_4]^{2+} + 4H_2O$

AIIMS-2013
BITSAT 2006

Ans. (d) :

$[Cu(H_2O)_4]^{2+} + 4NH_3 \rightleftharpoons [Cu(NH_3)_4]^{2+} + 4H_2O$

In the above reaction, no proton transfer but the electron pairs of ammonia is transferred to copper ion and Hence it is Lewis acid base reaction.

While other reaction involve a proton transfer and Hence they are bronsted acid-base reactions.

275. Which of these is least likely to act as Lewis base?

(a) F^- (b) BF_3
(c) PF_3 (d) CO

BITSAT 2010

Ans. (b) : BF_3 has vacant orbital in which it can accept a lone pair of electrons or Pie electron. Hence, it act as a Lewis acid. Thus, it has least tendency to act as Lewis base.
On the other hand CO, F^-, PF_3 can either donate a lone pair of electron or Pi electron. Hence, they act as Lewis base.

276. What is the correct increasing order of Bronsted bases ?

(a) $ClO_4^- < ClO_3^- < ClO_2^- < ClO^-$

(b) $ClO_4^- > ClO_3^- > ClO_2^- > ClO^-$

(c) $ClO_3^- < ClO_4^- < ClO_2^- < ClO^-$

(d) $ClO^- > ClO_3^- > ClO_2^- < ClO_4^-$

BITSAT-2015

Ans. (a) : With the Increase in the number of oxygen atom, the extent of delocalization of negative charge by $p\pi$-$d\pi$ bonding increases.
This stabilizes the ion and decreases the tendency to accept a proton. This decreases the basicity,
So, correct increasing order of bronsted base strength is.

$ClO_4^- < ClO_3^- < ClO_2^- < ClO^-$

277. Which of the following can act as both Bronsted acid and Bronsted base?

(a) Na_2CO_3 (b) OH^-
(c) HCO_3^- (d) NH_3

BITSAT-2017

Ans. (c) :

$HCO_3^- + H^+ \rightleftharpoons H_2CO_3$ (Bronsted base)

$HCO_3^- \rightleftharpoons H^+ + CO_3^-$ (Bronsted acid)

278. Which compound gives saccharin acid when it reacts with conc. HNO_3?

(a) Sucrose (b) Starch
(c) Maltose (d) Glucose

CG PET-2019

Ans. (d) : Glucose and Gluconic acid on oxidation with nitric acid give saccharin acid.

279. Which element from group 15 gives most basic compound with hydrogen?

(a) Nitrogen (b) Bismuth
(c) Arsenic (d) Phosphorus

CG PET-2007

Ans. (a) : Basic character of group 15 hydrides decreases down the group.
Thus, NH_3 is most basic and Bismuth is least basic. order of basic strength is-
$NH_3 > PH_3 > As > Bi$

280. The acid present in vinegar is

(a) CH_3COOH (b) H_2SO_4
(c) HCl (d) HNO_3

CG PET-2004

Ans. (a) : Vinegar is a liquid consisting mainly of acetic acid (CH_3COOH) and water. The acetic acid is produced by the fermentation of ethanol by acetic acid bacteria.
Vinegar is now mainly used as a cooking ingredient.

281. Strongest Bronsted base among the following anions is

(a) ClO^- (b) ClO_2^-
(c) ClO_3^- (d) ClO_4^-

CG PET-2006, 2004

Ans. (a) : Strongest acid among $HClO_4$, $HClO_3$, $HClO_2$ and HClO is $HClO_4$ (due to greater no. of attached O^- atoms) and weakest is HClO. But the corresponding conjugate base of HClO i.e. ClO^- is the strongest Bronsted base.

282. The pH of water decreases with?

(a) Increase in temperature
(b) Increase in pressure
(c) Decrease in temperature
(d) Decrease in pressure

CG PET-2005

Ans. (a) : An Increase in temperature increases K_w and a decreases in temperature decreases K_w.
The neutral pH point depends on the K_w of water where both H and OH ion are equal in number. Hence, pH of water decreases with increase in temperature.

283. The aqueous solution of which one of the following is basic?

(a) HOCl (b) $NaHSO_4$
(c) NH_4NO_3 (d) NaOCl

CG PET-2005

Ans. (d) : The mixture of strong base and weak acid is basic solution.
Hence, NaOCl is a mixture of strong base and weak acid.
So, aqueous solution is basic.

284. The weakest acid among the following is

(a) CH_3COOH (b) $CH_2ClCOOH$
(c) $CHCl_2COOH$ (d) CCl_3COOH

CG PET-2010

Ans. (a) : Among the following acetic acid (CH_3COOH) is the weakest acid.

285. Which of the following ligand is ambidentate ?

$\underset{(P)}{NO_3^-}, \underset{(Q)}{NO_2^-}, \underset{(R)}{CN^-}, \underset{(S)}{SCN^-}$

(a) R and S (b) P and Q
(c) Q and S (d) Q and R

GUJCET-2022

Ans. (a): Ligands which can bind through two different atom present in it are called ambidentate ligands.

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There are certain ligands which have two or more donor atom but during formation of complexes only one donar atom is attached to metal ion such ligands are called ambidentate ligands.
Such as CN^-, SCN^-, NO_2^-

286. Which of the following salts is the most basic in aqueous solution?
(a) $Al(CN)_3$ (b) CH_3COOK
(c) $FeCl_3$ (d) $Pb(CH_3COO)_2$
JEE Main-2018

Ans. (b) : Basic salt are salts that are product of the neutralization of a strong base and a weak acid.
CH_3COOK is the most basic in aqueous solution since it form strong base (KOH) and weak acid (CH_3COOH).

287. Which of the following are Lewis acids?
(a) PH_3 and BCl_3 (b) $AlCl_3$ and $SiCl_4$
(c) PH_3 and $SiCl_4$ (d) BCl_3 and $AlCl_3$
JEE Main 2018

Ans. (d) : BCl_3 and $AlCl_3$ are Lewis acid because Lewis acids are defined as electron deficient compounds which have the ability to accept at least one lone pair.

288. Three reactions involving $H_2PO_4^{2-}$ are given below

I. $H_3PO_4 + H_2O \rightarrow H_3O^+ + H_2PO_4^{2-}$

II. $H_2PO_4^{2-} + H_2O \rightarrow HPO_4^{2-} + H_3O^+$

III. $H_2PO_4^{2-} + OH^- \rightarrow H_3PO_4 + O^{2-}$

In which of the above does $H_2PO_4^{2-}$ act as an acid?
(a) II only (b) I and II
(c) III only (d) I only
[AIEEE-2010]

Ans. (a) : $H_2PO_4^- + H_2O \rightarrow HPO_4^{2-} + H_3O^+$
Only this reaction $H_2PO_4^-$ give H^+ to H_2O thus In this reaction $H_2PO_4^-$ behave as an acid.

289. Four species are listed below

I. HCO_3^- **II. H_3O^+**

III. HSO_4^- **IV. HSO_3F**

Which one of the following is the correct sequence of their acid strength?
(a) IV < II < III < I (b) II < III < I < IV
(c) I < III < II < IV (d) III < I < IV < II
[AIEEE-2008]

Ans. (c) : $HCO_3^- < HSO_4^- < H_3O^+ < HSO_3F$
HSO_3F is super acid and it is most acidic.
H_3O^+ is more acidic than anions because anions (HCO_3^-, HSO_4^-) do not release H^+ ion easily. HSO_4^- is more acidic than HCO_3^- because sulpher is more electronegative than carbon.

290. What is the conjugate base of OH^-?
(a) O^{2-} (b) O^-
(c) H_2O (d) O_2
[AIEEE-2005]

Ans. (c) : When acid give H^+ then the remaining of its part is called conjugate base.
So, if we remove H^+ from OH^-, we get O^{2-}. Hence, O^{2-} is the conjugate base of OH^-
OH^- is also a conjugate base of H_2O.

291. The conjugate base of $H_2PO_4^-$ is
(a) PO_4^{3-} (b) P_2O_5
(c) H_3PO_4 (d) HPO_4^{2-}
[AIEEE-2003]

Ans. (d) : We know that conjugate base of an acid, any acid is defined as the acid less of proton.
The conjugate acid of a base, any base is defined as the base plus a proton.
Now,
Acid + Base = Conjugate acid + Conjugate base
Acid donates hydrogen ions and the base is an acceptor of protons.
The reaction of hydrogen phosphate ion with a proton to form its conugate acid is given below–

$$HPO_4^{2-} + H^+ \rightarrow H_2PO_4^-$$

Hence, the conjugate acid that is formed is $H_2PO_4^-$, which is dihydrogen phosphate ion.

292. The increasing order of pK_a values for the following carboxylic acids is
(1) Acetic acid **(2) Formic acid**
(3) Benzoic acid **(4) Trichloroacetic acid**
(a) (4) < (2) < (3) < (1) (b) (3) < (1) < (2) < (4)
(c) (2) < (4) < (3) < (1) (d) (3) < (1) < (4) < (2)
J & K CET-(2016)

Ans. (a) : Acidic strength $\propto K_a \propto \dfrac{1}{pK_a}$
The order of acidic strength is– Thirchloracetic acid > Formic acid > Benzoic acid > Acetic acid.
Hence, the increasing order of pKa values is:- Trichloroacetic acid < Formic acid < Benzoic acid < Acetic acid.

293. Which of the following can behave as amphoteric oxide?
(a) Al_2Cl_6 (b) Na_2O
(c) SO_2 (d) Al_2O_3
J & K CET-(2001)

Ans. (d) : Those metal oxides which show basic, as well as acidic behaviour are known as amphoteric oxides. Al_2O_3 is an amphoteric oxide.

294. Which of the following is a Lewis acid?
(a) BF_4^- (b) OH^-
(c) $AlCl_3$ (d) RNH_2
J & K CET-(2013)

Ans. (c) : Lewis acid as a species which accepts electron pair and base which denote an electron pair. In Lewis concept many acid do not have proton.
Electron deficient species can act as Lewis acid.
$AlCl_3$ is e- deficient species. Hence, it is a Lewis acid.

295. Among the following, the one which can act as both Bronsted acid as well as Bronsted base is
(a) H_3PO_4 (b) $AlCl_3$
(c) CH_3COO^- (d) H_2O
J & K CET-(2011)

Ans. (d) : H_2O can behave as both Bronsted acid as well as Bronsted Base.

$$\underset{\text{acid}}{H_2O} + \underset{\text{base}}{H_2O} \rightleftharpoons H_3O^+ + OH^-$$

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296. Identify the substance whose 0.1 M solution is basic?

(a) Ammonium chloride (b) ammonium acetate
(c) Ammonium sulphate (d) Sodium acetate

J & K CET-(2010)

Ans. (d) : Sodium acetate is a salt of weak acid and strong base. Acetate ion on hydrolysis releases hydroxyl ions to form a basic solution.

In Ammonium acetate, both ammonium and acetate, ions hydrolyse to form ammonium hydroxide and acetic acid such that the solution is neutral in nature.

Ammonium chloride and ammonium sulphate are salt of weak base and strong acid. Ammonium ion hydrolyse to release hydrogen ion making the solution acidic

297. According to Lowry and Bronsted, the strength of an acid depends upon

(a) The dendency to gain protons
(b) The tendency to donate protons
(c) The tendency to accept electrons
(d) The tendency to donate electrons

J & K CET-(2007)

Ans. (b) : Acids are proton donors the strength of an acid will depend upon its ability to donate proton.

298. Which of the following in not a Lewis acid?

(a) BF_3 (b) $AlCl_3$
(c) HCl (d) $LiAlH_4$

J & K CET-(2005)

Ans. (c) : Hydrochloric acid (HCl) cannot be classified as a Lewis acid since it cannot accept an electron pair. However this compound dissociates into its constituents ions, liberating H^+ ion.

299. Which of the following is the strongest Lewis acid?

(a) BF_3 (b) BCl_3
(c) BBr_3 (d) BI_3

J & K CET-(2002)

Ans. (d) : The tendency of the halogen atom to back donate its electron to the boron atom and makes it less electron deficient. Hence, the relative strength of Lewis acids of boron trihalide

Increases in order $BF_3 < BCl_3 < BBr_3 < BI_3$.

Thus, BI_3 is strongest Lewis acid.

300. Which of the following is a Lewis base?

(a) CH_4 (b) $AlCl_3$
(c) Al $(OH)_3$ (d) NH_3

J & K CET-(2002)

Ans. (d) : Ammonia consist of a nitrogen atom as the control atom with a lone pair of electron the lone pair on the nitrogen atom is transferred to the hydrogen ion making the NH_3 a Lewis base.

301. The conjugate acid of NH_2^- is

(a) NH_4^+ (b) NH_3
(c) NH_2OH (d) N_2H_4

J & K CET-(1999)

Ans. (b) : The species formed after adding a proton to the base is known as conjugate acid of the base and the species formed after losing a proton is known as conjugate base of acid. The conjugate acid of amide ion (NH_2^-) is ammonia, NH_3.

$$\underset{\text{Base}}{NH_2^-} + H^+ \rightarrow \underset{\text{Conjugate acid}}{NH_3}$$

302. Mohr's salt is:

(a) $Na_2SO_4.Al_2\ (SO_4).24H_2O$
(b) $CuSO_4.Al_2\ (SO_4)_3.24H_2O$
(c) $FeSO_4.(NH_4)_2SO_4.6H_2O$
(d) $K_2SO_4.\ Fe_2(SO_4)_3.24H_2O$

JCECE - 2004

Ans. (c) : Mohr's salt also referred to as ammonium iron(II) sulfate, is an inorganic compound whose chemical formula is represented as

$$FeSO_4.(NH_4)_2SO_4.6H_2O$$

303. Which one of the following compounds, is not a protonic acid?

(a) $SO(OH)_2$ (b) $SO_2(OH)_2$
(c) $B(OH)_3$ (d) $PO(OH)_3$

JCECE - 2008

Ans. (c) : The acid which gives H^+ when placed in aqueous solution is called protonic acid.

Ortho boric acid does not donate proton like most of the acids but rather it accepts OH^- therefore it is a Lewis acid. $B(OH)_3$ in water gives H^+ ions as follows–

$$B(OH)_3 + 2H_2O \rightleftharpoons H_3O+ + [B(OH)_4]^-$$

$B(OH)_3$ is not a protonic acid because it does not give its hydrogen H^+ ions.

304. The strongest Bronsted base is

(a) ClO_3^- (b) ClO_2^-
(c) ClO_4^- (d) ClO^-

UPTU/UPSEE-2014
JCECE - 2010

Ans. (d) : Strongest Bronsted base is that which has weakest conjugate acid.

Base	**Conjugate acid (base + H^+)**
ClO^-	HClO
ClO_2^-	$HClO_2$
ClO_3^-	$HClO_3$
ClO_4^-	$HClO_4$

Order of basic strength–

$$ClO_4^- < ClO_3^- < ClO_2^- < ClO^-$$

$\therefore$ ClO^- is strongest Bronsted base.

305. Which of the following is not a Lewis base?

(a) CN^- (b) ROH
(c) NH_3 (d) $AlCl_3$

JCECE - 2011

Ans. (d) : Lewis base are the species which have a tendency to donate electrons. These contain either lone pair or negative charge.

$AlCl_3$ being electron deficient behaves as Lewis acid, not as Lewis base.

306. Which of the following salt when dissolved in water gets hydrolysed?

(a) NaCl (b) NH_4Cl
(c) KCl (d) Na_2SO_4

JCECE - 2011

@apna_pdf

Ans. (b) : Only salts of strong acid and strong base are not hydrolysed. All other salts can generally hydrolysed. NH_4Cl is a salt of weak base and strong acid, so it will hydrolyse in water.

$$NH_4Cl \xrightarrow{H_2O} \underset{\text{weak base}}{NH_4OH} + \underset{\text{strong acid}}{HCl}$$

307. Conjugate base of hydrazoic acid is

(a) HN_3^- (b) N_2^-

(c) N_3^- (d) N^{3-}

JCECE - 2011

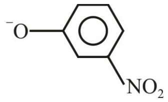
Ans. (c) : Hydrazoic acid is N_3H.

$$\underset{\text{Hydrazoic acid}}{N_3H} \longrightarrow H^+ + \underset{\text{Conjugate base}}{N_3^-}$$

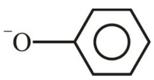
308. Which of the following species can act as the strongest base?

(a) OH^- (b) OR^-

(c)



(d)



JCECE - 2013

Ans. (b) : Weakest acid has the strongest conjugate base. Since, ROH is the weakest acid, therefore RO^- is the strongest base.

309. Species acting both as Bronsted acid and base is

(a) HSO_4^- (b) Na_2CO_3

(c) NH_3 (d) OH^-

JCECE - 2014

Ans. (a) : HSO_4^- can accept proton to form H_2SO_4 and also give a proton to form SO_4^{2-} therefore, it acts both as Bronsted acid as well as base.

$$HSO_4^- + H^+ \rightarrow H_2SO_4$$
$$HSO_4^- \rightarrow H^+ + SO_4^{2-}$$

310. Which of the following is least likely to behave as Lewis base?

(a) NH_3 (b) BF_3

(c) OH^- (d) H_2O

JIPMER-2014

Ans. (b) : Boron trifluoride BF_3 is least likely to behave as Lewis base. Electron rich species are called Lewis base. Among the given BF_3 is an electron deficient species. So have a capacity of electron accepting instead of donating. That's why it is least likely to act as a Lewis base. It is a Lewis acid.

311. The conjugate base of NH_3 is

(a) NH_4^+ (b) NH_4OH

(c) NH_2OH (d) NH_2^-

Karnataka-CET-2020

Ans. (d) : NH_3 can donate a proton & act as an acid,

$$NH_3 \longrightarrow NH_2^- + H^+$$

NH_2^- is the conjugate base of NH_3

312. Which of the following is the strongest base?

(a) CH_3COO^- (b) Cl^-

(c) OH^- (d) CH_3O^-

Karnataka-CET-2020

Ans. (d) : To check the basicity of an ion, the conjugate acid must be weak, the conjugate acid are given below. H_2O, CH_3OH, CH_3COOH and HCl.

We know that methanol is a stronger acid than water, weaker the acid. Stronger is the conjugate base, by the logic OH^- is the stronger base among the given option.

313. Acidity of BF_3 can be explained on which of the following concepts?

(a) Arrhenius concept

(b) Bronsted Lowry concept

(c) Lewis concept

(d) Bronsted Lowry as well as Lewis concept

Karnataka-CET-2018

Ans. (c) : The Lewis theory of acid defines acidic substances to be compounds or ions that have law electron density and look for loan pair supplier. Therefore boron trifluoride (BF_3) is an acid according to Lewis acid theory.

314. Identify a species which is not a Bronsted acid but a Lewis acid.

(a) BF_3 (b) H_3^+O

(c) NH_3 (d) HCl

Karnataka-CET-2013

Ans. (a) : Lewis acid are the acid which accept lone pairs. Bronsted defined an acid as a substance, which has a tendency to give a proton (H^+), on the other hand Lewis proposed an acid as a substance, which is capable of accepting a pair of electrons. As H_3O^+, NH_3 and HCl has H^+ ions, these are Bronsted acid whereas BF_3 is an electron deficient molecule, thus behave like a Lewis acid i.e. electron pair acceptor.

315. The vapour pressure of pure liquids A and B are 450 and 700 mm of Hg at 350 K respectively. If the total vapour pressure of the mixture is 600 mm of Hg, the composition of the mixture in the solution is

(a) $\chi_A = 0.4$ $\chi_B = 0.6$ (b) $\chi_A = 0.6$ $\chi_B = 0.4$

(c) $\chi_A = 0.3$ $\chi_B = 0.7$ (d) $\chi_A = 0.7$ $\chi_B = 0.3$

Karnataka-CET-2021

Ans. (c) : $P_A^\circ = 450mm, P_B^\circ = 700mm, P_{total} = 600mm$

As $P_{total} = P_A + P_B$

$= x_A P_A^\circ + x_B P_B^\circ$ (from raoult's law)

$= x_A P_A^\circ + (1 - x_A) P_B^\circ$

$= P_B^\circ + (P_A^\circ - P_B^\circ) x_A$

$\Rightarrow 600 = 700 + (450 - 700) x_A$

or $x_A = 0.40$

$\therefore x_B = 1 - x_A = 1 - 0.40 = 0.60$

$\therefore P_A = x_A P_A^\circ = 0.40 \times 450 = 180mm$

$\therefore P_B = x_B P_B^\circ = 0.60 \times 700 = 420mm$

$\therefore$ Mole fraction of A in vapoure phase

$$= \frac{P_A}{P_A + P_B} = \frac{180}{180 + 420} = 0.30$$

and, mole fraction of B in vapour phase

$= 1 - 0.30 = 0.70$

316. When conc. H_2SO_4 is heated with P_2O_5, the acid is converted into

(a) sulphur trioxide (b) sulphur dioxide

(c) sulphur

(d) a mixture of sulphur dioxide and sulphur trioxide

Karnataka-CET-2007

@apna_pdf

Ans. (a) : When conc. H_2SO_4 is heated with P_2O_5, the acid is converted into sulphur trioxide.

$$2H_2SO_4 + 2P_2O_5 \longrightarrow \underset{\text{Sulphur trioxide}}{2SO_3} + 4HPO_3$$

317. K_a values for acids H_2SO_3, HNO_2, CH_3COOH and HCN are respectively 1.3×10^{-2}, 4×10^{-4}, 1.8×10^{-5} and 4×10^{-10}, which of the above acids produces stronger conjugate base in aqueous solution ?

(a) HSO_3 (b) HNO_2

(c) CH_3COOH (d) HCN

Kerala-CEE-29.08.2021

Karnataka-CET-2021

Ans. (d) : The given values are :

Acid	K_a values
H_2SO_3	1.3×10^{-2}
HNO_2	4×10^{-4}
CH_3COOH	1.8×10^{-5}
HCN	4×10^{-10}

The species which has lower value of dissociation constant (K_a), having the least acidic behaviour. As we know, the conjugate base of weak acid has strongest conjugate basic character. Hence, the correct option is (d).

318. Which one of the following oxides is amphoteric?

(a) MgO (b) CaO

(c) Na_2O (d) CO_2

(e) ZnO

Kerala-CEE-2004

Ans. (e) : ZnO is a amphoteric oxide because it can act with acid as well as base.

$ZnO + 2NaOH \rightarrow Na_2ZnO_2 + H_2O$

$ZnO + HCl \rightarrow ZnCl_2 + H_2O$

319. Choose the weak monobasic acid, among the following

(a) H_3BO_3 (b) H_3PO_3

(c) H_3PO_4 (d) HNO_3

(e) $H_4P_2O_7$

Kerala-CEE-2012

Ans. (a) : H_3BO_3 is a weak Lewis monobasic acid because it can only accept a pair of electron. None of its hydrogen are ionisable.

H_3PO_3 is a dibasic acid, H_3PO_4 is a tribasic acid,

HNO_3 is a strong monobasic acid, $H_4P_2O_7$ is tetrabasic acid.

320. Which one of the following is the correct statement?

(a) HCO_3^- is the conjugate base of CO_3^{2-}

(b) NH_2^- is the conjugate base of NH_3

(c) H_2SO_4 is the conjugate base of HSO_4^-

(d) NH_3 is the conjugate base of NH_2^-

(e) H_2CO_3 is the conjugate base of HCO_3^-

Kerala-CEE-2012

Ans. (c) : Acid when loses a proton (H^+) gives its conjugate base and base when accepts a proton (H^+) gives conjugate acid.

(a) $\underset{\text{Base}}{CO_3^{2-}} + H^+ \rightarrow \underset{\text{Conjugate acid}}{HCO_3^-}$

(b) $\underset{\text{Base}}{NH_3} \rightarrow \underset{\text{Conjugate acid}}{NH_2^-} + H^+$

(c) $\underset{\text{Base}}{HSO_4^-} + H^+ \rightarrow \underset{\text{Conjugate acid}}{H_2SO_4}$

(d) $\underset{\text{Base}}{NH_2^-} + H^+ \rightarrow \underset{\text{Conjugate acid}}{NH_3}$

(e) $\underset{\text{Base}}{HCO_3^-} + H^+ \rightarrow \underset{\text{Conjugate acid}}{H_2CO_3}$

Hence, H_2SO_4 is the conjugate base of HSO_4^-.

321. Which one of the following is an amphoteric oxide?

(a) Mn_2O_7 (b) CrO

(c) V_2O_4 (d) Cr_2O_3

(e) V_2O_3

Kerala-CEE-2012

Ans. (d) : Cr_2O_3 (Chromic oxide) is an amphoteric oxide.

It has the ability to dissolve in acids. Liberating hydrated chromium ions in the process they hydrated Cr ions can react with base to form complex salt. Cr_3O_3 can show the property of acidic as well as basic oxide both.

322. Hard acids prefer to combine with

(a) Soft bases (b) Soft acids

(c) Hard acids (d) Hard bases

(e) Salts

Kerala-CEE-2019

Ans. (d) : Hard bases contain small, relatively nonpolarisable donor atoms (such as N, O and F).

Hard acids prefer to combine with hard bases.

Hard acids are the cations (electron accepting atom) having high charge and small sizes whereas hard bases are the Lewis bases where the electron are not easily polarised or where the base holds its electron strongly.

323. In hydrolysis of a salt of weak acid and strong base, $A^- + H_2O \rightleftharpoons HA^- + OH^-$, the hydrolysis constant (K_h) is equal to :

(a) $\dfrac{K_w}{K_a}$ (b) $\dfrac{K_w}{K_b}$

(c) $\sqrt{\dfrac{K_a}{C}}$ (d) $\dfrac{K_w}{K_a \times K_b}$

Manipal-2019

Ans. (a) : $A^- + H_2O \rightleftharpoons HA^- + OH^-$

$$K_h = \frac{[HA^-][OH^-]}{[A^-]} \qquad K_w = [H^+][OH^-]$$

$$HA \rightleftharpoons H^+ + A^-$$

$$K_a = \frac{[H^+][A^-]}{[HA]}$$

Also we know that,

$$\frac{K_w}{K_a} = \frac{[H^+][OH^-][HA]}{[H^+][A^-]}$$

@apna_pdf

$$\frac{K_w}{K_a} = \frac{[OH^-][HA]}{[A^-]}$$

$$\frac{K_w}{K_a} = K_h$$

324. The conjugate base of the acid H_2S is :

(a) HS^- (b) S^{2-}
(c) S (d) None of these

Manipal-2017

Ans. (a) : Conjugate base of H_2S is HS^-

When hydrogen sulfide (H_2S) denote a proton. The compound left behind will be the disulfide anion, HS its conjugate base.

$$\underset{\text{acid}}{H_2S} + H_2O \rightleftharpoons \underset{\substack{\text{conjugate}\\\text{base}}}{HS^-} + H_3O^+$$

325. Identify the element that forms amphoteric oxide.

(a) Carbon (b) Zinc
(c) Calcium (d) Sulphur

MHT CET-2018

Ans. (b) : The oxides which can react with both acid and base to give a salt are called amphoteric oxides. Oxides of carbon and sulphur are acidic and the oxide of calcium is basic. Zinc forms an amphoteric oxide. They show characteristics of both acidic as well as basic oxides.

Following reactions are given by ZnO –

$$ZnO + 2HCl \rightarrow ZnCl_2 + H_2O$$

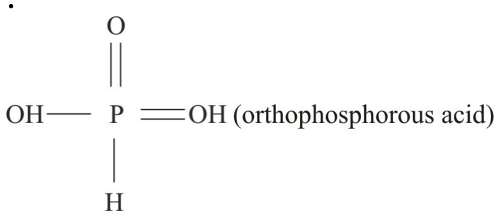
$$ZnO + 2NaOH \rightarrow Na_2ZnO_2 + H_2O$$

326. What is the basicity of orthophosphorous acid?

(a) One (b) Two
(c) Three (d) Four

MHT CET-2015

Ans. (b) :



$$OH-\overset{\overset{O}{||}}{\underset{\underset{H}{|}}{P}}=OH \text{ (orthophosphorous acid)}$$

The number of H atom bonded to the oxygen atoms in the above compound is equal to 2. Therefore the basicity of the orthophosphorous acid is 2.

327. The product of molar concentrations of hydrogen ions and hydroxide ions in a 0.01 M aqueous solution of sodium chloride is known as

(a) Hydrolysis constant of salt
(b) Dissociation constant of acid
(c) Dissociation constant of base
(d) Ionic product of water

MHT CET-2014

Ans. (d) : Sodium chloride is a salt of strong base NaOH and strong acid HCl. In its aqueous solution. Following equilibrium is observed.

$$NaCl + H_2O \rightleftharpoons Na^+ + Cl^- + H_2O$$

Hence, no hydrolysis takes place in this case, and the solution remains neutral.

Thus, here the product of molar concentrations of hydrogen ions and hydroxide ion is ionic product of water. Water is weak electrolyte and undergoes selfionstions to a small extent. The product of concentrations of H^+ and OH^- ions in water at a particular temperature is known as ionic product of water.

328. Which of the following is a weak acid?

(a) C_6H_6 (b) CH_3COOH
(c) $CH_2 = CH_2$ (d) CH_3COCH_3

MHT CET-2012

Ans. (b) : CH_3COOH is a weak acid because acetic acid is not a strong enough proton donor to be entirely converted to hydronium ions in aqueous solution. Therefore the nature of CH_3COO^- is basic, and we call CH_3COO^- the conjugate base of CH_3COOH. It is in equilibrium with its ions in water and its conjugate (CH_3COO^-, a weak base) is also in equilibrium in water.

So, it is called a weak acid.

329. The conjugate acid of HS^- is

(a) S^{2-} (b) H_2S
(c) Both (a) and (b) (d) None of these

MHT CET-2012

Ans. (b) : Conjugate acid of HS is H_2S

$HS^- + H^+ \rightarrow H_2S$ (Conjugate acid)

$HS^- \rightarrow S^{2-} + H^+$ (Conjugate acid)

330. Which of the following salts will not undergo hydrolysis?

(a) NH_4Cl (b) KCN
(c) KNO_3 (d) Na_2CO_3

MHT CET-2011

Ans. (c) : Salt of strong acid and strong base is not undergo hydrolysis.

Potassium nitrate (KNO_3) is a salt of strong base and strong acid hence, It is not hydrolysis.

331. Solutions in test tubes containing H_2O and aqueous NaOH can be differentiated with the help of:

(a) red litmus (b) blue litmus
(c) Na_2CO_3 (d) HCl (aqueous)

NDA (I)-2011

Ans. : (a) Solutions in test tubes containing H_2O and aqueous NaOH can be differentiated with the help of red litmus.

332. When concentrated H_2SO_4 splits of the surface, it should be immediately cleaned:

(a) with a piece of cloth.
(b) by adding cold water.
(c) by adding solid Na_2CO_3.
(d) by adding solid $BaCl_2$

NDA (I)-2011

Ans. : (c) When concentrated H_2SO_4 splits of the surface, it should be cleaned by adding solid Na_2CO_3.

333. A bee-sting leaves an acid which causes pain and irritation. The injected acid is:

(a) acetic acid (b) sulphuric acid
(c) citric acid (d) methanoic acid

NDA (I)-2011

@apna_pdf

Ans. : (d) Bee-sting leaves contains methanoic acid that cause pain and irritation.

- **Methanoic acid:–** It is utilized to deliver insect sprays and for colouring, tanning, and electroplating. It happens normally in different sources.

334. NH_4Cl is acidic due to

(a) Cationic hydrolysis (b) Anionic hydrolysis
(c) Its ionic nature (d) pH > 7

MHT CET-2010

Ans. (a) : NH_4Cl is a salt of strong acid HCl and weak base NH_4OH.

Hydrolysis:-

$$NH_4Cl + H_2O \rightleftharpoons NH_4OH + HCl$$

$$NH_4^+ + Cl^- + H_2O \rightleftharpoons NH_4OH + H^+ + Cl^-$$

$$NH_4^+(aq) + H_2O(l) \rightleftharpoons NH_4OH(aq) + H^+(aq)$$

Only the cation will undergo hydrolysis and the solution will be acidic in nature due to H^+ formation. So here the cation is responsible for the acidic nature of the solution.

335. Conjugate acid-base pair differ by

(a) Electron (b) Proton
(c) Neutron (d) Hydroxyl group

MHT CET-2010

Ans. (b) : Conjugate acid-base pair contains two compounds that differ only by a hydrogen ion H^+ (proton) and a charge of +1.

Acid – $H^+ \rightarrow$ conjugate base
Base + $H^+ \rightarrow$ conjugate acid

336. Reaction for the formation of NaCl is

(a) $Na(g) + Cl_2(g) \longrightarrow NaCl(s)$

(b) $Na(s) + \frac{1}{2}Cl_2(g) \longrightarrow NaCl(s)$

(c) $Na(g) + \frac{1}{2}Cl(g) \longrightarrow NaCl(s)$

(d) $Na(g) + Cl_2(g) \longrightarrow NaCl(g)$

MHT CET-2010

Ans. (b) : In the Born-Haber cycle given reaction for the formation of NaCl is:-

$$Na(s) + \frac{1}{2}Cl_2(g) \longrightarrow NaCl(s)$$

337. If 20 mL of an acidic solution of pH=3 is diluted to 100 mL, the H^+ ion concentration will be

(a) 1×10^{-3} M (b) 2×10^{-3} M
(c) 2×10^{-4} M (d) 0.02×10^{-4} M

MHT CET-2009

Ans. (c) : Given that –

pH = 3
V_1 = 20ml V_2 = 100ml
H^+ = ?
$H^+ = 1 \times 10^{-3}$ m $= 1 \times 10^{-3}$N
$N_1 V_1 = N_2 V_2$
$1 \times 10^{-3} \times 20 = N_2 \times 100$
$N_2 = 2 \times 10^{-4}$
$[H^+] = 2 \times 10^{-4}$M

338. Which of the following is the weakest base?

(a) Ethyl amine (b) Ammonia
(c) Dimethyl amine (d) Methyl amine

MHT CET-2008

Ans. (b) : NH_3 (Ammonia) is a weakest base because the ammonia's nitrogen atom has an electron pair that easily accepts a proton.
Hence, basic nature is Increased.
In Ammonia no Alkyl group is present. So it is least basic.

339. Which one of the following species acts as both Bronsted acid and base?

(a) $H_2PO_2^-$ (b) HPO_3^{2-}
(c) HPO_4^{2-} (d) All of these

UPTU/UPSEE-2015
MHT CET-2008

Ans. (c) : HPO_4^{2-} act as both Bronsted acid and bronsted base.

$$HPO_4^{2-} + H_2O \rightleftharpoons H_2PO_4^- + OH^-$$

$$HPO_4^{2-} + H_2O \rightleftharpoons PO_4^{3-} + H_3O^+$$

$H_2PO_2^-$ is conjugate base of H_3PO_2 (a monobasic acid) and does not give H^+.

HPO_3^{2-} is a conjugate base of $H_2PO_3^-$ and does not ionize further.

H_3PO_3 is a dibasic acid.

340. Lemon gives sour taste because of

(a) Citric acid (b) Tartaric acid
(c) Oxalic acid (d) Acetic acid

MHT CET-2007

Ans. (a): Lemon comes under the category of citrus fruit. Lemon is sour in teste. It is rich in citric acid which makes it sour.

Tartaric acid –It is a white, crystalline organic acid that occurs naturally in many fruits such as grapes.

Oxalic acid – It is the simplest dicarboxlic acid.

Acetic acid – Acetic acid is the second simplest carboxlic acid vinegar is no less than 4% acetic acid by volume, making acetic acid the main component of vinegar apart from water.

341. Which of the following is an amphoteric oxide?

(a) SO_3 (b) Mg
(c) Al_2O_3 (d) P_4O_{10}

MHT CET-2007

Ans. (c):

Amphoteric

- These are the oxides that can react with both acids and as well as bases to form salt and water.
- These possess both acidic and basic properties.
- Al_2O_3, SiO_2 is an example of Amphoteric oxide
- $Al_2O_3 + 2NaOH$ (Base) $\rightarrow 2NaAlO_2 + H_2O$
- $Al_2O_3 + 6HCl$ (acid) $\rightarrow 2AlCl_3 + 3H_2O$

342. The hydrolysis of sodium carbonate involves the reaction between

(a) Sodium ion and water (b) Na^+ and OH^-
(c) CO_3^{2-} and water (d) CO_3^{2-} and H^+

MHT CET-2007

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Ans. (c) : Reactions of hydrolysis would be the opposite of condensation reaction in which two molecules bind together into a larger one an expel a molecule of water. Hydrolysis thus requires water to breakdown, while condensation occurs by eliminating water and all the other solvents. Any reactions to the hydration are hydrolysis. Now, we will write the reaction of hydrolysis of sodium carbonate–

$$Na_2CO_3 + 2H_2O \rightleftharpoons 2NaOH + H_2CO_3$$

or $$2Na^+ + CO_3^{2-} + 2H_2O \rightleftharpoons 2Na^+ + 2OH^- + H_2CO_3$$

It is anionic is alkaline in nature due to hydrolysis.

343. 0.1 M solution of which one of these substances will act basic ?

(a) Sodium borate (b) Ammonium chloride
(c) Calcium nitrate (d) Sodium sulphate

NEET-1992

Ans. (a) : Salt formed strong base and weak acid act as basic. Sodium borate is a salt formed from strong base (NaOH) and weak acid (H_3PO_3) Hence, sodium borate will act basic.

344. Conjugate base for Bronsted acids H_2O and HF are

(a) H_3O^+ and H_2F^+, respectively
(b) OH^- and H_2F^+, respectively
(c) H_3O^+ and F^-, respectively
(d) OH^- and F^-, respectively

NEET-2019

Ans. (d) : Bronsted acid- Conjugate base

$$H_2O \rightarrow OH^- + H^+$$
$$HF \rightarrow F^- + H^+$$

Hence, OH^- and F^- are conjugate base of Bronsted acid (H_2O) and HF.

345. Which of the following cannot act both as Bronsted acid and as Bronsted base ?

(a) HCO_3^- (b) NH_3
(c) HCl (d) HSO_4^-

Odisha NEET-2019

Ans. (c) : HCl cannot act both as bronsted acid and Bronsted base because HCl can only donate proton. HCl cannot accept H^+ therefore cannot act as Bronsted base.

346. Which of the following fluoro-compound is most likely to behave as a Lewis base ?

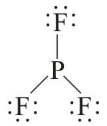
(a) BF_3 (b) PF_3
(c) CF_4 (d) SiF_4

NEET-II 2016

Ans. (b) : Lewis base is substance which contains lone pair on central atom.

Phosphorus is a group VA element so it has 5 valence electron. Fluorine is a group VII A element so it has 7 valence electrons.

So, total valence electrons = 5 + 7 (3)
= 5 + 21 = 26



As there is a lone pair on the central phosphorus atom. So PF_3 tends to donate its lone pair of electrons and behave as Lewis base.

347. Which of these is least likely to act as Lewis base?

(a) BF_3 (b) PF_3
(c) CO (d) F^-

NEET-2016

Ans. (a) : BF_3 has vacant orbital in which it can accent a lone pair of electron or π-electron. Hence, it act as a Lewis acid. BF_3 is an electron deficient species, so have a capacity of electron accepting instead of donating, it has least tendency to act as a Lewis base.

CO, F^- and PF_3 can either donate a lone pair of electron or π-electron. Hence they act as Lewis base.

348. Which of the strongest acid in the following ?

(a) $HClO_4$ (b) H_2SO_3
(c) H_2SO_4 (d) $HClO_3$

NEET-2013

Ans. (a) : Among the given acids, perchloric acid ($HClO_4$) is the strongest acids. This is because the conjugate base ClO_4^- ion is the weakest base.

The $HClO_4$ has the most oxygen atom so it would have to be the strongest acid.

349. Which of the following molecular hydrides acts as Lewis acid ?

(a) NH_3 (b) H_2O
(c) B_2H_6 (d) CH_4

NEET-2010

Ans. (c) : B_2H_6 is a electron deficient molecule so, it acts like an acid.

Electron deficient molecules act as Lewis acid. Among the given molecules only diborane is electron deficient it does not have complete octet. Thus it act as a Lewis acid. NH_3 and H_2O being electron rich molecules behaves as Lewis base.

350. Which of the following molecules acts as a Lewis acid ?

(a) $(CH_3)_2O$ (b) $(CH_3)_3P$
(c) $(CH_3)_3N$ (d) $(CH_3)_3B$

NEET-2009

Ans. (d) : Lewis acids are electron deficient compounds, since $(CH_3)_3$ B is electron deficient (due to incomplete octet of B). It act as a Lewis acid.

351. Which one of the following statement is not true?

(a) Among halide ions, iodide is the most powerful reducing agent
(b) Fluorine is the only halogen that does not show a variable oxidation state
(c) HOCl is a stronger acid than HOBr
(d) HF is a stronger acid than HCl

NEET-2003

Ans. (d) : Due to strong H-F bond H^+ ions are not easily removed due to higher electronegativity (E.N) of F, more bond dissociation energy required.

$$\text{acidic strength} \propto \frac{1}{\text{Bond dissocation energy}}$$

So, HF is not stronger acid than HCl.
Hence, option (d) is correct.

352. Which one of the following compounds is not a protonic acid ?

(a) $B(OH)_3$ (b) $PO(OH)_3$
(c) $SO(OH)_2$ (d) $SO_2(OH)_2$

NEET-2003

@apna_pdf

Ans. (a) : $B(OH)_3$ is not protonic acid because it does not give proton on ionisation directly. While it acts as Lewis acid due to acceptance of OH^- form water and forms a hydrated species.

$$B(OH)_3 + H_2O \rightleftharpoons [B(OH)_4]^- + H^+$$

353. In HS^-, I^-, $R–NH_2$, NH_3 order of proton accepting tendency will be

(a) $I^- > NH_3 > R–NH_2 > HS^-$
(b) $NH_3 > R–NH_2 > HS^- > I^-$
(c) $R–NH_2 > NH_3 > HS^- > I^-$
(d) $HS^- > R–NH_2 > NH_3 > I^-$

UPTU/UPSEE-2007
NEET-2000

Ans. (c) : The order of proton accepting tendency will be.

$$R\text{-}NH_2 > NH_3 > HS^- > I^-$$

Proton accepting tendency is known as strength of basicity. In $R\text{-}NH_2$ has lone pair of electron which intensify due 2 release of R group and increase the tendency to donate lone pair of electron $2H^+$.

354. Conjugate acid of NH_2^- is

(a) NH_2OH
(b) NH_4^+
(c) N_2H_4
(d) NH_3

NEET-2000

Ans. (d) : The species formed after adding a proton to the base is known as conjugate acid of the base and the species formed after losing a proton is known as conjugate base of acid So,

$$\underset{\text{(Base)}}{NH_2^-} + H^+ \rightarrow \underset{\text{(Conjugate acid)}}{NH_3}$$

355. Which compound is electron deficient ?

(a) BCl_3
(b) NH_4^+
(c) NH_2^-
(d) NH_3

COMEDK-2012, NEET-2000

Ans. (a) : In BCl_3 the central atom 'B' is sp^2 hybridised and contains only six electron in its valence shell. Therefore it is electron deficient.

356. The stronger conjugate base is

(a) SO_4^{2-}
(b) Cl^-
(c) NO_3^-
(d) CH_3COO^-

NEET-1999

Ans. (d) : $\underset{\text{weak acid}}{CH_3COOH} \rightleftharpoons \underset{\text{conjugate base}}{CH_3COO^-} + H^+$

As CH_3COOH is the weakest acid, so conjugate base (CH_3COO^-) is the strongest base.
H_2SO_4, HCl, HNO_3 are strong acid, so their conjugate base are weak.

357. Which of the following is not a Lewis acid ?

(a) SiF_4
(b) C_2H_4
(c) BF_3
(d) $FeCl_3$

NEET-1996

Ans. (b) : In BF_3 and $FeCl_3$ molecules, the central atoms have incomplete octet and in SiF_4, the central atom has empty d-orbitals. Hence according to Lewis concept these are Lewis acid. Lewis acid accept electron pair from donors. So, only C_2H_4 can not accept electron pair. Hence, it is not a Lewis acid.

358. Repeated use of which one of the following fertilizers would increase the acidity of the soil ?

(a) Ammonium sulphate
(b) Superphosphate of lime
(c) Urea
(d) Potassium nitrate

NEET-1998

Ans. (a) : Ammonium sulphate is used as an artificial fertilizer for alkaline soils. When introduced into soil, an ammonium ion is released.
It also contributes nitrogen, which aids in plant growth. It dissolves relatively slowly which makes it cheaper than some artificial fertilizer.
This creates a small amount of acid which lower the pH balance of the soil.

359. The species which acts as a Lewis but not a Bronsted acid is

(a) NH_2^-
(b) O^{2-}
(c) BF_3
(d) OH^-

UP CPMT-2014

Ans. (c) : BF_3 being electron deficient acts as a Lewis acid but it is not a Bronsted acid because of the absence of H atoms.

360. Two acids A and B have pK_a 4 and 6, then

(a) A is 4/6 times stronger than B
(b) A is 10 times stronger than B
(c) A is 6/4 times stronnger than B
(d) B is 10 times stronger than A

UP CPMT-2009

Ans. (b) $pK_a = -\log K_a$

$$\therefore \quad (pK_a)_A = -\log(K_a)_A$$

$$(K_a)_A = \text{antilog}(-4) = 10^{-4}$$

$$\text{Similarly,} (K_a)_B = \text{anti}\log(-6) = 10^{-6}$$

$$\frac{\text{Strength of A}}{\text{Strength of B}} = \sqrt{\frac{K_a}{K_b}}$$

$$= \sqrt{\frac{10^{-4}}{10^{-6}}} = 10$$

$\therefore$ Strength of A = 10 × strength of B.

361. Correct order of basic strength is

(a) $Mg(OH)_2 > NaOH > Al(OH)_3$
(b) $Mg(OH)_2 > Al(OH)_3 > NaOH$
(c) $NaOH > Mg(OH)_2 > Al(OH)_3$
(d) $Al(OH)_3 > Mg(OH)_2 > NaOH$

UP CPMT-2009

Ans. (c): Generally, basic strength of oxides/hydroxides decreases, as we move from left to right in a period of Periodic Table. Hence, alkali metal hydroxides are most basic and the order of basic strength is as

$$NaOH > Mg(OH)_2 > AI(OH)_2$$

362. Which of the following is not Lewis acid?

(a) $AlCl_3.6H_2O$
(b) $AlCl_3$
(c) $SnCl_4$
(d) $FeCl_3$

UP CPMT-2006

Ans. (a) : $AlCl_3$ is sp^2 hybridised, when it combines with H_2O molecules, one of the vacant p-orbitals and five d-orbitals are filled by electrons pairs and result of which it cannot accept more electron and so, will not act as electron acceptor of Lewis acid.

@apna_pdf

363. Cationic hydrolysis gives the following solution

(a) Acidic (b) Basic
(c) Neutral (d) Amphoteric

UP CPMT-2005

Ans. (b): $NH_4Cl \rightarrow \overset{+}{N}H4 + Cl^-$

$$\overset{+}{N}H_4 + Cl^- + H_2O \rightleftharpoons \underset{\text{Weak acid}}{NH_4OH} + \underset{\text{Strong acid}}{HCl}$$

$\overset{+}{N}H_4$ ion is a cation which react with water (H_2O) to form ammonium hydroxide (NH_4OH). Which is a basic in nature. The pH value of basic solution is greater than 7.

364. Hydrolysis of sodium acetate gives

(a) Acidic solution (b) Basic solution
(c) Amphoteric solution (d) Neutral sulution

UP CPMT-2005

Ans. (b):

$$CH_3COONa + H_2O \rightleftharpoons \underset{\text{(Weak acid)}}{CH_3COOH} + \underset{\text{(Strong acid)}}{NaOH}$$

Soldium acetate gives weak acid and strong base on hydrolysis. Therefore the aqueous solution of sodium acetate will be basic in nature.

365. Which of the following is amphoteric?

(a) V_2O_3 (b) CuO
(c) V_2O_5 (d) NiO

UPTU/UPSEE-2005

Ans. (c) : V_2O_5 is a amphoteric oxide.

366. Which of the following is not a Lewis base?

(a) NH_3 (b) H_2O
(c) $AlCl_3$ (d) None of these

UPTU/UPSEE-2005

Ans. (c) : $AlCl_3$ is a strong electrophile and has vacant orbital to accept electron lone pair. Thus it is a Lewis acid.

NH_3, H_2O have lone pair of electron and act as Lewis bases.

367. Which one of the following is called amphoteric solvent?

(a) Ammonium hydroxide (b) Chloroform
(c) Benzene (d) Water

UPTU/UPSEE-2004

Ans. (d) :

$H_2O \rightarrow H^+ + OH^-$ (Acid due to donation of proton)

$H_2O + H^+ \rightarrow H_3O^+$ (Basic due to gaining of proton)

$\therefore$ H_2O is amphoteric solvent because it dissolves both acids and basic.

368. Would gaseous HC*l* be considered as an Arrhenius acid?

(a) Yes
(b) No
(c) Not know
(d) Gaseous HC*l* does not exist

UPTU/UPSEE-2004

Ans. (b) : Gaseous HCl does not give H^+ but liquid HCl gives H^+ in aqueous solution there for gaseous HCl is not a Arrhenius acid due to covalent bonding in gaseous condition.

369. Which of the following pair of salt produces odourless gas with dil. H_2SO_4 ?

(a) HCO_3^- and HSO_3^-
(b) HCO_3^- and CO_3^-
(c) $S_2O_3^{2-}$ and $CH_3CO_2^-$
(d) CO_3^{2-} and $CH_3CO_2^-$

UPTU/UPSEE-2018

Ans. (b) : HCO_3 and CO_3^- will produce odourless gas i.e.
Carbon dioxide with dil. H_2SO_4

$$\underset{aq}{NaHCO_3} + H_2SO_4 \rightarrow \underset{aq}{Na_2SO_4} + \underset{g}{2CO_2} + \underset{l}{2H_2O}$$

$$\underset{\text{washing soda}}{Na_2CO_3} + \underset{aq}{H_2SO_4} \rightarrow \underset{aq}{Na_2SO_4} + \underset{l}{H_2O} + \underset{g}{CO_2}$$

370. Identify the Bronsted acid in the following equation

$$PO_4^{3-} + H_2O(l) \longrightarrow HPO_4^{2-}(aq) + OH^-(aq)$$

(a) PO_4^{3-} (b) HPO_4
(c) H_2O (d) OH^-

UPTU/UPSEE-2017

Ans. (c) : In the reaction:

$$PO_4^{3-} + H_2O(l) \longrightarrow HPO_4^{2-}(aq) + OH^-(aq)$$

Only H_2O act as Bronsted acid among the given options as it donate the proton (H^+) to OH^- ions

371. Of the given anions, the strongest Bronsted base is

(a) ClO^- (b) ClO_3^-
(c) ClO_2^- (d) ClO_4^-

UPTU/UPSEE-2014

Ans. (a) : HClO is the weakest acid , hence its conjugate base, i.e.,ClO^- is the strongest Bronsted base.
Conjugate base order–

$$ClO_4^- < ClO_3^- < ClO_2^- < ClO^-$$

372. Which of the following is the weakest acid?

(a) HCl (b) HF
(c) H_2SO_4 (d) HNO_3

UPTU/UPSEE-2009

Ans. (b) : HF (Hydrofluric acid) is thus the weakest acid of the hydrogen halides, because of the strength of the HX bond and the polarizing ability of F^-.

373. Water is well known amphoprotic solvent. In which chemical reaction water is behaving as a base?

(a) $H_2SO_4 + H_2O \longrightarrow H_3O^+ + HSO_4^-$
(b) $H_2O + H_2O \longrightarrow H_3O^+ + OH^-$
(c) $H_2O + NH_2^- \longrightarrow NH_3 + OH^-$
(d) $H_2O + NH_3 \longrightarrow NH_4^+ + OH^-$

UPTU/UPSEE-2009

Ans. (a) : According to Bronsted Lowry concept bases are the substance which have tendency to accept a proton.

$$\underset{\text{(acid)}}{H_2SO_4} + \underset{\text{(base)}}{H_2O} \longrightarrow \underset{\text{(Conjugated acid)}}{H_3O^+} + \underset{\text{(Conjugated base)}}{HSO_4^-}$$

@apna_pdf

374. Which of the following behaves as Lewis acid and not as Bronsted acid?

(a) HCl (b) H_2SO_4

(c) HSO_3^- (d) SO_3

UPTU/UPSEE-2009

Ans. (d) : Lewis acids have a tendency to accept electron while Bronsted acid have a tendency to donate proton.

(a) $HCl \rightarrow H^+ + Cl^-$ (b) $H_2SO_4 \rightarrow H^+ + HSO_4^-$

Bronsted acid Bronsted acid

(c) $HSO_3^- \rightarrow H^+ + SO_3^{2-}$ (d) $SO_3 + O^{2-} \rightarrow SO_4^{2-}$

Bronsted acid Lewis acid

375. Of the following acids the one which has the capability to form complex compound and also possesses oxidizing and reducing properties is

(a) HNO_3 (b) HNO_2

(c) HCOOH (d) HCN

WB-JEE-2009

Ans. (b) : HNO_2 has both oxidizing and reducing properties. It also has the capability to form complex compounds because Nitrogen has the middle valency.

376. The principle use of hydrofluoric acid is

(a) in etching glass

(b) as a bleaching agent

(c) as an extremely strong oxidizing agent

(d) in the preparation of strong organic fluorine compounds

NDA (II)-2017

Ans. (a) The principle use of hydrofluoric acid is a etching glass. It is used in production of chlorides, fertilizers, and dyes, in electroplating, and in photographic, textile, and rubber industries.

377. Of the following compounds, which one is the strongest Bronsted acid in a aqueous solution?

(a) $HClO_3$ (b) $HClO_2$

(c) HOCl (d) HOBr

WB-JEE-2017

Ans. (a) : The central atom in oxoacids, higher oxidation number more strongly it behave bronsted acid.

$HClO_3$

$+1\ x + (-2) \times 3 = 0$

$= 1 + x - 6 = 0$

$x - 5 = 0$

$x = +5$

Oxidation no. for Cl in $HClO_2 \rightarrow +3$

Oxidation no. for Cl in $HClO \rightarrow +1$

Oxidation no. for Br in $HBrO \rightarrow +1$

Hence, HClO3 is the strongest Bronsted acid in aqueous solution

378. Which of the following properties is true for a tooth paste?

(a) It is acidic

(b) It is neutral

(c) It is basic

(d) It is made up of Calcium phosphate, the material of tooth enamel

NDA (I)-2018

Ans. (c) : Toothpastes are basic in nature and prevents tooth decay by neutralizing the excess of acid. They can neither be acidic nor normal.

379. Which of the set of oxides are arranged in the proper order of basic, amphoteric, acidic?

(a) SO_2,P_2O_5,CO (b) BaO,Al_2O_3,SO_2

(c) CaO, SiO_2, Al_2O_3 (d) CO_2, Al_2O_3,CO

WB-JEE-2018

Ans. (b) : Oxides of non-metallic elements are acidic such as SO_2.

Oxides of less electropositive element such as Al_2O_3 are amphoteric i.e. those behaves as acids toward strong bases and as bases towards strong acid oxides of electropositive elements BaO are basic and contains discrete O^{2-} ions.

The correct set of oxides arranged in the proper order of basic, amphoteric, acidic are

BaO, Al_2O_3, SO_2

4. Buffer Solution

380. A student needs to prepare a buffer solution of propanoic acid and its sodium salt with pH 4. The ratio of $\frac{[CH_3CH_2COO^-]}{[CH_3CH_2COOH]}$ required to make buffer is _______.

Given : $K_a(CH_3CH_2COOH) = 1.3 \times 10^{-5}$

(a) 0.03 (b) 0.13

(c) 0.23 (d) 0.33

JEE Main-28.06.2022, Shift-II

Ans. (b) : We know that,

$$pH = pK_a + \log\frac{[Salt]}{[Acid]}$$

$$4 = 5 - \log 1.3 + \log\frac{[CH_3CH_2COO^-]}{[CH_3CH_2COOH]}$$

$$\log\frac{[CH_3CH_2COO^-]}{[CH_3CH_2COOH]} = \log 1.3 - 1 = \log\frac{1.3}{10}$$

$$\frac{[CH_3CH_2COO^-]}{[CH_3CH_2COOH]} = 0.13$$

381. The solution that is made by mixing appropriate amount of a weak acid and salt is called

(a) Basic buffer (b) Acidic buffer

(c) Neutral buffer (d) Both (a) and (b)

AP-EAMCET-1992

Ans. (b) : A buffer solution is one which resists changes in pH when small quantities of an acid or an alkali are added to it. Acid buffer has acidic pH. As the name suggests, these solutions are used to maintain acidic environments.

An acidic buffer solution is simply one which has a pH less than 7. Acidic buffer solutions are commonly made from a weak acid and one of its salts - often a sodium salt.

382. The solutions which tend to keep the concentration of hydrogen ions constant even when small amount of strong acid or strong base are added to them, are known as

(a) Acidic solution (b) Alkaline solution

(c) Buffer solution (d) Ideal solution

AP-EAMCET-1993

@apna_pdf

Ans. (c) : Buffer solution is an aqueous solution consisting of a mixture of a weak acid and its conjugate base. Buffer solution resist the change in its pH value on adding a small amount of an acid or base.

383. Which of the following solutions cannot act as a buffer?

(a) $NaH_2PO_4 + H_3PO_4$
(b) $CH_3COOH + CH_3COONa$
(c) $HCl + NH_4Cl$
(d) $H_3PO_4 + Na_2HPO_4$

AP-EAMCET-1998

Ans. (c) : $HCl + NH_4Cl$ cannot act as a buffer because it is a mixture of strong acid and weak base.

384. Which of the following is correct for acid buffer? [salt = S, acid = A]?

(a) $pK_a = pH + \log\frac{[S]}{[A]}$

(b) $pH = pK_a + \log\frac{[S]}{[A]}$

(c) $pK_a = pH - \frac{[A]}{[S]}$

(d) $pH = pK_a + \log\frac{[A]}{[S]}$

AP-EAMCET-2000

Ans. (b) : According to Henderson equation, pH of an acidic buffer-

$$pH = pK_a + \log\frac{[salt]}{[acid]}$$

or $$pH = pK_a + \log\frac{[S]}{[A]}$$

385. Which of the following would produce a buffer solution when mixed in equal volumes?

(a) 1 M CH_3COOH and 0.5 M NaOH
(b) 1 M CH_3COOH and 0.5 M HCl
(c) 1 M NH_4OH and 0.5 M NaOH
(d) 1 M NH_4OH and 0.5 M HCl

AP EAMCET (Engg.)-2001

Ans. (a) : $CH_3COOH + NaOH \rightarrow CH_3COONa + H_2O$
Hence, weak acid, CH_3COOH and its salt with strong base, CH_3COONa act as acidic buffer.

386. Study the following table

Buffer solution (in mL)	Volume (in mL) of 0.1 M weak acid	Volume (in mL) of 0.1 M sodium salt of weak acid
I	4.0	4.0
II	4.0	40.0
III	40.0	4.0
IV	0.1	10.0

Which of the two sets of buffer solutions have least pH?

(a) I and II (b) I and III
(c) II and III (d) II and IV

AP-EAMCET-2004

Ans. (b) : According to Henderson equation, pH of a buffer solution.

$$pH = pK_a + \log\frac{[salt]}{[acid]}$$

$pH \propto Salt \propto \frac{1}{acid}$

So, if ratio $\frac{[Salt]}{[Acid]}$ is low then the pH will also be low.

(i) $\frac{[Salt]}{[Acid]} = \frac{4.0}{4.0} = 1$

(ii) $\frac{[Salt]}{[Acid]} = \frac{40}{4} = 10$

(iii) $\frac{[Salt]}{[Acid]} = \frac{4}{40} = 0.1$

(iv) $\frac{[Salt]}{[Acid]} = \frac{10.0}{0.1} = 100$

So, min. ratio is in (i) & (iii).

387. An acidic buffer solution could be prepared by mixing the solutions of the following

(a) Sodium acetate and acetic acid
(b) Ammonium sulphate and sulfuric acid
(c) Ammonium chloride and ammonium hydroxide
(d) Sodium chloride and hydrochloric acid

MPPET-2012

Ans. (c) : Buffer solution:- A buffer solution that can resist pH change upon the addition of an acidic or basic components. It is able to neutralize small amounts of added acid or base, thus maintaining the pH of the solution relatively stable.

Acidic buffer solution = Weak acid + Salt of strong base

$= \underset{\text{Acetic acid}}{CH_3COOH} + \underset{\text{sodium acetate}}{CH_3COONa}$

Basic buffer solution = Weak base + salt of strong acid

$\underset{\text{Ammonium hydroxide}}{(NH_4OH)} \quad \underset{\text{Ammonium chloride}}{(NH_4Cl)}$

388. A buffer solution is prepared by mixing 10 mL of 1.0 M acetic acid and 20 mL of 0.5 M sodium acetate and then diluted to 100 mL with distilled water. If the pK_a of acetic acid is 4.76, what is the pH of the buffer solution prepared?

(a) 3.84 (b) 4.76
(c) 4.34 (d) 5.21

AP EAMCET (Medical) -1998

Ans. (b): Given that,
$pK_a = 4.76$, pH = ?
The expression for the pH of the acidic buffer solution is as given below–

$$pH = pK_a + \log\frac{[Salt]}{[Acid]}$$

Now, given data–

$M_1 = 1M, V_1 = 10mL, M_2 = ?\ V_2 = 100\,mL$

$\therefore \quad M_1V_1 = M_2V_2$

@apna_pdf

or $\quad M_2 = \dfrac{M_1V_1}{V_2} = \dfrac{1\times10}{100} = 0.1M$

Similarly, for sodium acetate–

$M_1V_1 = M_2V_2$

or $\quad M_2 = \dfrac{0.5\times20}{100} = \dfrac{1}{10}M = 0.1M$

$\therefore \quad pH = 4.76 + \log\dfrac{0.1}{0.1}$

or $\quad pH = 4.76$

389. Which one of the following will not function as buffer solution ?

(a) Borax + Boric acid
(b) NaH_2PO_4 + Na_2HPO_4
(c) NaCl + NaOH
(d) NH_4Cl + NH_4OH

SCRA - 2009

Ans. (c) : Buffer solution : A buffer solution is a salt of either weak acid and its salt with strong base or strong acid with weak base and its salt.

(i) Borax + Boric acid : Borax and Boric acid is an acid buffer solution. It consist of weak acid (Boric acid) and its salt (borax) with strong base.

(ii) NaH_2PO_4 and Na_2HPO_4 : NaH_2PO_4 and Na_2HPO_4 are acid salts so they canastas acid as well as salt. When one act as acid and other as salt they will form buffer solution.

(iii) NaCl + NaON : consist of salt of strong acid and strong base.

(iv) NH_4Cl+NH_4OH : It consist of weak base and its salt with strong acid.

So, $\boxed{NaCl + NaOH}$ Will not function as buffer solution.

390. Which among the following pairs constitute a buffer ?

(a) LiOH & LiCl (b) HNO_3 & NH_4NO_3
(c) HNO_2 & $NaNO_2$ (d) HBr & KBr

AP EAPCET 24.08.2021, Shift-I

Ans. (c) : As we know that, HNO_2 is a weak acid and $NaNO_2$ is salt of that weak acid and strong base (NaOH). So, both pair of HNO_2 and $NaNO_2$ formed the buffer solution.

391. The Henderson's equation for a basic buffer is

(a) $pOH = pK_b + \log\dfrac{[Salt]}{[Base]}$

(b) $pOH = pK_b - \log\dfrac{[Salt]}{[Base]}$

(c) $pOH = pK_b + \log\dfrac{[Base]}{[Salt]}$

(d) $pOH = pK_b + \dfrac{[Salt]}{[Base]}$

Manipal-2018
COMEDK-2011

Ans. (a) : The Henderson's equation for a basic buffer is

$$pOH = pK_b + \log\frac{[Salt]}{[Base]} \quad \& \ pH = 14 - pOH$$

392. Which of the following is a buffer solution?

(a) K_2SO_4+H_2SO_4 (b) NaOH+Na_2SO_4
(c) NaOH+CH_3COONa (d) NH_4OH+NH_4Cl

COMEDK-2016

Ans. (d) : Buffer solution is made by taking a solution of weak base (NH_4OH) and one of its salt with strong acid (NH_4Cl) [or weak acid and its salt]. It resists a change in pH upon addition of small amount of strong acid or strong base. Therefore (d) is a buffer solution.

393. Which of the following equations give ionic product of water?

(i) $NH_3(aq) + H_2O \rightleftharpoons NH_4^+(aq) + OH^-(aq)$
(ii) $NH_4^+(aq) + H_2O \rightleftharpoons H_3O^+ + NH_3(aq)$
(iii) $NH_2^-(aq) + H_2O \rightleftharpoons NH_3(aq) + OH^-$
(iv) $NH_3(aq) + OH^-(aq) \rightleftharpoons NH_2^-(aq) + H_2O$

(a) (ii) and (iii) (b) (iii) and (iv)
(c) (i) and (ii) (d) (iii) and (i)

COMEDK-2015

Ans. (c) : In the following question:

(i) $NH_3(aq) + H_2O \rightleftharpoons NH_4^+(aq) + OH^-$

Acid-base neutralization reaction will take place above and water will break into H^+ and OH^-.

(ii) $NH_4^+(aq) + H_2O \rightleftharpoons H_3O^+ + NH_3(aq)$

Here also, acid base neutralization will take place.

394. A buffer solution has equal volumes of 0.2 M NH_4OH and 0.02 M NH_4Cl. The pK_b of the base is 5. The pH is

(a) 10 (b) 9
(c) 4 (d) 7

COMEDK-2017

Ans. (a) : Given that–
volume of NH_4OH = 0.2 M and
volume of NH_4Cl = 0.02 M
$pK_b = 5$
According to the Henderson's equation.

$pOH = pK_b + \log\dfrac{[salt]}{[base]}$

$= 5 + \log\dfrac{0.02}{0.2} = 5 + \log\dfrac{1}{10} = 5 + (-1) = 4$

pH=14–pOH=14–4=10

395. When 0.1 mole of an acid is added to 2 L of a buffer solution, the pH of the buffer decreases by 0.5 . The buffer capacity of the solution is

(a) 0.6 (b) 0.4
(c) 0.2 (d) 0.1

AP-EAMCET (Medical), 2008

Ans. (d) : Given data:

Number of moles of acid added = $\dfrac{0.1}{2}$ per litre

Change of pH = 0.5

Now,

$\text{Buffer capacity} = \dfrac{\text{number of moles of acid added/L}}{\text{change in pH}}$

$\text{Buffer capacity} = \dfrac{0.1}{0.5\times2}$

Buffer capacity = 0.1

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396. $H_2 + CO + \text{alkene} \xrightarrow{\text{catalyst}} 1^{\circ}$ **alcohol**

What is the stable intermediate and the nature of the reaction?

(a) acid reduction (b) aldehyde, oxidation
(c) aldehyde, reduction (d) alcohol, oxidation

TS EAMCET 04.08.2021, Shift-I

Ans. (c) : Alkene combine with carbon monoxide and hydrogen in the presence of octa carbonyl dicobalt as catalyst under high temperature and pressure to form aldehydes.

$H_2 + CO + CH_2 = CH_2 \rightarrow CH_3CH_2OH$

- Stable intermediate aldehyde are from
- Reduction Reaction.

397. Assertion : Mixture of CH_3COOH and CH_3COONH_4 is an example of acidic buffer.

Reason : Acidic buffer contains equimolar mixture of a weak acid and its salt with weak base.

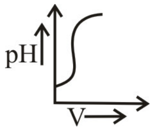
(a) If both Assertion and Reason are correct and the Reason is a correct explanation of the Assertion.
(b) If both Assertion and Reason are correct but Reason is not a correct explanation of the Assertion.
(c) In the Assertion is correct but Reason is incorrect.
(d) If both the Assertion and Reason are incorrect.
(e) If the assertion is incorrect but the Reason is correct.

AIIMS-(2007)

Ans. (d): Acidic buffer contains equimolar mixture of weak acid and its salt with strong base.

CH_3COOH/ CH_3COONH_4 is not an example of acidic buffer.

398. During titration of acetic acid with aq. NaOH solution, the neutralisation graph has a vertical line. This line indicates



(a) alkaline nature of equivalence.
(b) acidic nature of equivalence.
(c) neutral nature of equivalence.
(d) depends on experimental proceeding.

AIIMS- 2007

Ans. (a) : In the titration of a weak acid CH_3COOH with a strong base (NaOH), there is a change in the pH value at the end point. But it is not sharp due to weak ionisation of CH_3COOH. Due to the excess of free base beyond the equivalence point, there is a step rise in pH which is indicated by the vertical line. Hence, the ventical line in the graph indicates alkaline nature of equivalence.

399. Which one of the following in NOT a buffer solution?

(a) $0.8\,M\,H_2S + 0.8\,M\,KHS$

(b) $2M\,C_6H_5NH_2 + 2M\,C_6H_5\overset{+}{N}H_3Br^-$

(c) $3M\,H_2CO_3 + 3M\,KHCO_3$

(d) $0.05\,M\,KClO_4 + 0.05\,M\,HClO_4$

AIIMS-2003

Ans. (b): Buffer solution contains weak base +salt of weak base with strong acid or weak acid +salt of weak acid with a strong base.

In option (d) the used is $HClO_4$ which is strong base . hence,it is not an example of buffer solution.

400. Which one of the following statements is not correct?

(a) The pH of 1.0×10^{-8} M HCl is less than 7
(b) The ionic product of water at 25°C is $1.0\times10^{-14}\,mol^2L^{-2}$
(c) Cl^- is a Lewis acid
(d) Bronsted Lowry theory cannot explain the acidic character of $AlCl_3$

AP EAMCET (Engg.) 2012

Ans. (c) : Chlorine (Cl^-) is a Lewis base because it octet is complete and tendency to give an electros.

401. For a buffer of a mixture of 0.12 mol L^{-1} CH_3COOH and 0.12 mol L^{-1} CH_3COONa, the buffer capacity is

(a) 1.38 (b) 0.130
(c) 0.06 (d) 0.60

AMU-2017

Ans. (b) : Buffer capacity (β) = $\dfrac{\Delta C_a}{\Delta pH}$

Where C_a = concentration of acid for acidic buffer

Concentration of acid = concentration of salt

$\therefore\ \Delta C_a = 0.12\ molL^{-1}$

Hence, we use the following formula for calculating its pH.

$pH = -\log[H^+] = -\log(0.12) = 0.92$

Buffer capacity (β) = $\dfrac{0.12}{0.92} = \dfrac{12}{92} = \dfrac{6}{46} = \dfrac{3}{23} = 0.130$

402. A buffer contains equal concentrations of X^- and HX. The K_a for HX is 10^{-8}. The pH of the buffer is–

(a) 3 (b) 8
(c) 7 (d) 11

BCECE-2009

Ans. (b) : A buffer consist of a weak acid and its conjugate base or a weak base and its conjugate acid.

k_a is given to us it is an indication that the given buffer is an example of an acidic buffer.

Hence, we use the following formula for calculating its pH.

$pH = -\log k_w + \log\dfrac{[\text{conjugate base}]}{[\text{Acid}]}$

$pH = pk_a + \log_{10}\dfrac{[X^-]}{[HX]}$

$pH = -\log_{10}10^{-8} + \log_{10}1 = 8$

As the concentrations of X^- and HX are equal

403. A buffer solution contains 0.1 mole of sodium acetate in 1000 cm^3 of 0.1 M acetic acid. To the above buffer solution, 0.1 mole of sodium acetate is further added and dissolved. The pH of the resulting buffer is equal to–

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(a) $pK_a - \log 2$ (b) pK_a
(c) $pK_a + 2$ (d) $pK_a + \log 2$

BCECE-2014
Karnataka-CET, 2010

Ans. (d) : Given that–

$[CH_3COONa] = 0.1$ M

$[CH_3COOH] = 0.1$ M

0.1 mol $CH_3COONa \rightarrow$ add

$[CH_3COONa] = 0.1 + 0.1$
$= 0.2$ M

$[CH_3COOH] = 0.1$ M

According to the Henderson's equation

$$pH = pK_a + \log \frac{[Salt]}{[Acid]}$$

$$pK_a + \log \frac{0.2}{0.1}$$

$$pK_a + \log 2$$

404. Which of the following can form buffer solution?

(a) aq.NH_3 + NH_4OH (b) KOH + HNO_3
(c) NaOH + HCl (d) KI + KOH

BITSAT-2017

Ans. (a) : Ammonia is a weak base and a salt containing its conjugate acid, the ammonium cantion ,such as NH_4OH functions as a buffer solution when they are present together in a solutions.

405. Which of the following is not a buffer solution?

(a) 100 mL 0.1 M CH_3COOH + 50 mL 0.1 M CH_3 COONa
(b) 100 mL 0.1 M CH_3COOH + 50 mL 0.1 M NaOH
(c) 50 mL 0.1 M CH_3COOH+100 mL 0.1 M NaOH
(d) 100 mL 0.1 M NH_4OH+50 mL 0.1 M CI

CG PET-2009

Ans. (c) : Acidic buffer is mixture of weak acid and its salt with strong base, similarly, basic buffer is a mixture of weak base and its salt with strong acid.

Hence, 50 mL 0.1 M CH_3COOH+100 mL 0.1 M NaOH does not constitute a buffer solution. Because in this case millimoles of acid are less than that the strong base, which after reaction with strong base gives salt. Now, the solution contains only strong base and salt but no weak acid.

Hence, no buffer is formed.

406. Which solution is buffer?

(a) Acetic acid+ NaOH (equimolar ratio)
(b) Acetic acid+ NaOH (1:2 molar ratio_
(c) Acetic acid+ NaOH (2:1 molar ratio)
(d) HCl +NaOH (equimolar ratio)

CG PET-2013

Ans. (c) : A buffer solution can be described as a solution, which will resist changes in pH when a small amount of a strong acid or base is added.

An acidic buffer is compound of a weak acid and its conjugated base or a weak acid and the salt of the weak acid and a strong base. e.g., (CH_3COOH+CH_3COONa).

$$CH_3COOH \rightleftharpoons CH_3COO^- + H^+$$

(feebly ionised)

$$CH_3COONa \rightleftharpoons CH_3COO^- + Na^+$$

(completely ionised)

How to make a acidic buffer

(i) start with taking weak acid (CH_3COOH) and strong base (NaOH) in 2:1 molar concentration ratio, so that a sufficient number of moles of the CH_3COOH neutralize completely the same number of moles of NaOH.

$$\underset{1\,\text{mol}}{CH_3COOH} + \underset{1\,\text{mol}}{NaOH} \longrightarrow \underset{\substack{\text{Sodium acetate}\\ 1\text{mol}}}{CH_3COONa} + H_2O$$

How to make a acidic buffer.

Now, the resulting solution will contain the salt and acid in equimolar concentration and water.

$$\underset{1\,\text{limiting (mol)}}{OH^-(aq)} + \underset{(\text{excess } 2\,\text{mol})}{H^+(aq)} \longrightarrow \underset{\substack{\text{salt (1mol) buffer}\\ \text{solution}}}{A^+(aq)} + \underset{\text{remaining (mol)}}{H^+(aq)}$$

In the buffer solution, $[HA] = [A^-]$

i.e., equimolar concentrations

(ii) The acidic buffer can also prepared by taking equimolar concentrations and volume of weak acid (CH_3COOH) and the salt of the weak acid and strong base (CH_3COONa).

407. Heat of neutralisation of NH_4OH and HC1 is

(a) equal to 13.7 kcal
(b) more than 13.7 kcal
(c) less than 13.7 kcal
(d) more than one is correct

CG PET-2004

Ans. (c) : The heat of neutralization is the amount of heat evolved when one gram equivalent of an acid is neutralised by one gram equivalent of a base in dilute solution.

NH_4OH is a weak base. Heat of neutralization < 13.7 Kcal.

The heat released in the neutralization of a weak base or a weak acid by a strong acid or a strong base, respectively is less than 13.7 Kcal.

408. In the combustion of 2.0 g of methane, 25 kcal heat is liberated, heat of combustion of methane would be

(a) 100 kcal (b) 200 kcal
(c) 300 kcal (d) 400 kcal

CG PET-2004

Ans. (b) : $CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$

Molecular weight of $CH_4 = 12 + 4 = 16$

$\therefore$ On the combustion of 2.0 gm of methane = 25.0 kcal.

$\therefore$ On the combustion of 16.0 gm $= \frac{25 \times 16}{2} = 200$ kcal.

409. Which of the following mixtures forms an acid buffer?

(a) NaOH+HCl (b) CH_3COOH+CH_3COONa
(c) NH_4OH+NH_4Cl (d) H_2CO_3+$(NH_4)_2CO_3$

CG PET-2004

Ans. (b) : Acid buffer$\Rightarrow$ Weak Acid + Strong Base

Match in option

$$\text{(a) NaOH + HCl} \begin{pmatrix} \text{NaOH strong Base and} \\ \text{HCl is strong Acid} \end{pmatrix}$$

$$\text{(b) } CH_3COOH + CH_3COONa \begin{pmatrix} CH_3COOH \text{ is weak acid and} \\ CH_3COONa \text{ is a strong base} \end{pmatrix}$$

So, option (b) is correct.

@apna_pdf

410. In a 100 mL of buffer solution of acetic acid and sodium acetate, both are 0.1 mol. In this buffer, 10 mL of 0.01 mole of HCl is added. The pH of the buffer

(a) will be increased by 1
(b) will be decreased by 1
(c) first increases and then decreases
(d) no change

CG PET-2018

Ans. (d) : The solution which resist the change in pH even on small addition of an acid are called buffer solution. As the given solution of acetic acid and sodium acetate is a buffer solution, the addition of 10 ml of 0.01 mol HCL solution will not change the pH of the buffer solution .
hence, option (d) is the correct answer.

411. An aqueous solution of 1M NaCl and 1M HCl is

(a) not a buffer but pH< 7
(b) not a buffer but pH > 7
(c) a buffer with pH < 7
(d) a buffer with pH > 7

[AIEEE-2002]

Ans. (a) : NaCl is not the case of buffer
NaCl is salt of strong acid and strong base.
$NaCl + H_2O \rightleftharpoons NaOH + HCl$
aqueous NaCl, itself exact neutral solution
$HCl + H_2O \rightleftharpoons H_3O^+ + Cl^-$
make solution acidic.
So, not a buffer but pH < 7

412. The pK$_a$ of a weak acid (HA) is 4.5. The pOH of an aqueous buffered solution of HA in which 50% of the acid ionised is

(a) 4.5 (b) 2.5
(c) 9.5 (d) 7.0

[AIEEE-2010]

Ans. (c) : $pH = pk_a + \log \frac{[\text{conjugate base}]}{[\text{acid}]}$

$pk_a = 4.5$
[conjugate base] = [acid], as 50% ionification

$pH = 4.5 + \log \frac{0.5}{0.5}$

$pH = 4.5 + \log 1 \qquad (\because \log_{10} 1 = 0)$

$pH = 4.5$
Then, pOH = 14 – 4.5 = 9.5
(Note:– pH + pOH = 14)

413. The solubility of AgCN in a buffer solution of pH = 3 is x. The value of x is.......
[Assume: No cyano complex is formed; k$_{sp}$ (AgCN) = 2.2×10^{-16} and K$_a$ (HCN) = 6.2 × 10^{-10}]

(a) 0.625×10^{-6} (b) 1.6×10^{-6}
(c) 2.2×10^{-16} (d) 1.9×10^{-5}

[JEE Main 2021, 25 Feb Shift-I]

Ans. (d) : Let Solubility be x

$AgCN \rightleftharpoons Ag^+ + CN^- \qquad K_{sp} = 2.2 \times 10^{-16}$

$H^+ + CN^- \rightleftharpoons HCN$

$K = \frac{1}{K_a} = \frac{1}{6.2\times10^{-10}}$

$K_{sp} \times \frac{1}{K_a} = [Ag^+][CN^-] \times \frac{[HCN]}{[H^+][CN^-]}$

$2.2 \times 10^{-16} \times \frac{1}{6.2\times10^{-10}} = \frac{[S][S]}{10^{-3}}$

$S^2 = \frac{2.2\times10^{-16}\times10^{-3}}{6.2\times10^{-10}}$

$S^2 = 0.3548 \times 10^{-9}$
$S^2 = 3.548 \times 10^{-10}$
$S = \sqrt{3.55\times10^{-10}}$
$S = 1.88 \times 10^{-5}$
$S = 1.9 \times 10^{-5}$

414. An acidic buffer is obtained on mixing

(a) 100 mL of 0.1M CH_3COOH and mLof 0.1 MNaOH
(b) 100 mL of 0.1M HCl and 200 mL of 0.1 M Nacl
(c) 100 mL of 0.1M CH_3COOH and 200 mL of 0.1M NaCl
(d) 100 mL of 0.1M HCl and 200 mL of 0.1M CH_3COONa

[JEE Main 2020, 3 Sep Shift-I]
NEET-2019

Ans. (d) :

$$\begin{array}{cccccc} HCl + & CH_3COONa & \rightarrow & CH_3COOH + & NaCl \\ \text{10 milimole} & \text{20 milimole} & & - & - \\ - & \text{10 milimole} & & \text{10 milimole} & \text{10 milimole} \end{array}$$

So, finally we get mixture of
CH_3COOH + CH_3COONa that will work like Acidic buffer solution.

415. In order to prepare a buffer solution of pH 5.74 sodium acetate is added to acetic acid. If the concentration of acetic acid in the buffer is 1.0 M, the concentration of sodium acetate in the buffer is ....M. (Round off to the nearest integer)
[Given : pK$_a$ acetic acid = 4.74]

[JEE Main 2021, 18 March Shift-I]

Ans. (10) : $pH = pK_a + \log \frac{[CB]}{[WA]}$

$5.74 = 4.74 + \log \frac{[CB]}{1}$

[CB] = 10 M

416. The buffer present in blood plasma is

(a) borax, sodium hydroxide
(b) carbonic acid, bicarbonate ion
(c) acetic acid, sodium acetate
(d) citric acid, potassium dihydrogen phosphate

J & K CET-(2012)

Ans. (b) : The buffer present in blood plasma is carbonic acid bicarbonate ion.
Normal human blood has pH = 7.4.

417. Consider the following solutions of equal concentrations
A = NH_4Cl; B = CH_3COONa
C = NH_4OH; D= CH_3COOH
A buffer solution can be obtained by mixing equal volumes of

(a) C and D (b) A and B
(c) A and C (d) C and D

J & K CET-(2006)

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Ans. (a) : Buffer

(i) Acidic [weak acid + conjugate base]

(ii) Basic [weak base + conjugate acid]

$$\underset{(D)}{CH_3COO^-H^+} + \underset{(B)}{CH_3COO^-Na}$$

$$\underset{(C)}{NH_4OH} + \underset{(A)}{NH_4^+Cl^-}$$

So, Option (a) is correct.

418. Which of the following is not a buffer solution?

(a) $CH_3COOH + CH_3COONa$

(b) $H_3BO_3 + Na_3BO_3$

(c) $HClO_4 + NaClO_4$

(d) $NH_4OH + (NH_4)_2SO_4$

JCECE - 2004

Ans. (c) : A buffer solution is one which resist changes in pH when small quantities of an acid or an alkali are added to it.

A solution of $HClO_4$ and $NaClO_4$ is not an acid buffer because strong acid with its salt cannot form a buffer solution.

419. Which of the following 1 : 1 mixture will act as buffer solution?

(a) HCl and NaOH

(b) KOH and CH_3COOH

(c) CH_3COOH and NaCl

(d) CH_3COOH and CH_3COONa

JCECE - 2005

Ans. (d) : Buffer is a mixture of weak acid with its salt with strong base or mixture of weak base and its salt with strong acid.

(a) HCl + NaOH is not buffer because both are a strong acid strong base.

(b) KOH + CH_3COOH is not buffer because they do not have common ion.

(c) CH_3COOH + NaCl is not buffer because they do not have common ion.

(d) CH_3COOH + CH_3COONa are buffer because CH_3COONa its salt with strong base (NaOH).

420. A buffer solution is prepared in which the concentration of NH_3 is 0.30 M and the concentration of NH_4^+ is 0.20 M. If the equilibrium constant, K_b for NH_3 equals 1.8×10^{-5}, What is this pH of the solution? (log 2.7 =0.43)

(a) 9.43 (b) 11.72

(c) 8.73 (d) 9.08

JIPMER-2014
NEET-2011

Ans. (a) : According to the Henderson - Hasselbalch equation.

$$\text{pH of acidic buffer} = pK_a + \log\left[\frac{\text{Salt}}{\text{Acid}}\right]$$

$$\text{pH of basic buffer} = pK_b + \log\left[\frac{\text{Salt}}{\text{Base}}\right]$$

$$pk_b = -\log\left[1.8\times10^{-5}\right] = 4.74$$

$$pOH = pK_b + \log\left[\frac{\text{salt}}{\text{base}}\right]$$

$$pOH = 4.74 + \log\frac{0.2}{0.3} = 4.74 - 0.176 = 4.56$$

$$pH = 14 - 4.56$$
$$= 9.44$$

421. Which buffer solution comprising of the following has its pH value greater than 7?

(a) $CH_3COOH+CH_3COONa$

(b) HCOOH+HCOOK

(c) CH_3COONH_4

(d) NH_4OH+NH_4Cl

JIPMER-2012

Ans. (d) : The pH value of basic buffer is always greater than 7.

Among the given options, NH_4OH+NH_4Cl is the only mixture which consists of a mixture of a weak base and its conjugated salt and thus, has a pH greater than 7.

Basic buffer solution: A basic buffer solution consists of a mixture of a weak base and its salt with strong acid. the best known example in a mixture of NH_4OH and NH_4Cl.

422. An example for a neutral buffer is

(a) ammonium hydroxide and ammonium chloride

(b) acetic acid and sodium acetate

(c) acetic acid and ammonium hydroxide

(d) citric acid and sodium citrate

Karnataka-CET-2013

Ans. (c) : Neutral buffer solutions are formed by mixing weak acid or weak base. For example Ammonium Hydroxide or acidic acid is an example of neutral buffer solutions. So, according to the concept, the correct option is (c) acetic acid and ammonium hydroxide.

423. Which will make basic buffer ?

(a) 100 mL of 0.1 M HCl + 100 mL of 0.1 m NaOH

(b) 50 mL of 0.1 M NaOH + 25 mL of 0.1 M CH_3COOH

(c) 100 mL of 0.1 CH_3COOH + 100 mL of 0.1 M NaOH

(d) 100 mL of 0.1 HCl + 200 mL of 0.1 of NH_4OH

NEET-2019

Ans. (d) : Key idea A buffer solution having pH more that 7 is know as basic buffer. It is obtained by mixing weak base and its salt with strong acid in a fixed proportion.

Let us consider all the options,

(a) 100 mL of 0.1 M CH_3COOH + 100 mL of 0.1 M NaOH

$$CH_3COOH + NaOH \longrightarrow CH_3COONa + H_2O$$

	CH_3COOH	NaOH	CH_3COONa
Intial Conc.	100mL× 0.1M = 10 m mol	100mL× 0.1M =10 m mol	0 m mol
Final	0	0	10 m mol

It is not basic buffer because hydrolysis of salt takes place and final solution contains salt of weak acid with strong base only.

Hence, option (a) is incorrect.

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(b) 100 mL of 0.1 M HCl + 200 mL of 0.1 M NH_4OH

$$HCl + NH_4OH \longrightarrow NH_4Cl + H_2O$$

Intial Conc.	$100mL \times$ $0.1M\,HCl$ $= 10\,m\,mol$	$200mL \times$ $0.1M$ $= 20\,m\,mol$	$0\,m\,mol$
Final	0	10	$10m\,mol$

It is basic buffer because final solution contains weak base and its salt with storng acid. Hence, option (b) is correct.

(c) $HCl + NaOH \longrightarrow NaCl + H_2O$

Intial Conc.	$100mL$ $\times 0.1M$ $= 10\,m\,mol$	$100mL \times$ $0.1M$ $= 10\,m\,mol$	$0\,m\,mol$
Final	0	10	$10m\,mol$

It is a neutral solution. Hence, option (c) is incorrect.

(d) 50 mL of 0.1 M NaOH + 25 mL of 0.1M CH_3COOH

$$CH_3COOH + NaOH \longrightarrow CH_3COONa + H_2O$$

Intial Conc.	$25mL \times$ $0.1M$ $= 2.5\,m\,mol$	$50mL \times$ $0.1M$ $= 5\,m\,mol$	$0\,m\,mol$
Final conc.	0	2.5	$2.5\,m\,mol$

It is basic solution. Hence, option (d) is incorrect.

424. Which of the following pairs of solutions is not an acidic buffer ?

(a) CH_3COOH and CH_3COONa
(b) H_2CO_3 and $NaCO_3$
(c) H_3PO_4 and Na_3PO_4
(d) $HClO_4$ and $NaClO_4$

NEET-2015

Ans. (d) : Strong acid with its salt cannot form buffer solution. Hence, $HClO_4$ and $NaClO_4$ is not an acidic buffer.

425. The dissociation of a weak acid is 1×10^{-4}. In order to prepare a buffer solution with a pH = 5, the [Salt]/[Acid] ration should be

(a) 4 : 5
(b) 10 : 1
(c) 5 : 4
(d) 1 : 10

Karnataka NEET-2013

Ans. (b) : According to the Henderson's equation.

$$pH = pK_a + \log\frac{[salt]}{[Acid]}$$

$$5 = -\log K_a + \log\frac{[Salt]}{[Acid]} \qquad [\because pK_a = -\log K]$$

$$5 = -\log\left[1\times10^{-4}\right] + \log\frac{[Salt]}{[Acid]}$$

$$5 = 4 + \log\frac{[Salt]}{[Acid]}$$

$$5 - 4 = +\log\frac{[Salt]}{[Acid]}$$

$$1 = \log\frac{[Salt]}{[Acid]}$$

$$\frac{[Salt]}{[Acid]} = 10\text{ i.e., }10:1$$

426. Buffer solutions have constant acidity and alkalinity because

(a) These give unionised acid or base on reaction with added acid on alkali
(b) Acids and alkalies in these solution are shielded from attack by other ions
(c) They have large excess of H^+ or OH^- ions
(d) They have fixed value of pH

NEET-2012

Ans. (a) : If small amount of an acid or alkali is added to a buffer solution, it converts them into unionized acid or base. Thus, its pH remains unaffected or in other words its acidity/alkalinity remains constant. e.g.

$$H_3O^+ + A^- \rightleftharpoons H_2O + HA$$

$$^-OH + HA \longrightarrow H_2O + A^-$$

If acid is added, it reacts with A^- to form undissociated HA similarly, if base/alkali is added, OH^- combines with HA to give H_2O and A^- and thus, maintains the acidity/alkalinity of buffer solution.

427. A buffer solution prepared in which the concentration of NH_3 of 0.30 M and the concentration of NH_4^+ is 0.20 M. If the equilibrium constant K_b for NH_3 equals 1.8×10^{-5}, what is the pH of this solution ? (log 2.7 = 0.43)

(a) 9.08
(b) 9.43
(c) 11.72
(d) 8.73

NEET-2011

Ans. (b) $pOH = pK_b + \log\frac{[salt]}{[base]}$

$$= -\log K_b + \log\frac{[salt]}{[base]}$$

$$= -\log 1.8\times10^{-5} + \log\frac{0.20}{0.30}$$

$$= 5 - 0.25 + (-0.176)$$

$$= 4.75 - 0.176 = 4.57$$

$$\therefore \quad pH = 14 - 4.57 = 9.43$$

428. In a buffer solution containing equal concentration of B^- and HB, the K_b for B^- is 10^{-10}. The pH of buffer solution is

(a) 10
(b) 7
(c) 6
(d) 4

NEET-2010

Ans. (d) : Given, K_b for B^- is 10^{-10}

$\therefore$ $pK_b = -\log 10\ K_b = -\log(10^{-10}) = 10$

According to the Henderson's equation

We know that $pOH = pK_b + \log\frac{[salt]}{[Acid]}$

Here, the concentration of the salt and acid is same

$\therefore$ $\log_{10} 1 = 0$

$\therefore$ $pOH = pK_b = 10$

$pH = 14 - pOH = 14 - 10 = 4$

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429. Which of the following pairs constitutes a buffer?

(a) HCl and KCl
(b) HNO_2 and $NaNO_2$
(c) NaOH and NaCl
(d) HNO_3 and NH_4NO_3

NEET-2006

Ans. (b) : Acid pair constituent with NHO_2 and $NaNO_2$ because HNO_2 is weak acid and $NaNO_2$ is a salt of weak acid (HNO_2) with strong base (NaOH). Hence, it is an example of acidic buffer solution.

430. The rapid change of near the stoichiometric point of an acid base titration is the basis of indicator detection, pH of the solution is related to ratio of the concentration of the conjugate (HIn) and base (In^+) ions of the indicator by the expression

(a) $\log\frac{[In^-]}{[HIn]} = pK_{In} - pH$

(b) $\log\frac{[HIn]}{[In^-]} = pK_{In} - pH$

(c) $\log\frac{[HIn]}{[In^-]} = pH - pK_{In}$

(d) $\log\frac{[In^-]}{[HIn]} = pH - pK_{In}$

NEET-2004

Ans. (d) : $\underset{\text{Weak acid}}{HIn} \rightleftharpoons H^+ + \underset{\text{Base}}{In^-}$

Applying law of mass action

$$KIn = \frac{[H^+][In]}{[HIn]}$$

Taking –log on both side

$$-\log K_{In} = \frac{-\log[H^+][In^-]}{[HIn]}$$

$$PK_{In} = -\log[H^+] + -\log\frac{[In^-]}{[HIn]}$$

$$PK_{In} = pH - \log\frac{[In]}{[H_{In}]}$$

$$PK_{In} + \log\frac{[In^-]}{[HIn]} = pH, \quad \boxed{\log\frac{[In^-]}{[HIn]} = pH - PK_{In}}$$

431. The pH value of blood does not appreciably change by small addition of an acid or a base because the blood

(a) can be easily coagulated
(b) contains iron as a part of the molecule
(c) in a body fluid
(d) contains serum protein which acts as buffers

NEET-1995

Ans. (d) : Blood is an example of buffer solution, which contains serum protein, so its pH does not change appreciably by adding small amount of an acid or a base to it.

432. Solution of 0.1 N NH_4OH and 0.1 M NH_4Cl has pH 9.25. Then find out pK_b of NH_4OH.

(a) 9.25
(b) 4.75
(c) 3.75
(d) 8.25

BCECE-2012, NEET-2002

Ans. (b) : Given that - Normality of NH_4OH = 0.1 N
Molarity of NH_4Cl = 0.1 M
pH = 9.25
According to the Henderson's equation-

$$pOH = pK_b + \log\frac{[Salt]}{[Base]}$$

$$pH + pOH = 14 \ (\text{at } 25\,^\circ C)$$

$$pOH = 14 - 9.5 = 4.75$$

$$4.75 = pK_b + \log\frac{[1]}{[1]}$$

$$pK_b = 4.75$$

433. A physician wishes to prepare a buffer solution at pH = 3.85 that efficiently resists changes in pH yet contains only small concentration of the buffering agents. Which of the following weak acids together with its sodium salt would be best to use ?

(a) 2, 5-Dihydroxybenzoinc acid (pK_a = 2.97)
(b) Acetoacetic acid (pK_a = 3.58)
(c) m-Chlorobenzoic acid (pK_a = 3.98)
(d) p-Chlorocinnamic acid (pK_a = 4.41)

NEET-1997

Ans. (b) : By the use of Henderson's equation

$$pH = pK_a + \log_{10}\frac{[salt]}{[acid]}$$

When, [salt] = [acid]
$\therefore$ pH = pK_a
$\because$ pK_a = 3.58, thus at ths state
pH = 3.58
So, acetoacetic acid (pK_a = 3.58) is best to use.

434. Which one of the following pair shows Buffer's solution?

(a) NaCl+NaOH
(b) $CH_3COONa+CH_3COOH$
(c) $CH_3COOH+CH_3COONH_4$
(d) H_2SO_4+ $CuSO_4$

UP CPMT-2003

Ans. (b) : Buffer solution are those solutions which resist the change in pH on addition of small amount of acid or base.

Buffer solutions are mixture of either weak acid and its salt with strong base or a weak base and its salt with strong acid.

(a) NaCl + NaOH is not buffer solution because NaOH is strong base.
(c) CH_3COOH + CH_3COONH_4 is not buffer solution because CH_3COONH_4 is salt with weak base.
(d) H_2SO_4+$CaSO_4$ is not buffer solution because H_2SO_4 is strong acid.
(b) CH_3COOH+CH_3COONa is buffer solution. Because CH_3COOH is weak acid and CH_3COONa is its salt with strong base.

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435. Which of the following is not a buffer?

(a) $NH_3 + HCl$ (b) $CH_3COOH + NaOH$
(c) HCOOH + HCOOK (d) $NaOH + NaNO_3$

UPTU/UPSEE-2010

Ans. (d) : Because buffer solutions are mixture of weak acid or weak base their salts.

436. The buffering action of an acidic buffer is maximum when its pH is equal to

(a) 5 (b) 7
(c) 1 (d) pK_a

UPTU/UPSEE-2009

Ans. (d) : Buffer capacity of an acidic buffer is maximum when the ratio of HA to A^- is unity since, pH of acidic buffer ltbr.

$$= pK_a + \log\frac{[A^-]}{[HA]}$$

For maximum buffer capacity $[A^-] = [HA^-]$

$\therefore$ $pH = pK_a$

437. A buffer solution is prepared by mixing- 0.1M ammonia and 1.0 M ammonium chloride. At 298 K the pK_b of NH_4OH is 5.0 . The PH of the buffer is

(a) 10.0 (b) 9.0
(c) 6.0 (d) 8.0

UPTU/UPSEE-2008

Ans. (d) : From Henderson equation :-

$$pOH = pK_b + \log\frac{[Salt]}{[Base]}$$

$$pH + pOH = 14$$

$$pOH = 5.0 + \log\frac{[1.0]}{[0.1]} = 5 + \log 10 = 5 + 1$$

$$pOH = 6$$
$$pH + pOH = 14$$
$$pH + 6 = 14$$
$$pH = 14 - 6 = 8$$

438. The ratio of volumes of CH_3COOH 0.1 (N) to CH_3COONa 0.1 (N) required to prepare a buffer solution of pH 5.74 is
(Given, pK_a of CH_3COOH is 4.74)

(a) 10 : 1 (b) 5 : 1
(c) 1 : 5 (d) 1 : 10

WB-JEE-2015

Ans. (d) : The volumes of acetic acid and sodium acetate be VL and V'L respectively.
Given that normality of CH_3COOH [Acetic acid] = 0.1 N
Normality of CH_3COONa = 0.1 N

$$pH = 5.74$$

According to the Henderson's equation-

$$pH = pK_a + \log\frac{[CH_3COONa]}{[CH_3COOH]}$$

$$5.74 = 4.74 + \log\frac{0.1\times V'}{0.1\times V}$$

$$5.74 - 4.74 = \log\frac{V'}{V}$$

$$1 = \log\frac{V'}{V}$$

$$\frac{V'}{V} = 10^1 \qquad \left(\because \begin{array}{c}\log_b a = x\\ a = b^x\end{array}\right)$$

$$\frac{V'}{V} = 10$$

$$\frac{V}{V'} = 1 : 10$$

5. Hydrogen Ion Concentration pH Scale

439. The pH of the solution containing 50mL each of 0.10 M sodium acetate and 0.01 M acetic acid is [Given pK_a of CH_3COOH = 4.57]

(a) 2.57 (b) 5.57
(c) 3.57 (d) 4.57

NEET-17.07.2022

Ans. (b) : According to Henderson equation,

$$pH = pK_a + \log\frac{[Salt]}{[Acid]}$$

$$= 4.57 + \log\frac{0.10}{0.01}$$

$$= 4.57 + \log(10)$$

$$= 4.57 + 1 = 5.57$$

440. Which among the following has highest pH?

(a) $1M\,H_2SO_4$ (b) 0.1M NaOH
(c) 1 M HCl (d) 1M NaOH

Karnataka CET-17.06.2022, Shift-II

Ans. (d) : For high value of pH we required max conc. of OH^- ion.

$$[OH]\uparrow = pH\uparrow$$

So, H_2SO_4 and HCl are acid.
0.1m NaOH = $[OH^-] = 10^{-1}$ m
1m NaOH = $[OH^-]$ = 1m
So, 1m NaOH has highest pH.

441. 50 mL of 0.1 M CH_3COOH is being titrated against 0.1 M NaOH. When 25 mL of NaOH has been added, the pH of the solution will be____$\times 10^{-2}$ (Nearest integer)
(Given : pK_a (CH_3COOH) = 4.76
log 2 = 0.30
log 3 = 0.48
log 5 = 0.69
log 7 = 0.84
log 11 = 1.04

JEE Main-26.06.2022, Shift-I

Ans. (476) :

$$CH_3COOH(aq) + NaOH(aq) \longrightarrow CH_3OONa(aq) + H_2O(l)$$

	CH_3COOH	$NaOH$	CH_3OONa	H_2O
Milli moles	5	2.5		
After reaction Milli moles	2.5	......	2.5	

Resultant solution is acidic buffer solution with some concentration of acid and salts.
So, pH of solution = 4.76 = 476 × 10^{-2}
Here x = 476
The pH of solution will be 476.

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442. pH value of 0.001 M NaOH solution is______

JEE Main-27.06.2022, Shift-II

Ans. (11) : Given that,

$[OH^-] = 0.001$ M

$[OH^-] = 10^{-3}$ M

We know,

$pOH = -\log[OH^-]$

$= -\log[10^{-3}]$

$pOH = 3$

So, $pH + pOH = 14$

$pH + 3 = 14$

$pH = 11$

443. pH of a solution is 10. The number of hydrogen ions present per millilitre of solution is:

(a) 6.023×10^{23}
(b) 6.023×10^{13}
(c) 6.023×10^{10}
(d) 6.023×10^{7}

CG PET-22.05.2022

Ans. (c) : Given, pH = 10

$-\log[H^+] = 10$

$\log[H^+] = -10$

$[H^+] = 10^{-10}$ M

$$[H^+] = \frac{10^{-10}}{1000\ m^2} = 10^{-13}\ mL^{-1}$$

$\therefore$ No. of $[H^+]$ ions $= 10^{-13} \times N_A$

$= 10^{-13} \times 6.03 \times 10^{23}$

$= 6.023 \times 10^{10}$ ions

444. The pH of 0.05 M Solution of a strong dibasic acid is

(a) 0.0
(b) 1.0
(c) 0.2
(d) 0.5

CG PET- 2012

Ans. (b) : Given that-

Dibasic acid = H_2SO_4

$[H_2SO_4] = 0.05$

As we know $pH = -\log_{10}[H^+]$

$[H^+] = 2 \times 0.05$

$= 0.10$ or 10^{-1}

$pH = -\log_{10}[H^+]$

$= -\log_{10}[10^{-1}]$

$= +1 \log 10$

$pH = 1$

445. The pH of an aqueous solution of H_2O_2 is 6.0. Some chlorine is bubbled through this solution. The pH of the resultant solution will be.

(a) 6
(b) 7
(c) less than 6
(d) more than 7

AP-EAMCET (Med.)-1999

Ans. (c) : Hydrogen peroxide reacts with chlorine to form hydrochloric acid.

$$H_2O_2 + Cl_2 \rightarrow 2HCl + O_2$$

This increases the hydrogen ion concentration. Hence, pH will be less than 6.

446. 0.1 M HCl solution is diluted by 100 times. The pH of the solution so formed is ……..

(a) 4
(b) 1
(c) 2
(d) 3

AP-EAMCET-1991

Ans. (d) : When 0.1 M HCl solution is diluted 100 times, the molarity of solution will be $\frac{0.1}{100} = 0.001M$

HCl is strong electrolyte. It completely dissociates. Its hydrogen ion concentration will be 0.001 M.

$pH = -\log_{10}\left[H^+\right]$

$pH = -\log_{10}[0.001]$

$pH = 3\log_{10}10$

$pH = 3$

447. The pK_a of a certain weak acid is 4.0. What should be the [salt] to [acid] ratio, if we have to prepare a buffer with a pH = 5 using the acid and one of the salts?

(a) 4 : 5
(b) 5 : 4
(c) 10 : 1
(d) 1 : 10

AP-EAMCET-1991

Ans. (c) : Given that, pH = 5, $pK_a = 4$

According to Henderson equation for pH of an buffer is–

$$pH = pK_a + \log\frac{[salt]}{[acid]}$$

$$5 = 4 + \log\frac{[salt]}{[acid]}$$

$$1 = \log\frac{[salt]}{[acid]}$$

$$\therefore \quad \frac{[salt]}{[acid]} = 10:1$$

448. The pH of 10^{-2} M NaOH solution is ………..

(a) 2
(b) 12
(c) 10
(d) 4

AP-EAMCET-1992

Ans. (b) : Given that, $[OH^-] = 10^{-2}$ M

$$[H^+] = \frac{10^{-14}}{10^{-2}} = 10^{-12}$$

$\therefore$ $pH = -\log_{10}[10^{-12}] = 12$

449. If in 100 ml of an aqueous HCl of pH 1.00, 900 ml of more distilled water are added, the pH of the resultant solution will be

(a) 1.0
(b) 2.0
(c) 4.0
(d) 7.0

AP-EAMCET-1992

Ans. (b) : Given an aqueous HCl of pH = 1

we know that-

$pH = -\log[H^+]$

$pH = 1$

$H^+ = 10^{-1}$

When 900 ml water is added to 100 ml solution, total volume becomes 1000 ml. Thus the solution is diluted to 10 times. Hence the concentration will be one tenth of original concentration.

$[H^+] = 10^{-2}$.

$pH = -\log[H^+] = -\log 10^{-2} = 2.0$

450. The ionic product of water is 10^{-14}. What is the hydrogen ion concentration of a 0.1 M NaOH solution?

(a) 10^{-14}
(b) 14 M
(c) 13 M
(d) 10^{-13} M

AP-EAMCET-1994

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Ans. (d) : As we know that,
$K_w = [H^+][OH^-]$
Given :-
$K_W = 10^{-14}$
$[OH^-] = 0.1 = 10^{-1}$

$$\therefore [H^+] = \frac{10^{-14}}{10^{-1}} = 10^{-13}\text{ M}$$

451. The pH of a 0.05 M solution of H_2SO_4 is
(a) 5 (b) 1
(c) 3 (d) 0.1

AP-EAMCET-1994

Ans. (b) : Given that,
$[H^+] = 0.05 \times 2 = 0.10$
$pH = -\log[H^+]$
$= -\log[0.1]$
$pH = 1$

452. The pH of a 0.001 M aqueous solution of sodium hydroxide will be
(a) 5.0 (b) 7.5
(c) 9.0 (d) 11.0

AP-EAMCET-1993

Ans. (d) : We know that NaOH is a strong electrolyte. It completely dissociates.
Thus, $[OH^-] = [NaOH] = 0.001$ M.
$pOH = -\log[OH^+] = -\log 10^{-3} = 3.0$
$pH = 14.0 - pOH = 14.0 - 3.0 = 11$

453. Urine normally has a pH of 6. If a patient eliminates 1.3 L of urine per day, how many moles of H^+ ions does he urinate?
(a) 1.3×10^{-3} (b) 1.3×10^{-6}
(c) 1.3×10^{-7} (d) 1.3×10^{6}

AP-EAMCET-1996

Ans. (b) : Given that,
pH of urine is = 6
$\therefore \quad [H^+] = 1 \times 10^{-6}$ mol/L
Volume of urine eliminated = 1.3 litre

$$[H^+] = \frac{\text{no. of moles}}{\text{volume}}$$

no. of moles $= 10^{-6} \times 1.3$
A patient eliminates 1.3L of urine per day then 1.3×10^{-6} mol/lit. of H^+ ions present.

454. The pH of the aqueous solution containing 0.49 g of H_2SO_4 in one litre is
(a) 2 (b) 1 (c) 1.7 (d) 0.3

AP-EAMCET-1997
AP – EAMCET - (Medical)-1997

Ans. (a) : Given that,
Weight of sulphuric acid (H_2SO_4) = 0.49 gm.

$$\therefore \text{ Molar concentration} = \frac{\text{Weight}}{\text{M.weight}}$$
$$= \frac{0.49}{98} = 0.005\text{ moles}$$

Since, H_2SO_4 contain 2 ionisable hydrogen ion,
Thus, $[H^+] = 2 \times 0.005 = 0.01$ M
$pH = -\log[H^+] = -\log(0.01)$
$pH = -\log_{10}[10^{-2}]$
$pH = 2\log 10$
$pH = 2$

455. The pH of a solution is increased from 3 to 6. Its H^+ion concentration will be
(a) Reduced to half
(b) Doubled
(c) Reduced by 1000 times
(d) Increased by 1000 times

AP-EAMCET-1998, 1996

Ans. (c) : Given that, $pH_1 = 3$, $pH_2 = 6$
$\therefore$ Change in pH $= pH_2 - pH_1$
$= 6 - 3 = 3$
Thus, the ratio of hydrogen ion concentration =

$$\frac{[H^+]_2}{[H^+]_1} = 10^{-3} = 0.001$$

Hence, hydrogen ion concentration should be decreased by 1000 times.

456. The pH of a 1 L solution is 2. It is diluted with water till its pH becomes 4. How many litres of water are added?
(a) 99 (b) 9
(c) 999 (d) 9.9

AP-EAMCET-1999

Ans. (a) : Given that,
$pH = 2$, $[H^+] = 10^{-2}$ M, $V_1 = 1$ litre
$pH = 4$, $[H^+] = 10^{-4}$ M, $V_2 = ?$
$\therefore \quad M_1V_1 = M_2V_2$
$10^{-2} \times 1 = 10^{-4} \times V_2$

$$V_2 = \frac{10^{-2}}{10^{-4}} = 100\text{ litre}$$

Therefore, 99 litre of water is added.

457. The pH of an aqueous solution of a salt is 10. The salt is
(a) NaCl (b) NH_4Cl
(c) CH_3COONa (d) $(NH_4)_2SO_4$

AP-EAMCET-1999

Ans. (c) : The pH of an aqueous solution of salt is 10 mean that salt of weak acid and strong base. The salt is CH_3COONa.
$CH_3COOH + NaOH \rightarrow CH_3COONa + H_2O$

458. The pK_a of a weak acid is 4.8. What should be the ratio of $\frac{[\text{acid}]}{[\text{salt}]}$, if a buffer of pH = 5.8 is required?
(a) 0.1 (b) 10
(c) 1 (d) 2

AP-EAMCET-2001

Ans. (a) : Given that, $pk_a = 4.8$, $pH = 5.8$
We know that,

$$pH = pK_a + \log\frac{[\text{salt}]}{[\text{acid}]}$$
$$5.8 = 4.8 + \log\frac{[\text{salt}]}{[\text{acid}]}$$

or $$\log\frac{[\text{salt}]}{[\text{acid}]} = 5.8 - 4.8 = 1.0$$

or $$\frac{[\text{salt}]}{[\text{acid}]} = 10 \Rightarrow \frac{[\text{acid}]}{[\text{salt}]} = \frac{1}{10} = 0.1$$

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459. Which one of the following statements is correct?

(a) Bronsted-Lowry theory could not explain the acidic nature of BCl_3
(b) The pH of 0.01 M NaOH solution is 2
(c) The ionic product of water at 25ºC is 10^{-10} $mol^2\ L^{-2}$
(d) The pH of a solution can be calculated using the equation $pH = \log[H^+]$

AP-EAMCET-2002

Ans. (a) : According to Bronsted-Lowry theory proton doners are called acid (i.e. a compound from which a proton can be removed)
Bronsted-Lowry theory cannot explain the acidic nature of BCl_3.

460. 75 ml of 0.2 M HCl is mixed with 25 ml of 1 M HCl. To this solution, 300 ml of distilled water is added. What is the pH of the resultant solution?

(a) 1 (b) 2
(c) 4 (d) 0.2

AP-EAMCET-2002

Ans. (a) : Given that,
$V_1 = 75$ ml, $V_2 = 25$ ml, $V_3 = 300$ ml
$M_1 = 0.2$ M, $M_2 = 1$ M, pH = ?
$\therefore\ V = V_1 + V_2 = 75 + 25 = 100$ ml

$$M = \frac{V_1M_1 + V_2M_2}{V_1 + V_2}$$

$$M = \frac{75 \times 0.2 + 25 \times 1}{75 + 25} = 0.4\ M$$

$\therefore$ Total volume (V') = $V_1 + V_2 + V_3$
= 75 + 25 + 300 = 400 ml

Hence,
MV = M'V'
0.4 × 100 = M' × 400

$$M' = \frac{40}{100} = 0.1\ M$$

Concentration of HCl = 0.1 = 10^{-1}
$pH = -\log_{10}[H^+]$
$pH = -\log_{10}[10^{-1}]$
pH = 1

461. The pH of a solution of H_2O_2 is 6.0. Some chlorine gas is bubbled into this solution. Which of the following is correct?

(a) The pH of resultant solution becomes 8.0
(b) Hydrogen gas is liberated from resultant solution
(c) The pH of resultant solution becomes less than 6.0 and oxygen is liberated
(d) Cl_2O is formed in the resultant solution

AP-EAMCET-2005

Ans. (c) : $H_2O_2 + Cl_2 \rightarrow 2\ HCl + O_2$
HCl is formed by the reduction of chlorine by H_2O_2, Hence, pH less than 6.0 and oxygen gas is liberated.

462. Assertion (A) : The pH of a buffer solution containing equal moles of acetic acid and sodium acetate is 4.8 (pK_a of acetic acid is 4.8).
Reason (R) : The ionic product of water at 25ºC is 10^{-14} $mol^2\ L^{-2}$.
The correct answer is

(a) Both (A) and (R) are true and (R) is the correct explanation of (A)
(b) Both (A) and (R) are true and (R) is not correct explanation of (A)
(c) (A) is true but (R) is not true
(d) (A) is not true but (R) is true

AP-EAMCET-2005

Ans. (b) : According to the Henderson-Haselbalch a pH of a buffer solution is given by–

$$pH = pK_a + \log\frac{[salt]}{[acid]}$$

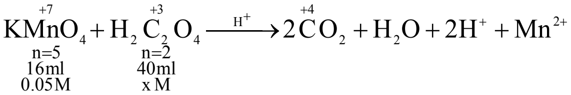
$\therefore\ pH = pK_a$ $\qquad (\because [salt] = [acid])$

463. The concentration of oxalic acid is 'x' mol L^{-1}. 40 mL of this solution reacts with 16 mL of 0.05 M acidified $KMnO_4$. What is the pH of 'x' M oxalic acid solution? (Assume that oxalic acid dissociates completely.)

(a) 1.3 (b) 1.699
(c) 1 (d) 2

AP-EAMCET-2006

Ans. (c) :



$$\underset{\substack{n=5\\16ml\\0.05M}}{K\overset{+7}{Mn}O_4} + \underset{\substack{n=2\\40ml\\x\,M}}{H_2\overset{+3}{C_2}O_4} \xrightarrow{H^+} 2\overset{+4}{C}O_2 + H_2O + 2H^+ + Mn^{2+}$$

$\therefore$ Molar equilibrium of $KMnO_4$ = M.eq. of $H_2C_2O_4$
16 × 0.05 × 5 = 2 × 40 × x

$$x = \frac{80 \times 0.05}{80} = 0.05\ M$$

Since, $[H^+] = 0.05 \times 2 = 0.1 = 10^{-1}$ M
$pH = -\log[H^+]$
$pH = -\log[10^{-1}]$
pH = 1

464. 50 mL of H_2O is added to 50 mL of 1×10^{-3} M barium hydroxide solution. What is the pH of the resulting solution?

(a) 3.0 (b) 3.3
(c) 11.0 (d) 11.7

AP-EAMCET-2008

Ans. (c) : $M_1 = 0.001$, $V_1 = 50$ ml, M_2 = ?
$V_2 = 50 + 50 = 100$ ml
Now, solving for M_2 we get,
$M_2 = 0.0005$
Now we will check the dissociation of $Ba(OH)_2$ –
$Ba(OH)_2 \rightarrow Ba^{2+} + 2OH^-$
1 mole of $Ba(OH)_2$ gives rise to 2 moles of OH^- ions.
Therefore, the concentration of hydroxide ions would be 2 times the concentration of solution of barium hydroxide.
$OH^- = 2 \times (0.0005) = 0.001$
pOH = –log (0.001)
pOH = 3
Therefore pH will be 14 – pOH
= 14 – 3
pH = 11

465. Which of the following is an acid?

(a) $Ca(OH)_2$ (b) $P(OH)_3$
(c) NH_4OH (d) NaOH

AP-EAMCET-2000

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Ans. (b) : Proton donors are called as **acids**. In H_3PO_3 or $P(OH)_3$ it contains two ionisable proton and behave as acid.

- $Ca(OH)_2$, NH_4OH and NaOH are basic in nature. Sodium hydroxide is the strong base.

466. Among the following the lowest pK_a value is of
(a) 4- Methoxybenzoic acid
(b) Benzoic acid
(c) 4- Nitrobenzoic acid
(d) 4- Methylbenzoic acid

JHARKHAND – 2019

Ans. (c) : When the pK_a value is maximum then the acid is weak. While pK_a value is minimum means the stronger acid. Hence, the 4-Nitrobenzoic is a strong acid so, it has the lowest pK_a value.

467. A 0.20 molar solution of a weak monoprotic acid, HA, has a pH of 3.0. The ionization constant of the acid is
(a) 5.0 x 10^{-7} (b) 2.0 x 10^{-7}
(c) 5.0 x 10^{-6} (d) 5.0 x 10^{-3}

SCRA-2014

Ans. (c) : Let weak monoprotic acid is – CH_3COOH
The dissociation of CH_3COOH is :–

$$CH_3COOH \rightleftharpoons CH_3COO^- + H^+$$

Initial – 0.20 0 0
at equilibrium (0.20 – x) x x

$$HA = \frac{x^2}{(0.20-x)}$$

pH = 3, So, $H^+ = 10^{-3}$
$x = 10^{-3}$

$$K_a = \frac{(10^{-3})^2}{(0.20-10^{-3})} = \frac{10^{-6}}{.20-.001} = \frac{10^{-6}}{.199}$$

$$= \frac{1}{2} \times 10^{-5}$$

$$= .5 \times 10^{-5}$$

$K_a = 5 \times 10^{-6}$

468. pH of water is 7.0 at 25°C. If water is heated to 80°C :
(a) pH will increase
(b) pH will decrease
(c) pH remains 7.0
(d) H^+ ion concentration will increase but OH^- ion concentration will decrease

MPPET-2013

Ans. (b) :
- pH of water 0 is 7 at 25°C as temperature increases ionic product of water increase so pH decreases.

Note-On heating water K_W increases and thus pH scale for neutrality changes from 7 to some lower value.

469. Which of the following gas the highest pH at 25°C?
(a) Distilled H_2O (b) 1 M aq NH_3
(c) 1 M NaOH (d) 1M HCl

AP EAPCET 23-08-2021 Shift-I

Ans. (c) : (i) Distilled H_2O
Pure water has a pH of 7 at 25°C.
(ii) 1M aq NH_3
$pOH = -\log [OH^-]$
$= -\log [2\times10^{-3}]$
$pOH = 2.7$
Now, we know that
$pH + pOH = 14$
$pH = 14 - 2.7 = 11.3$
(iii) 1 M NaOH
$pOH = -\log [1]$
$= 0$
$\therefore pH + pOH = 14$
$pH = 14 - 0 = 14$
(iv) 1 M HCl
$pH = -\log[1]$
$pH = 0$
So, the option (c) has maximum pH at 25°C.

470. pH of an aqueous solution of NH_4Cl is
(a) 7 (b) > 7
(c) < 7 (d) 1

TS-EAMCET-2016

Ans. (c) : Ammonium chloride (NH_4Cl) is a salt of ammonia (NH_3) and HCl.

$$\underset{\text{(Weak base)}}{NH_3} + \underset{\text{(Strong acid)}}{HCl} \longrightarrow NH_4Cl$$

Therefore, the pH of $NH_4Cl < 7$.

471. Which of the following will have the highest pH?
(a) Saturated solution of NaOH
(b) M HCl solution
(c) Human Saliva
(d) Lemon Juice

AP EAMCET (Engg.) 17.09.2020, Shift-II

Ans. (a) :
(a) For saturated solution of NaOH pH = 15
(b) M HCl pH = 0
(c) Human saliva pH = 6.4
(d) Lemon Juice pH = 2.2
Hence, option (a) is correct.

472. The pH of 10^{-8} M HCl solution is
(a) 8 (b) –8
(c) Between 7-8 (d) Between 6-7

AP EAMCET (Engg.) 21.09.2020, Shift-I

Ans. (d) : 10^{-8} M HCl $\longrightarrow 10^{-8}$ M H^+
$K_w = [H^+] \times [OH^-]$
$10^{-14} = (10^{-8} + x) \times x = 10^{-8}x + x^2$
$x = 10^{-7}$
total $[H^+] = 10^{-7} + 10^{-8} = 1.1 \times 10^{-10}$
$pH = -\log (1.1 \times 10^{-7}) = 7 - \log 1.1$
$pH = 6.99$

473. The dissociation constant of a weak monobasic acid K_a is 1×10^{-5}. The pH of 0.1 M of that acid would be:
(a) 3 (b) between 2-3
(c) 1 (d) 5

AP EAMCET (Medical) -1998

Ans. (a): Given values, $K_a = 1 \times 10^{-5}$, pH = ?
Concentration = 0.1 M
Now, $pH = -\log[H^+]$

$$\left[H^+\right] = \sqrt{K_a \times M}$$

or $$\left[H^+\right] = \sqrt{1\times10^{-5} \times 0.1}$$

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$$\left[H^+\right] = 1\times10^{-3}$$

$\therefore$ $$pH = -\log\left[1\times10^{-3}\right]$$

or $pH = 3$

474. Calculate the pH of a solution containing 0.2 M CH_3COOH and 0.1 M CH_3COONa. The K_4 of $CH_3COOH = 1.8\times10^{-5}$ ($-\log1.8\times10^{-5}$) = 4.74

(a) 4.74 (b) 4.43
(c) 5.01 (d) 5.32

TS EAMCET 10.08.2021, Shift-II

Ans. (b) : pH of acidic buffer solution

$$pH = pK_a + \log\frac{[salt]}{[Acid]}$$

Given that,

$$K_a = 1.8\times10^{-5}$$

$$pH = -\log K_a + \log\frac{[salt]}{Acid}$$

$$pH = -\log1.8\times10^{-5} + \log\frac{[0.1]}{[0.2]}$$

$= 5\log_{10}10 + -\log1.8 + \log0.5$

$= 5 - 0.2552 - 0.3010$

$= 4.74 - 0.3010 = 4.43$

475. Sulphurous acid (H_2SO_3) has $K_{a_1} = 1.7\times10^{-2}$ and $K_{a_2} = 6.4\times10^{-8}$. The pH of 0.588 M H_2SO_3 is ---------. (Round off to the Nearest Integer).

JEE Main 16.03.2021, Shift-II

Ans. (1) : The given data is:

$$K_{a_1} = 1.7\times10^{-2}$$

$$K_{a_2} = 6.4\times10^{-8}$$

and $[H_2SO_3] = 0.588M$

$pH = ?$

The dissociation of H_2SO_3 is:

$$H_2SO_3(aq) \rightleftharpoons H^+(aq) + HSO_3^-(aq)$$

The pH of solution depend upon the first value of dissociation constant i.e. $K_{a_1} >>> K_{a_2}$

$$K_{a_1} = \frac{\alpha^2}{(c-\alpha)}$$

$$\frac{1.7}{100} = \frac{\alpha^2}{(0.58-\alpha)}$$

or $100\alpha^2 + 1.7\alpha - 1 = 0$

or $$\alpha = [H^+] = \frac{-1.7\pm\sqrt{(1.7)^2 + 4\times100\times1}}{2\times100}$$

or $[H^+] = 0.09186$

$\therefore pH = -\log[H^+]$

$pH = -\log0.09186$

$pH = 1.036$

$pH \approx 1$

476. Calculate the molar ratio of a weak acid HA ($K_a = 10^{-6}$) and its salt with strong base, so that the pH of buffer solution is 6.

(a) 10 (b) 1
(c) 6 (d) 0.1

AP EAMCET (Engg.) 21.09.2020, Shift-II

Ans. (d) : $$pH = pK_a + \log\frac{[Salt]}{[Acid]}$$

$$= \frac{pH}{pK_a} = \frac{6}{6} = 1$$

$$\left[K_a = 10^{-6} \therefore pK_a = -\log K_a = \log\left(10^{-6}\right) \Rightarrow 6\right]$$

$$\log\frac{[Salt]}{[Acid]} = 1$$

$\therefore$ $$\frac{[Acid]}{[Salt]} = 10^{-1}$$

$$\frac{[Acid]}{[Salt]} = 0.1$$

Hence, the correct option is (d).

477. 20 ml of 0.1 M acetic acid is mixed with 50 ml of potassium acetate. Ka of acetic acid = 1.8×10^{-5} at 27°C calculate concentration of potassium acetate if pH of the mixture is 4.8

(a) 0.1 M (b) 0.04 M
(c) 0.4 M (d) 0.02 M

AP EAMCET (Engg.)-2009

Ans. (b): Let, the concentration of potassium acetate is x.

According to Henderson's equation,

$$pH = pK_a + \log\frac{[salt]}{[acid]}$$

$$4.8 = -\log(1.8\times10^{-5}) + \log\frac{x\times50}{20\times0.1}$$

$4.8 = 5\log_{10}10 - \log1.8 + \log25x$

$4.8 = 5 - 0.2552 + \log25x$

$4.8 = 4.74 + \log25x$

or $\log25x = 0.06$

$25x = 1.48$

$\therefore x = 0.045$ M

478. pH of a buffer solution decreases by 0.02 units when 0.12 g of acetic acid is added to 250 mL of a buffer solution of acetic acid and potassium acetate at 27°C. The buffer capacity of the solution is

(a) 0.1 (b) 10
(c) 1 (d) 0.4

AP EAMCET (Engg.)-2009
VITEEE-2009

Ans. (d): Buffer capacity, $\beta = \frac{dC_{HA}}{d_{pH}}$

where, dC_{HA} = no. of moles of acid added per litre

d_{pH} = change in pH

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$$dC_{HA} = \frac{\text{Moles of acetic acid}}{\text{Volume}}$$

$$= \frac{0.12/60}{250/1000} = \frac{0.12\times1000}{60\times250} = \frac{0.12\times4}{60} = \frac{0.12}{15}$$

$$\beta = \frac{0.12}{0.02\times15} = \frac{6}{15} = 0.4$$

479. The pK_a of a weak acid, benzoic acid and pK_b of a weak base, ammonium hydroxide are 4.25 and 4.75 respectively. Then the pH of 0.1 M solution of ammonium benzoate will be

(a) 7.10 (b) 7.50

(c) 6.75 (d) 6.50

AP EAMCET (Engg.) 18.9.2020 Shift-I

Ans. (c) : Ammonium benzoate ($C_6H_5COONH_4$) is the salt weak benzoic acid (C_6H_5COOH pK_a = 4.25) and weak ammonium hydroxide (NH_4 OH, pK_b = 4.75).

So, pH of the solution of C_6H_5COOH will be,

$$pH = 7 + \frac{1}{2}(pK_a - pK_b)$$

$$= 7 + \frac{1}{2}(4.25 - 4.75) = 7 - 0.25 = 6.75$$

480. If hydrogen electrode dipped in two solutions of pH = 3 and pH = 6 are connected by a salt bridge, the emf of the resulting cell is

(a) 0.177 V (b) 0.3 V

(c) 0.052 V (d) 0.104 V

AP EAPCET 20.08.2021 Shift-I

Ans. (a) : Given that.

$pH_1 = 3$

$pH_2 = 6$

We know

$pH = -\log_{10}[H^+]$

$pH_1 = [3] = 10^{-3}$ M

$pH_2 = 10^{-6}$ M

$$\therefore \text{ E cell} = E^o \text{ cell}^\circ + \frac{0.0591}{1}\log\frac{10^{-3}}{10^{-6}}$$

E cell = 0 + 0.0591 × 3

= 0.177 V

481. The pH of acid rain water is ________

(a) Between 6 – 7 (b) Between 5.2 – 5.8

(c) Between 4 – 5 (d) < 4.0

AP EAPCET-6 Sep. 2021, Shift-II

Ans. (b): Due to atmospheric pollution, when the rain fall through this polluted air, it consume oxides of sulphur (SO_x) and oxides of nitrogen (NO_x). Thus make the rain acidic with the pH range 5.2 to 5.8.

482. Two solutions A and B have pH 3 and 6 respectively. Which of the following statement is correct?

(a) Solution A is twice acidic than B

(b) Solution B is twice acidic than A

(c) Solution A is 1000 times more acidic than B

(d) Solution B is 1000 times more acidic than A

AP EAPCET-6 Sep. 2021, Shift-II

Ans. (c): We know that–

$pH = -\log[H^+]$

Solution A: $[H^+] = 10^{-3}$ M

$pH = -\log[10^{-3}]$

$= 3$

Solution B: $[H^+] = 10^{-6}$ M

$pH = -\log[10^{-6}]$

$= 6$

483. In an amino acid, the carboxylic group ionizes at pH = 2.56 (pK_{a_2}) and ammonium ion ionizes at pH = 9.38 (pK_{a_2}) The isoelectric point of the amino acid is at ______

(a) 11.94 (b) 6.82

(c) 5.97 (d) 3.41

AP EAPCET 24.08.2021, Shift-I

Ans. (c) : The isoelectric point is defined as it is halfway between two given values of pKa_1 and pKa_2.

$$\text{i.e. isoelectric point} = \frac{pKa_1 + pKa_2}{2}$$

Given - $pKa_1 = 2.56$, $pKa_2 = 9.38$

$$\therefore \text{ isoelectic point} = \frac{2.56 + 9.38}{2} = 5.97$$

484. The pH of 0.1 M solution of acetic acid will be _____ [degree of dissociation of acetic acid is 0.0132]

(a) 4.32 (b) 3.14

(c) 1.14 (d) 2.88

AP EAPCET 20.08.2021 Shift-II

Ans. (d): Given that

Degree of dissociation of acetic acid = 0.0132

Concentration = 0.1 M

∴ Dissociation of acetic acid

$CH_3COOH + H_2O \rightarrow CH_3COO^- + H_3O^+$

So,

amount of H_3O^+ ions formed

= 0.0132 × 0.1

= 0.00132

So, pH of acetic acid will be,

$pH = -\log[H_3O^+]$

$= -\log[0.00132]$

pH = 2.88

485. The dissociation constant of a weak base is 1×10^{-5} at 25°C. The pH of its 0.1 M solution at the same temperature will be

(a) 11 (b) 3

(c) 6 (d) 13

COMEDK-2011

Ans. (a) : Given,

dissociation constant of weak base = 1×10^{-5}

concentration = 0.1 M

By Ostwald dilution law,

$[OH^-]$ in weak base $= \sqrt{K_bC}$

$$= \sqrt{1\times10^{-5}\times0.1} = 1\times10^{-3} \text{ M}$$

$pOH = -\log[OH^-]$

$= -\log(1\times10^{-3})$

pOH = 3

We know that–

$\Rightarrow pH + pOH = 14$

$\Rightarrow pH = 14 - 3 = 11$

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486. The pH of a solution of NaOH is 12. The mass of NaOH present in 500 mL of the solution is

(a) 400 mg (b) 200 mg

(c) 20 mg (d) 40 mg

COMEDK-2011

Ans. (b) : Given that,

pH = 12

∵ pH + pOH = 14

pOH= 14–12=2

Hence, NaOH concentration = 10^{-2} M= 10^{-2} N

We know that, $N=\frac{w\times1000}{\text{Eq.wt}\times\text{Volume(mL)}}$

$$\Rightarrow 10^{-2}=\frac{w\times1000}{40\times500}$$

$$\Rightarrow w=\frac{10^{-2}\times40\times500}{1000}=10^{-2}\times20=0.2g=200mg$$

487. The pOH of 0.0005 M sulphuric acid is

(a) 5 (b) 3

(c) 11 (d) 12

COMEDK-2011

Ans. (c) : The equation for ionization is–

$$H_2SO_4 \rightleftharpoons 2H^+ + SO_4^{2-}$$

Each molecule of acid gives 2 molecules of H^+

So, $[H^+]$ = 2 ×0.0005= 1×10^{-3}M

pH= –log $[H^+]$= –log (1×10^{-3})=3

We know that-

∵ pH+pOH=14

3+pOH=14

pOH=14–3

pOH=11

488. The pH of HCl is 5. If 10 mL of this solution is diluted to 100 mL, the pH of the resultant solution is

(a) 5.1 (b) 6.9

(c) 11 (d) 12

COMEDK-2011

Ans. (b) : Given that,

pH of HCl=5

So, Concentration of $[H^+] = 10^{-5}$ mol/L

Concentration of H^+ ions in 10 ml of the solution

$$=\frac{10^{-5}\times10}{1000}$$

= 10^{-7} mol

We know that, solution is diluted to 100 ml i.e. 10 times

No. of H^+ ions = $\frac{10^{-7}}{10}=10^{-8}$

Total $[H^+]$= $10^{-8}+10^{-7}$

($[H^+]$ from water cannot be neglected.)

= 10^{-8} (1+10) = 11×10^{-8} M

pH= – log (11×10^{-8})= – (1.0413–8)=6.95

489. The pH of a mixture of 10 ml of 0.1 M H_2SO_4, 5 ml of 0.2 M HCl and 5 ml of 0.1 M $Ca(OH)_2$ is

(a) 1 (b) 0.5

(c) 0 (d) 1.5

COMEDK-2012

Ans. (a) : Molarity of mixture of 10 ml H_2SO_4 = 0.1M

= 1 millimole of H_2SO_4

= 2 millimole of H^+ ions

5 ml of 0.2 M HCl = 1 millimole of H^+ ions

5 ml of 0.1 M $Ca(OH)_2$ = 0.5 millimole of $Ca(OH)_2$

= 1 millimole of OH^- ions

1 millimole of OH^- ions will neutralize the 1 millimole of H^+ ions.

So, 2 millimoles of H^+ ions will remain in solution.

$[H^+]\ \frac{2}{20}$ = 0.1=10^{-1} mol/L

Hence, pH= –log $[H^+]$ = –log (10^{-1}) =1

490. The pH of boiling water is 6.4. This implies that boiling water is

(a) slightly basic (b) slightly acidic

(c) neutral (d) amphoteric.

COMEDK-2012

Ans. (c) : The pH of boiling water is 6.4. This implies that boiling water is neutral. When water is boiled, the dissociation of water increases with temperature. So, both hydrogen ion and hydroxide ion concentration increases with same extent. Therefore, it is neutral.

491. At 100°C the K_w of water is 55 times its value at 25°C, What will be the pH of neutral solution? (log 55=1.74)

(a) 7.00 (b) 7.87

(c) 5.13 (d) 6.13

Karnataka NEET-2013

Ans. (d) : We know that, at 25°C, $K_w = 1\times10^{-14}$

At 100°C, $K_w = 55\times10^{-14}$

$H^+ = \sqrt{55\times10^{-14}}$

pH= –log $[H^+]$

pH of neutral solution.

$$pH = -\log\left[\sqrt{55\times10^{-14}}\right]=\frac{1}{2}[-\log(55\times10^{-14})]$$

$$=\frac{1}{2}[-\log55+14\log10] \qquad (\log55=1.74)$$

$$=\frac{1}{2}[-1.74+14]$$

$$=\frac{1}{2}[12.26]=6.13$$

492. The numbers of H^+ ions present in 1 ml of a solution whose pH is 13

(a) 6.022×10^{10} (b) 6.022×10^{7}

(c) 6.022×10^{20} (d) 6.022×10^{23}

COMEDK-2015

Ans. (b) : Given that-

pH=13

$\Rightarrow [H]^+ = 10^{-13}$ mol/L

⇒ 1000 mL solution contains

$10^{-13}\times6.022\times10^{23}$ H^+ ions

= 6.022×10^{10} H^+ ions

∴ 1ml solution contains

$$\frac{6.022\times10^{10}}{1000}=6.022\times10^{7}\ H^+\ \text{ions.}$$

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493. In the hydrolysis of a salt of weak acid and weak base, the hydrolysis constant (K_t) is equal to

(a) $\frac{K_w}{K_b}$ (b) $\frac{K_w}{K_a}$

(c) $\frac{K_w}{K_a.K_b}$ (d) $K_a.K_b$

COMEDK-2016

Ans. (c) : $K_h = \frac{K_w}{K_a.K_b}$

where, K_w= ionic product of water, K_a and K_b are dissociation constants of the weak acid and base respectively.

494. K_p for the following reaction will be equal to
$$Fe(s) + H_2O(g) \rightleftharpoons Fe_3O_4(s) + H_2(f)$$

(a) $\frac{(p_{H_2})^4 (p_{Fe_3O_4})}{(p_{Fe})^3 (p_{H_2O})^4}$ (b) $\frac{(p_{H_2})}{(p_{H_2O})}$

(c) $\frac{(p_{H_2})^4}{(p_{H_2O})^4}$ (d) $\frac{(p_{H_2})(p_{Fe_3O_4})}{(p_{Fe})}$

COMEDK-2016

Ans. (c) : The balanced equation is
$$3Fe(s) + 4H_2O(g) \rightleftharpoons Fe_3O_4(s) + 4H_2$$
Take [solid]=1 $\therefore K_p = \frac{(p_{H_2})^4}{(p_{H_2O})^4}$

495. The highest pH is exhibited by

(a) 0.001 M KOH (b) 0.01 M KOH

(c) 0.1 M HCl (d) 0.01 M HCl

COMEDK-2017

Ans. (b) : We know that,
pH + pOH = 14
pOH = –log[OH^-]
For 0.001 M KOH,
pOH = –log (0.001) = –log (10^{-3}) = 3
pH = 14 – pOH = 14 – 3 = 11
For 0.01M KOH,
pOH = – log (0.01) = –log(10^{-2}) = 2
pH = 14 – pOH = 14 – 2 = 12
For 0.1 M HCl
pH = – log (0.1) = – log (10^{-1}) = 1
pOH= –log(0.001)= –log(10^{-3}) =3
pH=14–pOH=14–3=11
For 0.01 M HCl,
pH= –log(0.01) = –log(10^{-2}) =2

496. 5 L of NaOH solution of pH 12 contains

(a) 200 g (b) 0.2 g

(c) 20 g (d) 2 g

COMEDK-2020

Ans. (d) : Given that,
pH of solution =12
We know, (pH + pOH = 14)
$\Rightarrow [OH^-] = 10^{-2}$ mol / L
pOH= 14 – 12 = 2
1 L contains 10^{-2} moles of OH^- ions.
$\therefore$ 5 L will contain 5×10^{-2} moles of OH^- ions.
We know that, no. of moles = $\frac{\text{weight}}{\text{mol} \times \text{mass}}$
$w = 5\times10^{-2}\times40 = 2g$

497. The pH of a solution having hydronium ion conc $H_3O^+; 6.2\times10^{-9}$ will be

(a) 9.0 (b) 8.9

(c) 5.0 (d) 8.21

COMEDK-2019

Ans. (d) : pH = –log[H^+]
[H^+] = [H_3O^+]
pH= –log [H_3O^+]
= – log (6.2×10^{-9})
$pH = 9\log_{10}10 + -\log 6.2$
$pH = 9 - 0.7925$
pH = 8.21

498. When solid potassium cyanide is added in water then

(a) pH will increase

(b) pH will remain the same

(c) pH will decrease

(d) electrical conductivity will not change.

COMEDK-2019

Ans. (a) : $\underset{\text{(Potassium cyanide)}}{KCN(aq)} \rightleftharpoons \underset{\text{(Potassium ion)}}{K^+} + \underset{\text{(Cyanide ion)}}{CN^-}$

$$\underset{\text{(Cyanide ion)}}{CN^-} + \underset{\text{(Water)}}{HOH} \rightleftharpoons \underset{\text{(Hydrogen cyanide)}}{HCN} + \underset{\text{(Hydroxyl ion)}}{OH^-}$$

In the process, the pH will increase due to increase in OH^- ion concentration.

499. The four acids A_1, A_2, A_3 and A_4 have the pK_a values of 3.75, 4.75, 4.20, 5.72 respectively. The weakest acid is

(a) A_1 (b) A_2

(c) A_3 (d) A_4

COMEDK-2018

Ans. (d) : Higher the pK_a value, weaker is the acid.
Hence pK_a values is maximum in A_4 So, It is the weakest acid.

500. The pH range of methyl red indicator is:

(a) 4.2 to 6.3 (b) 8.3 to 10.0

(c) 8.0 to 9.6 (d) 6.8 to 8.4

AP-EAMCET (Medical), 2001

Ans. (a) : In the titration of weak base-strong acid, methyl red indicator is used. In this titration, methyl red indicator gives red colour in acidic medium and yellow colour in alkaline medium. Thus, the pH range of methyl red indicator is 4.2 to 6.3

501. What will be pH of aqueous solution of electrolyte in electrolytic cell during electrolysis of $CuSO_4$(aq) between graphite electrodes?

(a) pH = 14.0 (b) pH > 7.0

(c) pH < 7.0 (d) pH = 7.0

GUJCET-2011

Ans. (c): The pH of aqueous solution of electrolyte in electrolytic cell during electrolysis of $CuSO_4$(aq) between graphite electrodes is pH < 7.0
At cathode

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$Cu^{2+} + 2e^- \rightarrow Cu(s)$

At anode: $2H_2O \rightarrow O_2 + 4H^+ + 4e^-$

It can be seen that OH^- ions from the solution are converted to O_2 which left out the solution acidic.

502. The pH of ammonium phosphate solution, if pK_a of phosphoric acid and pK_b of ammonium hydroxide are 5.23 and 4.75 respectively, is _____.

JEE Main 26.02.2021,Shift-II

Ans.: Given that

$pK_a = 5.23$

$pK_b = 4.75$

$$(NH_4)_3PO_4 \rightleftharpoons 3NH_4^+ + PO_4^{3-}$$

$$\left[H^+\right] = K_a \times \sqrt{\frac{K_w}{K_a \times K_b}}$$

$$\therefore pH = pK_a + \frac{1}{2}\{pK_w - pK_a - pK_b\}$$

$$pH = 5.23 + \frac{1}{2}\{14 - 5.23 - 4.75\}$$

$$pH = 5.23 + \frac{1}{2} \times 4.02$$

$pH = 7.24$

$pH \approx 7$

504. Acetylsalicylic acid has pK_a value 3.5. The pH of gastric juice in human stomach is 2 – 3 and the pH in the small intestine is approximately 7. 4 then acetylsalicylic acid will be

(a) Unionized in the stomach and ionized in the small intestine

(b) Unionized in the small intestine and in the stomach

(c) Completely get ionized in both small intestine and stomach

(d) Ionized in the stomach and almost unionized in the small intestine

TS-EAMCET 09.08.2021, Shift-I

Ans. (a) : The pH of gastric juice in human stomach is about 2-3 (highly acidic) and acetyl salicylic acid is a weak acid, as such its ionization will be suppressed in the presence of a strong acid. Thus it will be weak acid, as such its ionization will be suppressed in the presence of a strong acid.

pH in small intestine is 8, basic, aspirin will be neutralized here.

505. Given below are two statements :

Statements I :

The pH if rain water is normally ~5.6.

Statements II :

If the pH of rain water drops below 5.6, it is called acid rain.

In the light of the above statements, choose the correct answer from the options given below :

(a) Both Statement I and Statement II are true.

(b) Both Statement I and Statement II are false.

(c) Statement I is true but Statement II is false.

(d) Statement I is false but Statement II is true.

JEE Main 25.02.2021, Shift-II

Ans. (a) : Normal rain has pH of about 5.6:

It is slightly acidic because carbon dioxide (CO_2) dissolves into it forming weak carbonic acid. Acid rain usually has pH between 4.2 and 4.4.

Acid rain results when sulphur oxide (SO_2) and nitrogen oxides (NO_x) emitted into the atmosphere react with rain water and oxygen.

506. pH of a salt solution of weak acid (pK_a = 4) & weak base (pK_b = 5) at 25 ºC is:

(a) 6.5
(b) 6
(c) 7
(d) 7.5

AIIMS 26 May 2019 (Evening)

Ans. (a): Given that,

$pK_a = 4, pK_b = 5$

then,

$$pH = \frac{1}{2}(pK_w + pK_a - pK_b)$$

$$= \frac{1}{2}(14 + 4 - 5)$$

$= 6.5$

507. The aqueous solution of which of the following salt will have the lowest pH?

(a) $NaClO_3$
(b) $NaClO$
(c) $NaClO_4$
(d) $NaClO_2$

AIIMS-1996

Ans. (c): Salt of SA + SB : pH will remain neutral at 7

Salt of SA + WB : pH < 7 (acidic)

Salt of WA +SB : pH > 7 (basic)

$NaClO_4 \Rightarrow$ Neutral (pH = 7)

$HClO_4 + NaOH \rightarrow NaClO_4 + H_2O$

(SA) (SB)

Where,

SA = strong acid

SB = strong base

WB = weak base

WA = weak acid

$NaClO_4$, on hydrolysis gives strongest acid $HClO_4$ as compared to other salt. This is strongly ionized and gives highest concentration of H^+ therefore, aqueous solution of $NaCl_4$ will have lowest pH value.

508. The pH value of human blood is about

(a) 4.5 to 5.6
(b) 2.3 to 3.4
(c) 7.3 to 7.5
(d) 3.5 to 4.3

AIIMS-1996

Ans. (c): Human blood is slightly basic i.e. pH 7.3 to 7.5 usually the body maintains the pH of blood close to 7.4 (pH = 7 is neutral)

509. The pH of 0.001 (N) acetic acid solution, which is 10% dissociated, is

(a) 3
(b) 1
(c) 4
(d) 2

AIIMS-1996

Ans. (c): Given that,

Concentration of acetic acid = 0.001 N for 10% dissociation,

the effective concentration of H^+ is 1/10th of total concentration.

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Hence, effective concentration

$= \frac{1}{10} \times 0.001 = 0.0001\,N = 1 \times 10^{-4}N$

$pH = -\log[H^+]$
$pH = -\log[1\times10^{-4}]$
$= 4$

510. Assertion : In a titration of weak acid and NaOH, the pH at half equivalence point is pK_a.
Reason : At half equivalence point, it forms an acidic buffer and the buffer capacity is maximum where [acid] =[salt]

(a) If both Assertion and Reason are correct and the Reason is the correct explanation of Assertion.
(b) If both assertion and Reason are correct, but Reason is not the correct explanation of assertion.
(c) If Assertion if correct but Reason is incorrect.
(d) If both the Assertion and Reason are incorrect.

AIIMS-2009, 26 May,2018(M)

Ans. (a): $pH = pK_a + \log\frac{[A^-]}{[HA]}$

At the half-equivalence point say we have 10 moles of weak acid, and so there will be 5 moles of strong base as the name suggests (half equivalence).

$HA + OH^- \rightarrow A^- + H_2O$

for the half equivalent point, $[H.A] = [A^-]$

So, $pH = pK_a$

511. 20 mL of 0.1 M acetic acid is mixed in a solution of NaOH. If 10 mL of 0.1 M NaOH is present then H^+ concentration in resulting solution is (K_a of acetic acid = 1.7×10^{-5})

(a) 3.4×10^{-5} (b) 1.7×10^{-2}
(c) 1.7×10^{-5} (d) 1.7×10^{-7}

AIIMS-27 May,2018(M)

Ans. (c): Given, $K_a = 1.7 \times 10^{-5}$

Solution of NaOH = 20 ml

$CH_3COOH + NaOH \rightarrow CH_3COONa + H_2O$
20 × 0.1   10 × 0.1
2M mole   1M mole
1M mole   0   1M mole

We know that,

$$pOH = pK_b + \log\frac{salt}{acid}$$

Therefore,

$pH = pK_a$
$(H^+) = K_a = 1.7 \times 10^{-5}$ M

512. Which of the following have maximum pH?

(a) Black coffee (b) Blood
(c) Gastric juice (d) Saliva

AIIMS-26 May,2018(M)

Ans. (b): Material	**pH**
i. Black coffee	- 5.0
ii. Blood	- 7.4
iii. Gastric Juicev	- 1.8–2.0
iv. Saliva	- 6.8

513. K_{sp} of $M(OH)_2$ is 3.2×10^{-11}. The pH of saturated solution in water is

(a) 3.40 (b) 10.30
(c) 10.60 (d) 3.70

AP-EAMCET-(2014)

Ans. (c): $M(OH)_2 \rightarrow M^{2+} + 2OH^-$
[x]   [2x]

$K_{sp} = [x]\,[2x]^2$
$= 4x^3$
$3.2 \times 10^{-11} = 4x^3$
$0.8\times10^{-11} = x^3$
$x^3 = 8 \times 10^{-12}$
$x = 2 \times 10^{-4}$
$[OH] = 4 \times 10^{-4}M$
$pOH = -\log[OH^-]$
$= 4 - 2\log 2$
$= 4 - 2 \times 0.03$
$= 3.4$

We know,

$pH + pOH = 14$
$pH = 14 - 3.4$
$= 10.60$

514. The pH of blood does not appreciably change by a small addition of acid or a base because blood

(a) contains serum protein which acts as buffer.
(b) contains iron as a part of the molecule.
(c) can be easily coagulated.
(d) is body fluid.

AP-EAMCET-(2012)

Ans. (a): Blood is an example of buffer solution, which contains serum protein, its pH does not change appreciably by adding small amount of an acid or base to it. The Buffer System present in serum is H_2CO_3 + $NaHCO_3$

515. The pH of the solution obtained on neutralisation of 40 mL 0.1M NaOH with 40 mL 0.1 M CH_3COOH is

(a) 7 (b) 8
(c) 6 (d) 3

AP-EAMCET-(2007)

Ans. (b) : NaOH is a strong Base and CH_3COOH is a weak acid on neutralisation of 40 mL of 0.1 M NaOH with 40 mL of 0.1 M

$NaOH + CH_3COOH \rightarrow CH_3COONa + H_2O$

By above reaction CH_3COOH Na forms with give basic solutioh with pH > 7.

516. What is the pH value of 1 M H_2SO_4?

(a) 0 (b) –0.213
(c) –2 (d) –0.3010

AP-EAMCET-(2008)

Ans. (d) : $H_2SO_4 \rightarrow 2H^+ + SO_4^{2-}$
1M   2M   1M

By above reaction we get, $[H^+] = 2$

So, $pH = -\log[H^+] = -\log 2 = -0.3010$

517. 40 mL of 0.1 M ammonia solution is mixed with 40 mL of 0.1 MHCl. What is the pH of the mixture? (pK_b of ammonia solution is 4.74).

(a) 4.74 (b) 2.26
(c) 9.26 (d) 5.00

AP-EAMCET-(2006)

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Ans. (c): Henderson - Haselbalch equation

$$\mathrm{pOH} = \mathrm{p}K_b + \log\left(\frac{\text{salt}}{\text{base}}\right)$$

$$\mathrm{pOH} = \mathrm{p}K_b + \log\left(\frac{NH_4Cl}{NH_3}\right)$$

At half stage of titration salt = Base

as $\mathrm{pOH} = \mathrm{p}K_b = 4.74$

So, $\mathrm{pH} = 14 - \mathrm{pOH} = 14 - 4.74 = 9.26$

518. When 10 mL of 0.1 M acetic acid ($\mathrm{p}K_a = 5.0$), is titrated against 10 mL of 0.1 M ammonia solution ($\mathrm{p}K_b = 5.0$), the equivalence point occurs at pH:

(a) 5.0 (b) 6.0 (c) 7.0 (d) 9.0

AP-EAMCET-(2005)

Ans. (c): $CH_3COOH + NH_4OH \rightarrow CH_3COONH_4 + H_2O$

Here, given that

$\mathrm{p}K_a = 5$

$\mathrm{p}K_b = 5$

$\mathrm{p}K_a = -\log K_a$ and $\mathrm{p}K_b = -\log K_b$

$$\mathrm{pH} = -\frac{1}{2}[\log K_a + \log K_w - \log K_b]$$

$$= -\frac{1}{2}[-5 + \log 10^{-14} - (-5)]$$

$$= -\frac{1}{2}[-5 - 14 + 5]$$

$$= -\frac{1}{2}\times(-14)$$

$$= 7$$

Thus, the end point or equivalence point is obtained at pH = 7 in neutral medium.

519. The pH value of N/10 NaOH is:

(a) 9 (b) 10 (c) 12 (d) 13

AP-EAMCET-(2001)

Ans. (d): $NaOH \rightarrow Na^+ + OH^-$

Normality of NaOH = molarity of NaOH = 0.1 M

$[OH^-] = 10^{-1}M$

$[H^+][OH^-] = 10^{-14}$

$\therefore$ $[H^+] = \dfrac{10^{-14}}{10^{-1}} = 10^{-13}m$

$\mathrm{pH} = -\log[H^+]$

$\therefore$ $\mathrm{pH} = -\log 10^{-13}$

$\therefore$ $\mathrm{pH} = 13$

520. A solution having hydrogen ion concentration 0.0005 g eqvt./litre, its pOH is:

(a) 8.2798 (b) 10.6990

(c) 12.7854 (d) 13.3344

AP-EAMCET-(2001)

Ans. (b): We know that $\mathrm{pH} = -\log[H^+] = -\log[5 \times 10^{-4}]$

$4 - \log 5 = 4 - [\log 10 - \log 2]$

$= 3 + \log 2 = 3.3010$

$\mathrm{pOH} = 14 - \mathrm{pH} = 14 - 3.3$

$= 10.6990$

Hence, pOH = 10.7

521. The pH of a solution containing 0.10 M sodium acetate and 0.03 M acetic acid is ($\mathrm{p}K_a$ for $CH_3COOH = 4.57$)

(a) 4.09 (b) 6.09

(c) 5.09 (d) 7.09

AP-EAMCET-(2000)

Ans. (c): According to Henderson's equation

$$\mathrm{pH} = \mathrm{p}K_a + \log\left(\frac{\text{salt}}{\text{acid}}\right)$$

$CH_3COOH + NaOH \rightarrow CH_3COONa + H_2O$

Given value,

$\mathrm{p}K_a = 4.57$

Sodium acetate concentration = 0.10 M

acetic acid concentration = 0.03 M

Putting the value we get

$$\mathrm{pH} = 4.57 + \log\frac{0.10}{0.03}$$

$\mathrm{pH} = 5.09$

522. Calculate the pOH of 0.10 M HC*l* solution.

(a) 13 (b) 1

(c) 7 (d) 14

AP EAPCET 19-08-2021, Shift-II

Ans. (a) : Given,

$[H^+] = 0.10M$

pOH =?

Formula $\mathrm{pH} = -\log[H^+]$

$$\mathrm{pH} = -\log\left[\frac{0.10}{100}\right]$$

$$\mathrm{pH} = -\log 1 + \log 10$$

$$\mathrm{pH} = 1$$

$\because \mathrm{pH} + \mathrm{pOH} = 14 \Rightarrow 1 + \mathrm{pOH} = 14 \Rightarrow \mathrm{pOH} = 13$

523. One litre of an aqueous solution has 3.65 g of HCl. If it is desired to increase the pH of the solution to 2 then H_3O^+ ion concentration present initially should be

(a) also doubled

(b) reduced to half

(c) increased by 10 times

(d) reduced by 10 times.

SRMJEEE – 2012

Ans. (d) : Given –

amount of aqueous solution = 1L

amount of HCl = 3.65g

Molar mass of HCl = 36.5

$$\therefore \text{ Molarity} = \frac{3.65}{36.5\times 1} = \frac{1}{10}\,M \qquad \text{....(i)}$$

$$\mathrm{pH} = -\log\left[\frac{1}{10}\right] = 1$$

Given – pH = 2

$= -\log_{10}[H^+] = 2$

$$\frac{1}{[H]^+} = 100$$

$$\text{or} \quad [H^+] = \frac{1}{100}\,M \qquad \text{....(ii)}$$

From equation (i) and (ii), it is clear that initially concentration reduced by 10 times.

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524. Dissociation constant of a weak acid is 1×10^{-6} at 25°C. Find the pOH of 0.01 M of its aqueous solution.

(a) 4 (b) 3
(c) 10 (d) 12

SRMJEEE – 2012

Ans. (c) : Let HA be the weak acid. So the dissociation of weak acid HA is written as :

$$\begin{array}{lccc} & HA & \rightleftharpoons H^+ + & A^- \\ \text{Initial} & 0.01 & 0 & 0 \\ \text{equi.conc} & 0.01-0.01\alpha & 0.0 & 0.01\alpha \end{array}$$

Given :- $Ka = 1 \times 10^{-6}$

$pOH = ?$

$$\therefore \quad Ka = \frac{\left[H^+\right]\left[A^-\right]}{[HA]}$$

or

$$1\times10^{-6} = \frac{0.01\alpha\times0.01\alpha}{0.01(1-\alpha)} \qquad (\because \alpha <<<<1)$$

$$1\times10^{-6} = 0.01\times\alpha^2$$

or $\alpha^2 = 10^{-4}$

$\alpha = \sqrt{10^{-4}}$

or $\alpha = 10^{-2}$

$\therefore \quad [H^+] = \alpha \times 0.01 = 10^{-2} \times 0.01 = 10^{-4}$

Now, $pH = -\log [H^+]$

$pH = -\log [10^{-4}]$

$pH = 4$

$\because pH + pOH = 14$

$4 + pOH = 14$

$pOH = 14 - 4$

Hence, $pOH = 10$

525. A solution which is resistant to change of pH on addition of small amount of an acid or base is known as

(a) buffer solution (b) true solution
(c) isohydric solution (d) ideal solution.

SRMJEEE – 2016

Ans. (a) : A buffer solution is such type of solution in which after adding the small amount of acid or bases but no change in pH of the solution i.e. pH remains constant of solution. There is two type of buffer solution, acidic and alkaline buffers.

526. Calculate the pH of 0.1 M CH_3COOH solution. Dissociation constant of acetic acid is 1.8×10^{-5} M.

(a) 2.87 (b) 3.52
(c) 2.62 (d) 6.54

SRMJEEE – 2015

Ans. (a) : The dissociation of CH_3COOH is :

$$\begin{array}{lccc} & CH_3COOH & \rightleftharpoons CH_3COO^- & + H^+ \\ \text{Initially} & 0.1\ M & 0 & 0 \\ \text{Equili.Conc.} & 0.1-0.1\alpha & 0.1\alpha & 0.1\alpha \end{array}$$

$$\text{Now, } K_a = \frac{[CH_3COO^-][H^+]}{[CH_3COOH]}$$

$$1.8 \times 10^{-5} = \frac{0.1\alpha\times0.1\alpha}{0.1(1-\alpha)}$$

$$\text{or} \quad 1.8 \times 10^{-5} = \frac{0.1\times\alpha^2}{(1-\alpha)} \quad (\because \alpha<<<1)$$

$\therefore \quad \alpha^2 = 1.8 \times 10^{-4}$

$\alpha = \sqrt{1.8\times10^{-4}}$

$\alpha = 1.34 \times 10^{-2}$

Concentration of $H^+ = \alpha \times 0.1$

$[H^+] = 1.34 \times 10^{-2} \times 0.1$

$[H^+] = 1.34 \times 10^{-3}$

$\therefore \quad pH = -\log\left[1.34\times10^{-3}\right]$

$pH = -\left[\log 1.34 - 3\right]$

$pH = -\left[0.12 - 3\right]$

$pH = 2.87$

527. The pH of 0.05 M acetic acid is $\left(K_a = 2\times10^{-5}\right)$

(a) 2 (b) 11 (c) 10^{-3} (d) 3

AP-EAMCET- (Engg.)-2011

Ans. (d) : $CH_3COOH \rightleftharpoons H^+ + CH_3COO^-$

Given that, $K_a = 2\times10^{-5}$

$[CH_3COOH] = 0.05$ M

$$K_a = \frac{[H^+][CH_3COO^-]}{[CH_3COOH]} = \frac{[H^+]^2}{[CH_3COOH]}$$

$$[H^+] = \sqrt{K_a[CH_3COOH]}$$

$$= \sqrt{2\times10^{-5}\times0.05}$$

$$= \sqrt{10^{-6}}$$

$[H^+] = 10^{-3}$

$\because pH = -\log[H^+]$

$pH = -\log[10^{-3}]$

$\therefore pH = 3$

528. What is the pH of the NaOH solution when 0.04 g of it dissolved in water and made to 100 mL solution?

(a) 2 (b) 1
(c) 13 (d) 12

AP-EAMCET (Engg.) 2015

Ans. (d) : Given that, mass of solute = 0.04 gm

$$\text{Molarity} = \frac{\text{Mass of solute}}{\text{M. weight of solute}\times\text{Volume}}$$

$$= \frac{0.04\times1000}{40\times100}$$

$= 10^{-2}$

$\therefore \quad OH^- = 10^{-2}$ mol/litre

So, $pOH = -\log [OH^-]$

$pOH = -\log [10^{-2}] = 2$

We know that :

$pOH + pH = 14$

$pH = 14 - pOH$

$pH = 14 - 2 = 12$

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529. The pH of 0.01 M solution of acetic acid is 5.0. What are the values of $[H^+]$ and K_a respectively?

(a) $1\times10^{-5}M, 1\times10^{-8}$ (b) $1\times10^{-5}M,\ 1\times10^{-9}$

(c) $1\times10^{-4}M, 1\times10^{-8}$ (d) $1\times10^{-3}M, 1\times10^{-8}$

AP-EAMCET- (Engg.) - 2010

Ans. (a) : Given,

pH of 0.01 M CH_3COOH solution =5

C= 0.01 M

$$\therefore \quad [H^+]=1\times10^{-pH}$$

$$=1\times10^{-5}\ \text{mol/L}$$

Since, acetic acid is a weak acid and for weak acid.

$$[H^+]=\sqrt{K_a\cdot C}$$

$$K_a=\frac{[H^+]^2}{C}=\frac{(1\times10^{-5})^2}{0.01}$$

$$K_a=1\times10^{-8}$$

Hence, the value of $[H^+]$ is 1×10^{-5} M and $K_a = 1\times10^{-8}$

530. The pK_a values of four carboxylic acids are given below. Identify the weakest carboxylic acid.

(a) 4.89 (b) 1.28

(c) 4.76 (d) 2.56

AP-EAMCET (Engg.) 2013

Ans. (a) : The more the value of pK_a compound will be less acidic indicating the less value of K_a. The weakest carboxylic acid is the carboxylic acid with $pK_a = 4.89$.

531. The pH of a buffer solution made by mixing 25 mL of 0.02 M NH_4OH and 25 mL of 0.2 mL NH_4Cl at 25°C is (pK_b of NH_4OH = 4.8)

(a) 5.8 (b) 8.2

(c) 4.8 (d) 3.8

AP-EAMCET (Engg.) 2013

Ans. (b) : Given that, $pK_b = 4.8$

As a mixture of weak base ammonium hydroxide and salt of ammonium chloride $pOH=pK_b+\log\frac{[NH_4Cl]}{[NH_3OH]}$

$$pOH=4.8+\log\frac{25\times0.2}{25\times0.02}$$

$$pOH=4.8+\log10=4.8+1=5.8$$

$$\therefore\ pH=14-pOH=14-5.8=8.2\ \text{(Base)}$$

532. 100 ml of 0.1 M H_2SO_4 is added to 200 ml of 0.1 M NaOH. What is the pH of the resulting mixture ?

(a) 2 (b) 7

(c) 10 (d) 12

AP - EAMCET (Medical) - 2007

Ans. (b) : Given data,

For H_2SO_4	For NaOH
V_1 = 100 mL	V_2 = 200 mL
Molarity = 0.1 M	Molarity = 0.1 M

$\therefore$ 0.1 M H_2SO_4 can be written as 0.2M H_2SO_4.

And 0.1 M NaOH can be written as 0.1 M NaOH.

Milliequivalent of acid = N_1V_1 = 0.2 × 100 = 20

Milliequivalent of base = $N_2 \times V_2$ = 0.1 × 200 = 20

Hence, both mixture is neutral and its pH is 7.

533. Calculate pH of a buffer prepared by adding 10 mL of 0.10 M acetic acid to 20mL of 0.1 M sodium acetate [pK_a (CH_3COOH) = 4.47]

(a) 3.00 (b) 4.44

(c) 4.74 (d) 5.04

VITEEE-2013

Ans. (d) : Given that

CH_3COOH = 0.1 M in 10 ml = 0.1×10 = 1.0

CH_3COONa = 0.1M in 20 ml = 0.1×20 = 2.0

pK_a = 4.47

From, Henderson Hassel balch equation,

$$pH=pK_a+\log\frac{[Salt]}{[acid]}$$

$$pH=4.74+\log\frac{2}{1}$$

$$pH=4.74+0.3010$$

pH = 5.04

534. 20 mL of 0.2 M NaOH is added to 50 mL of 0.2 M acetic acid. The pH of this solution after mixing is ($K_a = 1.8 \times 10^{-5}$)

(a) 4.5 (b) 2.3

(c) 3.8 (d) 4

VITEEE- 2011

Ans. (a) :

$$NaOH+CH_3COOH \rightleftharpoons CH_3COONa + H_2O$$

	NaOH	CH_3COOH	CH_3COONa	H_2O
Initial conc–	20 × 0.2 = 4	50 × 0.2 =10	0	0
After time –	(4–4) = 0	(10–4) = 6	4	4

Volume of solution (V) = 20+50 = 70 ml

$$[CH_3COONa]=\frac{n}{v}=\frac{4}{70}$$

Similarly

$$[CH_3COOH]=\frac{n}{v}=\frac{6}{70}$$

$$pH=\ PK_a+\log_{10}\frac{[Salt]}{[Acid]}$$

$$pH=-\log_{10}K_a+\log_{10}\frac{[CH_3COONa]}{[CH_3COOH]}$$

$$pH=-\log_{10}\left[1.8\times10^{-5}\right]+\log_{10}\left[\frac{4/70}{6/70}\right]$$

$$pH=5\log_{10}10+-\log_{10}1.8+\log_{10}\left[\frac{2}{3}\right]$$

$$pH=5\times1-0.2552+\log_{10}2-\log_{10}3$$

$$pH=5-0.2552+0.3010-0.4771$$

$$pH=5-0.2552-0.1761$$

$$pH=5-0.4313$$

$$pH=4.5$$

535. Which of the following is pH of solution formed by mixing 0.2 M NH_4Cl and 0.1 M NH_3? The pOH of ammonia solution is 4.75.

(a) 9.85 (b) 7.05

(c) 6.95 (d) 8.95

AMU-2019

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Ans. (d) : It is pK_b of ammonia solution, $pK_b = 4.75$. It is a buffer solution.

$$pOH = pK_b + \log\left(\frac{\text{salt}}{\text{base}}\right)$$

$$pOH = 4.75 + \log\frac{0.2}{0.1}$$

$$pOH = 4.75 + \log 2$$
$$pOH = 4.75 + 0.30$$
$$pOH = 5.05$$
$$pH = 14 - pOH$$
$$pH = 14 - 5.05$$
$$pH = 8.95$$

536. The pH of a solution having the H^+ ion concentration of 1×10^{-4} ions/litre is

(a) 2 (b) 3
(c) 4 (d) 5

AP-EAMCET-(1999)

Ans. (c): As we know

$pH = -\log[H^+]$

Here, $pH = -\log 10^{-4}$

$pH = -(-4)\log 10$

$pH = 4$

537. The following cell has a potential of 0.27 V at 25^oC:

$$Pt_{(s)}|H_2(atm)|H^+(?M)||Ni^{2+}(1M)|Ni$$

What is the pH of the solution in anodic compartment?

(a) 2.6 (b) 5.9
(c) 8.9 (d) 5.3

AMU-2019

Ans. (c) : $E_{cell} = E^0_{cell} - \frac{0.0591}{2}\log\frac{[H^+]^2}{[Ni^{2+}]}$

$$0.27 = -0.25 - \frac{0.0591}{2}\log\frac{[H^+]^2}{1}$$

$$[\because E°Ni^{2+}/Ni = -0.25V]$$

$$0.52 = -0.0591\log[H^+]$$

$$-\log[H^+] = \frac{0.52}{0.0591}$$
$$= 8.7986$$
$$= 8.9$$

538. 0.0002 M solution of a weak acid has an equivalent conductance (Λ) 60 ohm^{-1} cm^2 eq^{-1}. What will be the pH? (Given $\overset{o}{\Lambda} = 400$ ohm^{-1} cm^2 eq^{-1}]

(a) 3.52 (b) 2.52
(c) 1.87 (d) 2.7

AMU-2018

Ans. (a) : C = 0.002 M

equivalent conductance, $\wedge = 60$ ohm^{-1} cm^2 equation, pH = 0

Molar conductance, $\overset{o}{\wedge} = 400$ ohm^{-1} cm^2 equation

Degree of dissociation, $\alpha = \frac{\wedge}{\overset{o}{\wedge}} = \frac{60}{400} = 0.15$

$$\alpha = \sqrt{\frac{K_a}{C}} = K_a = \alpha^2C = (0.15)^2 \times 0.002$$
$$= 4.5\times10^{-5}$$

$$[H^+] = \sqrt{Ka\times C} = \sqrt{4.5\times10^{-5}\times0.002}$$
$$= 3\times10^{-4}$$
$$pH = -\log[H^+] = -\log(3\times10^{-4})$$
$$= 3.52$$

539. What shall be the pH of a solution formed by mixing 10 mL of 0.1 M H_2SO_4 and 10 mL of $\frac{N}{10}$ KOH?

(a) 11.40 (b) 8.64
(c) 3.00 (d) 7.00

AMU-2014

Ans. (d) : Molar mass of KOH = 56g

Equivalent mass of KOH = 56g

Since there is no replaceable hydrogen hence molar mass is equal to equivalent of mass.

So, 1M KOH = 1N KOH

0.1M KOH = 0.1N KOH

Now given that 10ml of 0.1M H_2SO_4 and 10ml of 0.1N (0.1M) KOH is mixed.

No. of Milli moles of H_2SO_4 present = 10×0.1 = 1

No. of Milli moles of KOH present = 10×0.1 = 1

Since the no. of millimoles of both H_2SO_4 and KOH are equal, they neutralize each other.

Hence pH of the solution is 7.

Note : Official answer is (c).

540. A ten fold increase in the $[H^+]$ of a solution

(a) increases its pH by one unit
(b) decreases its pH by one unit
(c) increases its pH by 10 unit
(d) decreases its pH by 10 unit

AMU-2012

Ans. (b) : $pH_1 = -\log[H_1^+]$

$pH_2 = -\log[10H_1^+]$

$= -\log[H^+] - \log 10$

$= -\log[H^+] - 1$

$= pH_1 - 1$

541. The number of moles of $Ca(OH)_2$ that must be dissolved to make 250 mL solution in water of pH =10.65 is

(a) 5.6×10^{-5} (b) 6.5×10^{-5}
(c) 4.5×10^{-5} (d) 5.4×10^{-5}

AMU-2012

Ans. (a) : Given that,

pH = 10.65

We know that,

pH+pOH = 14

pOH = 14–pH

pOH = 14–10.65

pOH=3.35

$pOH = -\log_{10}[OH^-]$

$[OH^-]$= Antilog[–3.35]

$[OH^-] = 0.0004467$

$[OH^-] = 4.46\times10^{-4}$

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We know that,

$Ca(OH)_2$ is diabasic acid

$$Ca(OH)_2 \to C\overset{++}{a} + 2OH^-$$

Normality (N) = $= \frac{[OH^-]}{2}$

$$[N] = \frac{4.46\times10^{-6}}{2}$$

$$[N] = 2.23\times10^{-4}$$

$$N = \frac{W}{E\times V}\times1000$$

$$W = \frac{NEV}{1000}$$

Number of moles $\left(\frac{W}{E}\right) = \frac{NV}{1000}$

Number of moles $\left(\frac{W}{E}\right) = \frac{2.23\times10^{-4}\times250}{1000}$

Number of moles $\left(\frac{W}{E}\right) = 0.5575\times10^{-4}$

$$\frac{W}{E} = 5.6\times10^{-5}$$

542. What shall be the pH of a weak acid of 10^{-3} M concentration which is only 10% ionized?

(a) 3	(b) 4
(c) 5	(d) 6

AMU-2010

Ans. (b) : Assuming that the acid is monobasic, for a weak acid,

$$pH = -\log\left(\frac{Ka}{\alpha}\right)$$

But $\left(\frac{Ka}{\alpha}\right) = C\alpha$

$\Rightarrow pH = -\log(C\alpha)$

Where, α= degree of dissociation.

Given, $C = 10^{-3}$ M and $\alpha = 0.1$

$\therefore\ pH = -\log(10^{-4}) = 4$

543. The pH of the solution produced by mixing equal volume of 2.0×10^{-3} M $HClO_4$ and 1.0×10^{-2} M $KClO_4$ is

(a) 2.7	(b) 2.3
(c) 3.0	(d) 1.0

AMU-2010

Ans. (c) : Given that initial concentration = 2×10^{-3}M

$$\underset{\text{Strong Acid}}{HClO_4} \to H^+ + ClO4^-$$

$$\underset{\text{Salt}}{KClO_4} \to K^+ + ClO4^-$$

Mixing of equal volume then concentration decreases.

$$[HClO_4]_{\text{initial conc.}} = 2\times10^{-3}$$

Volume = 2L

Number of moles of $HClO_4$ (n) = 2×10^{-3}

$$(HClO_4)_{\text{new conc.}} = \frac{\text{number of moles of } HClO_4}{\text{Volume}}$$

$$(HClO_4)_{\text{new conc.}} = \frac{2\times10^{-3}}{2}$$

$$[H^+] = 10^{-3}$$

$$pH = -\log_{10}[H^+]$$

$$pH = -\log_{10}[10^{-3}]$$

$$pH = 3\log_{10}10 \qquad [\because \log_{10}10 = 1]$$

$$pH = 3\times1$$

$$pH = 3$$

544. An aqueous solution whose pH is zero will be called as

(a) acidic	(b) basic
(c) netural	(d) amphoteric

AMU-2009

Ans. (a) : pH = 0, $[H^+] = 10^0$

It means the solution is strongly acidic.

Note: pH scale 0 to 14

- pH < 7 → solution is acidic
- pH > 7 → solution is basic
- pH = 7 → solution is netural

545. Which of the following solution has pH = 7 ?

(a) $NaNO_2 + H_2O$	(b) $Na_2CO_3 + H_2O$
(c) $NaCl + H_2O$	(d) $CH_3COONa + H_2O$

AMU-2008

Ans. (c) : The reaction between an acid and a base to from salt and water is termed neutralisation. A strong acid plus a strong base give a neutral solution because both are completely ionised and the reaction goes to completion.

$$H^+ + Cl^- + Na^+ + OH^- \to H_2O + Na^+ + Cl^-$$

for neutral salt the pH is given 7.

546. The pK_b value of NH_3 is 5. Calculate the pH of the buffer solution, 1L of which contains 0.01 M NH_4Cl and 0.10M NH_4OH.

(a) 4	(b) 6
(c) 8	(d) 10

AMU-2005

Ans. (d) : $pOH = pK_b + \log\frac{[\text{salt}]}{[\text{base}]}$

$$pOH = 5 + \log\ \frac{0.01}{0.1}$$

$= 5 + \log(0.1)$

$= 5 + \log_{10} 10^{-1}$

$= 5 + (-1) = 4$

$pH = 14 - pOH = 14 - 4 = 10$

547. The OH^- ion concentration of as solution having pH 2 is

(a) 1×10^{-2} M	(b) 1×10^{-9} M
(c) 1×10^{-12} M	(d) 1×10^{-7} M

AMU-2004

Ans. (c) : pH=2

$\therefore\quad [H^+]=10^{-2} \qquad (pH = -\log[H^+])$

Also, $\quad [H^+][OH^-]=10^{-14}$

[Ionic product of water $=10^{-14}$]

$$[OH^-] = \frac{10^{-14}}{[H^+]} = \frac{10^{-14}}{10^{-2}} = 1\times10^{-12}\,M$$

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548. The term pH comes from

(a) "pure voiv hydrogen" which implies potential of hydrogen
(b) pure hydrogen content
(c) purity of hydrogen ions in solution
(d) name of the scientist associated.

AMU-2002

Ans. (a) : pH stands for potential of hydrogen. It represents the ratio of hydronium ions (H_3O) to hydroxide ions (OH). It is a measure of acidity and alkalinity of a solution. The pH scale usually ranges from 0 to 14.

549. Which of the following will have largest pH?

(a) $\frac{M}{100}$ NaOH (b) $\frac{M}{10}$ NaOH
(c) $\frac{M}{100}$ HCl (d) $\frac{M}{10}$ HCl

AMU–2001, BCECE-2003

Ans. (b) : $\frac{M}{10}$ NaOH Or $\frac{1}{10}$ NaOH

$pOH = -\log 10\left[OH^-\right]$

$pOH = -\log_{10}\left[\frac{1}{10}\right]$

$pOH = -\log 10\left[10^{-1}\right]$

$pOH = 1\log_{10} 10 \quad [\because \log_{10} 10 = 1]$

$pOH = 1 \times 1$

pOH = 1
pH + pOH = 14
pH +1 = 14
pH = 14–1
pH = 13

550. A certain buffer solution contains equal concentration of X^- and HX. The K_a for HX is 10^{-8}. The pH of the buffer is

(a) 3 (b) 8
(c) 11 (d) 14

Assam CEE-2014

Ans. (b) : We know that,

$K_a \times K_b = 10^{-14} \Rightarrow 10^{-8} \times K_b = 10^{-14}$

$K_b = 10^{-6}$

Where,

K_a = acid dissociation constant
K_b = base dissociation constant

$pH = -\log K_a + \log\frac{[salt]}{[acid]} \quad [\because [salt] = [acid]]$

$= -\log 10^{-8} + \log 1 = -\log 10^{-8} = 8$

$\boxed{pH = 8}$

551. The pH of a solution at 25 °C is 2. If the pH is to be doubled, then hydronium ion concentration should be

(a) doubled
(b) halved
(c) decreased by 100 times
(d) increased by 100 times

Assam CEE-2014

Ans. (c) : pH = 2

$pH = -\log [H^+]$

$2 = -\log [H^+] \Rightarrow [H^+] = 10^{-2}$ …..(i)

For pH = 4

$4 = -\log [H^+] \Rightarrow H^+ = 10^{-4}$ …..(ii)

From equation (i) and (ii), this $[H^+]$ conc. should decrease from 100 times.

552. An acid solution of pH = 6 is diluted 1000 times. The pH of the final solution becomes

(a) 6.99 (b) 6
(c) 3 (d) 9

Assam CEE-2018

Ans. (a) : $pH = 6 \Rightarrow pH = -\log [H^+]$

$H^+ = 10^{-6}$

After dilution $[H^+] = \frac{10^{-6}}{1000} = 10^{-9}$

$\therefore [H^+]$ from H_2O cannot be neglected

Total $[H^+] = 10^{-9} + 10^{-7}$

$= 10^{-7}(10^{-2} + 1)$

$= 10^{-7}(1.01)$

$pH = -\log(1.01 \times 10^{-7})$

$= 7 - 0.0043$

$= 6.9957$

553. pH of 10^{-8} M HCI solution is :

(a) 8 (b) between 7 and 8
(c) between 6 and 7 (d) between 8 and 9

Karnataka-CET-2013

JCECE - 2009, BCECE-2005

Ans. (c) : $[H^+][OH^-] = 10^{-14}$

$(10^{-8} + x) \times x = 10^{-14} \Rightarrow x \simeq 10^{-7}$

Total $[H^+] = 10^{-7} + 10^{-8} = 10^{-7}(1+0.4) = 1.1 \times 10^{-7}$

$pH = -\log [H^+] = -\log(1.1 \times 10^{-7}) = 7 - \log(1.1)$

pH = 6.98

554. Degree of dissociation of NH_4OH in water is 1.8×10^{-5}, then hydrolysis constant of NH_4Cl is :

(a) 1.8×10^{-5} (b) 1.8×10^{-10}
(c) 5.55×10^{-5} (d) 5.55×10^{-10}

BCECE-2004

Ans. (d) : $K_h =$

$K_b = 10^{-14}$

$K_w = 1.8 \times 10^{-5}$

$K_h = \frac{K_w}{K_b} = \frac{10^{-14}}{1.8 \times 10^{-5}}$

$= 0.555 \times 10^{-9}$

$= 5.55 \times 10^{-10}$

555. What is the pH of 0.01 m glycine solution ? For glycine,

$K_{a_1} = 4.5 \times 10^{-3}$ and $K_{a_2} = 1.7 \times 10^{-10}$

at 298 K?

(a) 3.0 (b) 10.0
(c) 6.1 (d) 7.1

AP-EAMCET-(2004)

Ans. (d): For glycine solution

$K = K_{a_1} \times K_{a_2} = 4.5 \times 10^{-3} \times 1.7 \times 10^{-10} = 7.74 \times 10^{-13}$

$[H^+] = \sqrt{K.C.}$

@apna_pdf

$= \sqrt{7.74\times10^{-13}\times0.01} = 8.79\times10^{-8}$

$pH = -\log[H^+]$

$pH = -\log[8.79\times10^{-8}]$

$pH = -[\log 10^{-8} + \log 8.7]$

$pH = 8 - 0.93 = 7.07 \approx 7.1$

556. Which of the following solutions will have pH = 9 at 298 K?

(a) 1×10^{-9}M HCI solution

(b) 1×10^{-5}M NaOH solution

(c) 1×10^{-9}M KOH solution

(d) Both (a) and (b)

BCECE-2008

Ans. (b) : 10^{-5} M NaOH $\rightarrow$ 10^{-5} M $[OH^-]$

$pOH = -\log[OH^-] = -\log(10^{-5}) = 5$

$pH = 14 - pOH = 14 - 5 = 9$

557. The pH of buffer of NH_4Cl type is given by

(a) $pH = pK_b$

(b) $pH = 1/2pK_b - 1/2 \log [salt]/[base]$

(c) $pH = 14 - pK_b - \log [salt]/[base]$

(d) $pH = pOH - pK_b + \log [salt]/[base]$

BCECE-2011

Ans. (c) : For basic buffer

$$pOH = pK_b + \log\frac{[salt]}{[base]}$$

$pH + pOH = 14$

$pOH = 14 - pH$

or $pH = 14 - pOH$

$$\therefore \quad pH = 14 - pK_b - \log\frac{[salt]}{[base]}$$

558. The pH value for 1/1000 N-KOH solution is

(a) 3 (b) 10^{-11}

(c) 2 (d) 11

BCECE-2010

Ans. (d) Normality = $\dfrac{1}{1000}$

Normality = molarity × valency factor

$\because$ valency factor = 1

Molarity = 10^{-3}

$[OH^-] = 10^{-3}$

$pOH = -\log[OH^-] = -\log(10^{-3}) = 3$

$pH = 14 - pOH = 14 - 3 = 11$

559. In the sample of soft drink, the concentration of H^+ ion is 3.8×10^{-3}M. Its pH is

(a) 2 (b) 2.42

(c) 3 (d) 3.42

BCECE-2012

Ans. (b) : $pH = -\log[H^+]$

$pH = -\log(3.8\times10^{-3})$

$pH = -\log 3.8 - \log 10^{-3}$

$pH = -0.5798 + 3$

$pH = 2.4202$

560. Calculate pH change when 0.01 mol CH_3COONa solution is added to 1L of 0.01 M CH_3COOH solution.

K_a (CH_3COOH) = 1.8×10^{-5}, pK_a=4.74)

(a) 3.37 (b) 1.37

(c) 4.74 (d) 8.01

BCECE-2013

Ans. (b)

$[H^+] = \sqrt{K_a\times c}$

$$pH = -\log[H^+] = \frac{1}{2}pK_a - \frac{1}{2}\log(c)$$

$$= \frac{1}{2}\times4.74 - \frac{1}{2}\log(0.01) = 3.37$$

$$pH = pK_a + \log\frac{[salt]}{[base]} = 4.74 + \log\frac{0.01}{0.01} = 4.74$$

$\Delta pH = 4.74 - 3.37 = 1.37$

561. pK_b of NH_3 is 4.74 and pK_b of A^-, B^- and C^- are 4, 5 and 6 respectively. Aqueous solution of 0.01 M has pH in the increasing order–

(a) $NH_4A < NH_4B < NH_4C$

(b) $NH_4C < NH_4B < NH_4A$

(c) $NH_4C < NH_4A < NH_4B$

(d) All have equal pH

BCECE-2013

Ans. (a)

$pK_a = -\log K_a$

Note: K_a → increases, pK_a → decreases

acidity → increases, pH → decreases

$$\boxed{K = c\alpha^2, \alpha = \sqrt{\frac{K}{c}}}$$

For NH_4A,

$$\alpha = \sqrt{\frac{10^{-4}}{0.01}} = 0.01$$

$[H^+] = 0.01\times0.1 = 10^{-3}$

$pH = -\log[H^+] = -\log(10^{-3}) = 3$

For NH_4B,

$$\alpha = \sqrt{\frac{10^{-5}}{0.01}} = 0.032$$

$[H^+] = 0.01\times0.032 = 3.2\times10^{-4}$

$pH = -\log(3.2\times10^{-4}) = 4 - 0.505 = 3.495$

For NH_4C,

$$\alpha = \sqrt{\frac{10^{-6}}{0.01}} = 0.01$$

$[H^+] = 0.01\times0.01 = 10^{-4}$

$pH = -\log(10^{-4}) = 4$

Increases order of pH values,

$$\boxed{NH_4A < NH_4B < NH_4C}$$

562. If the pK_a of a weak acid HA is 4.80 and the pK_b of a weak base BOH is 4.78. Then, the pH of an aqueous solution of the corresponding salt, BA will be–

(a) 8.23 (b) 9.41

(c) 7.01 (d) 5.91

BCECE-2015, [AIEEE-2010]

Ans. (c) : For weak acid & weak base

$$pH = 7 + \frac{1}{2}(pK_a - pK_b)$$

$$pH = 7 + \frac{1}{2}(4.8 - 4.78) = 7 + \frac{1}{2}\times0.02 = 7 + 0.01 = 7.01$$

@apna_pdf

563. 0.005 mol of $Ba(OH)_2$ is dissolved in 100 mL of water. Assuming complete ionisation of $Ba(OH)_2$ the pOH of the solution will be–

(a) 1	(b) 5
(c) 2	(d) 14

BCECE-2017

Ans. (a) : $Ba(OH)_2 \to Ba^{2+} + 2OH^-$

$$M = \frac{mol}{liter} = \frac{0.005}{100\times10^{-3}} = 0.05M$$

$[OH^-] = 2 \times 0.05 = 0.1$ M

pOH = –log [0.1]

pOH = –log $[10^{-1}]$

pOH = 1

564. What will be the pH of a solution by mixing 40 mL of 0.1M HCl with 10 mL of 0.45M NaOH?

(a) 12	(b) 10
(c) 8	(d) 6

BCECE-2018

Ans. (a) :

$$[OH^-] = \frac{M_{NaOH}\cdot V_{NaOH} - M_{HCl}\cdot V_{HCl}}{V_{NaOH}+V_{HCl}}$$

$$= \frac{(0.45\times10)-(0.1\times40)}{40+10}$$

$$= \frac{4.5-4}{50} = \frac{0.5}{50} = 10^{-2}$$

pOH = –log$[OH^-]$ = –log(10^{-2}) = 2

pH = 14 – pOH = 14 – 2 = 12

565. The correct method of finding the pH of a solution is to

(a) heat the solution in a test tube and expose the pH paper to the vapours formed.

(b) pour few drops of the solution from the test tube on the pH paper.

(c) drop the pH paper in the solution.

(d) put a drop of the solution on the pH paper using a dropper.

[BITSAT-2005]

Ans. (d) : For find the pH of a substance using pH paper. Dip the end of the pH strip into chemical or substance which is going to test, after a couple of second, remove the paper and compare the color of the pH strip to the color chart.

566. A little dilute hydrochloric acid is dropped on a pH paper. The colour of the pH paper turns to

(a) dark pink	(b) light green
(c) light blue	(d) bright yellow

[BITSAT-2008]

Ans. (c) : Dilute sodium bicarbonate is basic in nature and will show a change in color corresponding to the basic pH range in the standard litmus paper chart. The color of the pH paper turns blue. Blue color indicates that the solution is faintly basic in nature and as the solution is dilute it will not be a strongly basic solution. yellow and red color corresponds to the acidic range whereas violet corresponds to a strongly basic solution.

567. The pH of a solution is increased from 3 to 6; its H^+ ion concentration will be

(a) reduced to half

(b) doubled

(c) reduced by 1000 times

(d) increased by 1000 times

BITSAT 2011

Ans. (c) : Change in pH is $\Delta pH = pH_2 - pH_1 = 6 - 3 = 3$

Thus, the ratio of hydrogen ion concentration

$$\frac{[H^+]_2}{[H^+]_1} = 10^{-3} = 0.001$$

Hence, hydrogen ion concentration should be decreased by 1000 times.

568. The pOH value of a solution whose hydroxide ion concentration is 6.2×10^{-9} mol/liter is

(a) 8.21	(b) 6.21
(c) 7.75	(d) 7.21

BITSAT-2012

Ans. (a) : $[H^+] = 6.2 \times 10^{-9}$ mol/liter

pH = –log$[H^+]$ = – log(6.2×10^{-9}) = 9 – 0.81 = 8.19

569. The pH of 0.1 M solution of the following salts increases in the order :

(a) $NaCl < NH_4Cl < NaCN < HCl$

(b) $HCl < NH_4Cl < NaCl < NaCN$

(c) $NaCN < NH_4Cl < NaCl < HCl$

(d) $HCl < NaCl < NaCN < NH_4Cl$

BITSAT 2018

Ans. (b) : (i) $HCl \to \underset{0.1M}{H^+} + \underset{0.1M}{Cl^-}$

$\therefore [H^+] = 0.1M$

$pH = -\log[H^+] = -\log 0.1 = 1$

(ii) NaCl is a salt of strong acid and strong base so it is not hydrolysed and hence its pH is 7.

(iii) $NH_4Cl + H_2O \rightleftharpoons NH_4OH + HCl$

$\therefore$ The solution is acidic and its pH is less than that of 0.1 M HCl.

(iv) $NaCN + H_2O \rightleftharpoons NaOH + HCN$

$\therefore$ The solution is basic and its pH is more than that of 0.1 M HCl.

$\therefore$ Correct order for increase in pH is

$HCl < NH_4Cl < NaCl < NaCN.$

570. The degree of ionisation of decinormal solution of CH_3 COOH is 1.3%. If the log of 1.3 is 0.11, the pH of this solution is

(a) 2.89	(b) 3.89
(c) 4.89	(d) 0.89

CG PET-2008

Ans. (a) : Decinormal mean = $\frac{1}{10}$N

= 0.1 N

Degree of dissociation, $\alpha = 1.3\% = 1.3\times10^{-2}$

N = M × n-factor [$\because$ n-factor = 1]

$0.1 = M \times 1 \Rightarrow M = 0.1$ M

$[H^+] = \alpha C$

$= 0.1\times 1.3 \times 10^{-2} = 1.3 \times 10^{-3}$

pH = –log$[H^+]$ = –log(1.3×10^{-3}) = 3 – 0.11

pH = 2.89

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571. A buffer solution is obtained by mixing 10 mL of 1.0M CH_3COOH and 20 mL of 0.5M CH_3COONa and it is diluted to 100 mL using distilled water. pK_a of CH_3 COOH is 4.76. The pH of this buffer solution is

(a) 2.76 (b) 3.76
(c) 4.76 (d) 0.76

CG PET-2008

Ans. (c) : The expression for the pH of the acidic buffer solution is as given below

$$pH = pK_a + \log\frac{[salt]}{[acid]}$$

$$pK_a = 47.6$$

$$[salt] = \frac{20\times0.5}{100} = 0.1M$$

$$[acid] = \frac{10\times1}{100} = 0.1\ M$$

Substitute value in the above equation

$$pH = 4.76 + \log\frac{0.1}{0.1} = 4.76$$

572. The pH values of 0.1 M solution of HCl, CH_3 COOH,NH_4Cl and CH_3COONa will have the order

(a) HCl<CH_3COOH<NH_4Cl<CH_3COONa
(b) CH_3COONa<NH_4Cl<CH_3COOH<HCl
(c) NH_4Cl<CH_3COONa<CH_3COON<HCl
(d) All will have same pH value

CG PET-2009

Ans. (a) : pH (0.1M CH_3COOH) = $\frac{1}{2}(pK_a - \log C)$

pH (0.1 M NH_4Cl) = $7 - \frac{1}{2}(pK_a - \log C)$

CH_3COONa solution is basic.

pH value increase,

Hence, (HCl)<(CH_3COOH)< (NH_4Cl) < (CH_3COONa).

573. A weak acid HX has dissociation constant 10^{-5}. The pH of 0.1 M solution of this acid will be

(a) 2 (b) 3
(c) 4 (d) 5

CG PET-2009

Ans. (b) : $[H^+] = \sqrt{K_a\times C} = \sqrt{10^{-5}\times0.1}$

$= \sqrt{10^{-6}} = 10^{-3}$

$pH = -\log[H^+] = -\log 10^{-3} = 3$

574. The number of moles of sodium acetate to be added to 0.1 M acetic acid for the buffer to have a pH= 4.7 is
[pK_a for acetic acid is 4.7]

(a) 0.2M (b) 0.4M
(c) 0.1M (d) None of these

CG PET-2016

Ans. (c) : ∵ $pH = pK_a + \log\frac{[salt]}{[acid]}$

Given,

pH = 4.7

pK_a = 4.7

$$4.7 = 4.7 + \log\left[\frac{salt}{0.1}\right]$$

∴ $\log[CH_3COONa] - \log(0.1) = 0$

$\log[CH_3COONa] - \log(10^{-1}) = 0$

$\log[CH_3COONa] + 1 = 0$

$\log[CH_3COONa] = -1$

∴ On taking antilog on both sides–

$[CH_3COONa]$ =0.1M

575. pH of a solution is 4. The hydroxide ion concentration of the solution would be

(a) 10^{-4} (b) 10^{-10}
(c) 10^{-2} (d) 10^{-12}

CG PET-2004

Ans. (b) : $pH = -\log[H^+] = 4$

Hence, $[H^+] = 10^{-4}$ M

But, $[H^+][OH^-] = 10^{-14}$

$10^{-4}\times[OH^-] = 10^{-14}$

$[OH^-] = 10^{-10}$

576. The pH of 10^{-7} M NaOH is

(a) 7.01 (b) between 7 and 8
(c) between 9 and 10 (d) greater than 10

CG PET-2005

Ans. (a) : The concentration of $[OH^-]$ ion in the NaOH 10^{-7}.

The formula is used as-

$pOH = -\log[OH^-]$

$pOH = -\log(10^{-7}) = 7$

pH = 14 – pOH = 14 – 7 = 7

577. Which of the following statement is correct?

(a) Basic nature increases on increasing pH
(b) Basic nature decreases on increasing pH
(c) Acidic nature increases on increasing pH
(d) None of the above

CG PET-2006

Ans. (a) : $pH = -\log[H^+]$

$pOH = -\log[OH^-]$ and pH +pOH = 14

As pH of solution decreases it mean concentration of H^+ increase, hence acidic nature increase. On the other hand if pH of solution increases concentration of OH^- also increases, so basic nature increases.

578. The pH of a soft drink is 3.92. The hydrogen ion concentration will be(given antilog 0.08=1.2)

(a) 1.96×10^{-2} mol L^{-1} (b) 1.96×10^{-3} mol L^{-1}
(c) 1.2×10^{-4} mol L^{-1} (d) 1.2×10^{-3} mol L^{-1}

CG PET-2015

Ans. (c) : pH = 3.92

∵ $pH = -\log[H^+]$

$3.92 = -\log[H^+] \Rightarrow [H^+] = 10^{-3.92} = 10^{(-4+0.08)}$

$[H^+] = 10^{-4}\times10^{0.08}$

$[H^+] = 10^{-4}\times1.2 = 1.2\times10^{-4}$ mol L^{-1}

579. The pOH of a solution is 6.0. its pH will be

(a) 6 (b) 8
(c) 0 (d) 14

CG PET-2010

Ans. (b) : We know that,

pH + pOH = 14

pH = 14 – pOH

pH = 14 – 6 = 8

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580. The pH of the solution _________ during the electrolysis of dilute aqueous solution of $CuSO_4$

(a) First increases then decreases
(b) Decreases
(c) Remains constant
(d) Increases

GUJCET-2017

Ans. (b) : At anode : $2H_2O \rightarrow O_2 + 4H^+ + 4e^-$
At cathode : $Cu^{2+}(aq) + 2e^- \rightarrow Cu(s)$
Production of H^+ ions will decrease pH.

581. pH of 0.005 M calcium acetate (pK_a of $CH_3COOH = 4.74$) is

(a) 7.04 (b) 9.37
(c) 9.26 (d) 8.37

[AIEEE-2002]

Ans. (a) : $\underset{0.005M}{Ca(CH_3COOH)_2} \rightarrow Ca^{2+} + \underset{2 \times 0.005 = 0.01}{\underset{\downarrow}{2CH_3COO^-}}$

For weak acid & weak base,

$$pH = 7 + \frac{pK_a}{2} + \frac{\log c}{2}$$

$$pH = 7 + 2.37 + \log \frac{0.01}{2}$$

$$pH = 7 + 2.37 - 2 = 7.37 \approx 7.04$$

582. The pH of a 0.02 M NH_4Cl solution will be [Given K_b (NH_4OH) = 10^{-5} and log2 = 0.301]

(a) 4.65 (b) 2.65
(c) 5.35 (d) 4.35

[JEE Main-2019, 10 April shift-II]

Ans. (c) : Given, K_b (NH_4OH) = 10^{-5}
$pK_b = -\log K_b = -\log(10^{-5}) = 5$
C = concentration of salt solution = 0.02 M = 2×10^{-2} M
Now,

$$pH = 7 - \frac{1}{2}(pK_b + \log C)$$

On substituting the given values in above equation, we get,

$$= 7 - \frac{1}{2}\left[5 + \log(2 \times 10^{-2})\right]$$

$$= 7 - \frac{1}{2}\left[5 + \log 2 - 2\right]$$

$$= 7 - \frac{1}{2}\left[5 + 0.301 - 2\right] = 7 - 1.65 = 5.35$$

583. Hydrogen ion concentration in mol/L in a solution of pH = 5.4 will be

(a) 3.98×10^{-6} (b) 3.68×10^{-6}
(c) 3.88×10^{6} (d) 3.98×10^{8}

[AIEEE-2005]

Ans. (a) : pH = $-\log[H^+]$
$5.4 = -\log[H^+]$
H^+ = antilog $(-5.4) = 3.98 \times 10^{-6}$

584. Which one of the following Statements is not true?

(a) The conjugate base of $H_2PO_4^-$ is HPO_4^{2-}
(b) pH + pOH = 14 for all aqueous solutions at 25ºC
(c) The pH of 1×10^{-8} M HCl is 8
(d) 96,500 C of electricity when passed through a $CuSO_4$ solution deposits 1gm equivalent of copper at the cathode

[AIEEE-2003]

Ans. (c) : HCl is an acid so, its pH should be < 7
from acid $[H^+] = 10^{-8}$ M
from H_2O $[H^+] = 10^{-7}$ M
$\therefore$ Total $[H^+] = 10^{-8} + 10^{-7}$
So, pH = $-\log[H^+]$ = 6.95
Hence, the pH of 10^{-8} M HCl is not 8. It is 6.95. So, the correct options is c.

585. At 25ºC, the solubility product of $Mg(OH)_2$ is 1.0×10^{-11}. At which pH, will Mg^{2+} ions start precipitating in the form of $Mg(OH)_2$ from a solution of 0.001 M Mg^{2+} ions?

(a) 9 (b) 10
(c) 11 (d) 8

[AIEEE-2010]

Ans. (b) : Given, $K_{sp} = 1.0 \times 10^{-11}$
$[Mg^{2+}] = 0.001M$
$Mg^{2+} + 2OH^- \rightleftharpoons Mg(OH)_2$
$K_{sp} = [Mg^{2+}][OH^-]^2$

$$[OH^-] = \sqrt{\frac{K_{sp}}{[Mg^{2+}]}} = 10^{-4}$$

$\therefore$ pOH = 4 and pH = 10

586. pK_a of a weak acid (HA) and pK_b of a weak base (BOH) are 3.2 and 3.4 respectively. The pH of their salt (AB) solution is

(a) 7.2 (b) 6.9
(c) 7.0 (d) 1.0

[JEE Main-2017]

Ans. (b) : $pH = \frac{1}{2}(pK_w + pK_a - pK_b)$

$$pH = \frac{1}{2}(14 + 3.2 - 3.4)$$

$$pH = \frac{1}{2}(13.8)$$

pH = 6.9

587. How many litres of water must be added to 1 L of an aqueous solution of HCl with a pH of 1 to create an aqueous solution with pH of 2?

(a) 0.1L (b) 0.9L
(c) 2.0L (d) 9.0L

[JEE Main-2014]

Ans. (d) : At pH = 1
Concentration of $[H^+] = 10^{-2}M = 0.1$ M
at pH = 2
Concentration of $[H^+] = 10^{-2}$ M = 0.1 M
Now, Dilution formula
$M_1V_1 = M_2V_2$
0.1 M × 1L = 0.01 M × V_2
V_2 = 10 L
Volume of water = 10 – 1 = 9L

588. Consider the following statements.

I. The pH of a mixture containing 400 mL of 0.1M H_2SO_4 and 400 mL of 0.1M NaOH will be approximately 1.3.

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II. Ionic product of water is temperature dependent.

III. A monobasic acid with $K_a = 10^{-5}$ has a pH = 5. The degree of dissociation of this acid is 50%.

IV. The Le-Chatelier's principle is not applicable to common-ion effect.

The correct statements are

(a) I, II and IV (b) II and III
(c) I and II (d) I, II and III

[JEE Main-2019, 10 April Shift-I]

Ans. (d) : (I) $H_2SO_4 + 2NaOH \rightarrow Na_2SO_4 + 2H_2O$

$400 \times 0.1 = 40 \quad 400 \times 0.1 = 40$

$20 \quad\quad 0$

$$\therefore [H^+] = \frac{20 \times 2}{800} = \frac{1}{20} \Rightarrow pH = -\log\left(\frac{1}{20}\right)$$

$\therefore$ pH = 1.3

So (I) is correct.

$$\text{(II)} \log\left(\frac{K_{w_2}}{K_{w_1}}\right) = \frac{\Delta H}{2.303R}\left[\frac{1}{T_1} - \frac{1}{T_2}\right]$$

So, ionic product of water is temperature dependent hence (II) is correct.

(III) $K_a = 10^{-5}$, pH $\Rightarrow [H^+] = 10^{-5}$

$$10^{-5} = \frac{10^{-5}.x}{(1-x)} \Rightarrow 1 - x = x \Rightarrow x = \frac{1}{2} = 50\%$$

So, (III) is correct.

(IV) Le-chatelier's principle is applicable to common-ion effect so option (IV) is wrong.

589. 20 mL of 0.1 M H_2SO_4 solution is added to 30 mL of 0.2 M NH_4OH solution. The pH of the resultant mixture is [pK_b of NH_4OH = 4.7]

(a) 9.3 (b) 5.0
(c) 9.0 (d) 5.2

[JEE Main-2019, 9 Jan Shift-I]

Ans. (c) : 20 ml 0.1 M $H_2SO_4 \Rightarrow \eta_{H^+} = 4$ M mol

30 ml 0.2 M $NH_4OH \Rightarrow \eta_{NH_4OH} = 6$ M mol

$$\begin{array}{lcccc} & NH_4OH + & H^+ \rightleftharpoons & NH_4^+ + & H_2O \\ \Rightarrow & 6 & 4 & 0 & 0 \\ \Rightarrow & 2 & 0 & 4 & 4 \end{array}$$

So, solution is a basic buffer

$$pOH = pK_b + \log\frac{NH_4^+}{NH_4OH}$$

$pOH = pK_b + \log 4/2$

$pOH = 4.7 + \log 2$

$pOH = 4.7 + 0.3 = 5$

$pH + pOH = 14$

$pH = 14 - 5 = 9$

590. For the following Assertion and Reason, the correct option is

Assertion (A) The pH of water increases with increase in temperature.

Reason (R) The dissociation of water into H^+ and OH^- is an exothermic reaction.

(a) Assertion is not true, but Reason is true.
(b) Both assertion and Reason are true and the Reason is the correct
(c) Both Assertion and Reason are false.
(d) Both Assertion and Reason are true, but the Reason is not the correct explanation for the Assertion.

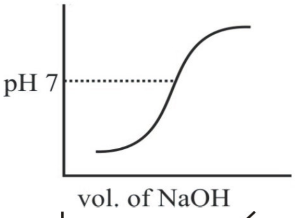
[JEE Main-2020, 8 Jan Shift-II]

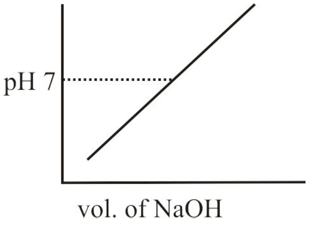
Ans. (c) : $H_2O \longrightarrow H^+ + OH^-$

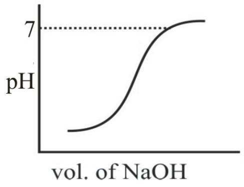
Dissociation of H_2O is an endothermic reaction.

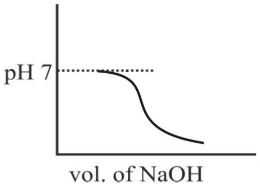
On increasing temperature $[H^+]$ ion concentration increase pH decrease.

591. 100 ml of 0.1M HCl is taken is a beaker and to it 100 mL of 0.1M NaOH is added in steps of 2 mL and the pH continuously measured. Which of the following graphs correctly depicts the change in pH?

(a)


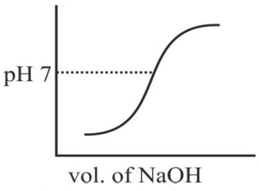
(b)


(c)


(d)


[JEE Main-2020, 3 Sep Shift-II]

Ans. (a) :



Rise in pH around the equivalence point for titration so strong acid with strong base.

592. A soft drink was bottled with a partial pressure of CO_2 of 3 bar over the liquid at room temperature. The partial pressure CO_2 over the solution approaches a value of 30 bar when 44 g of CO_2 is dissolved in 1 kg of water at room temperature. The approximate pH of the soft drink is ....$\times 10^{-1}$

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(First dissociation constant of H_2CO_3=4.0×10^{-7}) log2 = 0.3; density of the soft drink = 1g mL^{-1}

[JEE Main-2020, 6 Sep Shift-I]

Ans. (37) : $CO_2 + H_2O \rightarrow H_2CO_3$

30 bar = 1 m/lit

3 bar = 0.1 m/lit

$H_2CO_3 \rightleftharpoons H^+ + HCO_3^-$

t = 0 0.1 0 0

eq. 0.1(1–α) 0.1α 0.1α

$$4\times10^{-7} = \frac{0.1\alpha^2}{1-\alpha}$$

∵ (1–α) = 1

$\alpha^2 = 4 \times 10^{-6}$

$\alpha = 2 \times 10^{-3}$

$[H^+] = 2 \times 10^{-4}M$

pH = –[–4 × log(2)] = 3.7 = 37 × 10^{-1}

593. Arrange the following solutions in the decreasing order of pOH.

(A) 0.01 M HCl (B) 0.01 M NaOH

(C) 0.01 M CH_3COONa (D) 0.01 M NaCl

(a) (A) > (C) > (D) > (B)

(b) (A) > (D) > (C) > (B)

(c) (B) > (C) > (D) > (A)

(d) (B) > (D) > (C) > (A)

[JEE Main-2020, 6 Sep Shift-I]

Ans. (b) : (i) 10^{-2}M HCl → $[H^+] = 10^{-2}$M → P^H = 2

(ii) 10^{-2}M NaOH → $[OH^-] = 10^{-2}$M → P^{OH} = 2

(iii) 10^{-2}M $CH_3COO^-Na^+$ → $[OH^+] > 10^{-7}$ → P^{OH} < 7

(iv) 10^{-2}M NaCl Neutral poH = 7

594. Two solutions, A and B, each of 100 L was made by dissolving 4 g of NaOH and 9.8 g of H_2SO_4 in water, respectively. The pH of the resultant solution obtained from mixing 40 L of solution A and 10 L of solution B is............

[JEE Main-2020, 7 Jan Shift-I]

Ans. (10.60) : Molarity of NaOH (4g in 100L) = 10^{-3}M

Molarity of H_2SO_4 (9.8g in 100L) = 10^{-3}M

Equivalent of

NaOH = M×V×n_f = 10^{-3}×40×1=0.04

Equivalent of

H_2SO_4 = M×V×n_f = 10^{-3}×10×2=0.02

$M_{NaOH}\times(n_f)_{NaOH}\times V_{NaOH} - M_{H_2SO_4}\times V_{H_2SO_4}\times(n_f)_{H_2SO_4} = M.V_{total}$

10^{-3}×40×1–10^{-3}×10×2=M.50

M=4×10^{-4}

pOH = –logM

= –log [4 × 10^{-4}]

= 4 – 2 log 2

= 3.4

pH = 14 – 3.4 = 10.6

595. Sulphurous acid (H_2SO_3) has K_{a_1} = 1.7 ×10^{-2} and K_{a_2} = 6.4 × 10^{-8}. The pH of 0.588 M is........(Round off to the nearest integer)

[JEE Main-2021, 16 March Shift-II]

Ans. (1)

$$\left.\begin{array}{ll} H_2SO_3 \rightleftharpoons H^+ + HSO_3^- & K_1 = 1.7\times10^{-2} \\ HSO_3^- \rightleftharpoons H^+ + SO_3^- & K_2 = 6.4\times10^{-8} \end{array}\right\} K_1 >> K_2$$

When we consider first ionization is dominating

$H_2SO_3 \rightleftharpoons H^+ + HSO_3^-$

At equilibrium C–Cα Cα Cα

Hence,

$[H^+] = C\alpha = \sqrt{K_1 \times C} = \sqrt{1.7\times10^{-2}\times0.588} = 0.9998\times10^{-1}$

∴ pH = 1 (Rounded figure)

596. The pH of ammonium phosphate solution, if Pk_a of phosphoric acid and pK_b of ammonium hydroxide are 5.23 and 4.75 respectively, is.......

[JEE Main-2021, 26 Feb Shift-II]

Ans. (7) : $pH = 7 + \frac{1}{2}(pK_a - pK_b)$

$= 7 + \frac{1}{2}(5.23 - 4.75)$

$= 7.24 \approx 7$

597. The pH of a solution obtained by mixing 50 mL of 1 M HCl and 30 mL of 1 M NaOH is x ×10^{-4}. The value of x is......... (Nearest integer) [log 2.5 = 0.3979]

[JEE Main-2021, 31 Aug Shift-II]

Ans. (6021) :

$HCl(aq.) + NaOH(aq.) \rightarrow NaCl(aq.) + H_2O(l)$

50ml,1M 30ml, 1M

t = 0 50ml 30ml

t = ∞ 20ml –

$[HCl] = \frac{20}{80} = \frac{1}{4}M = 2.5\times10^{-1}M$

pH = –log (2.5×10^{-1}) = 1–0.3979 = 0.6021

pH = 6021 × 10^{-4}

598. The pH of a solution containing 100 mg of sodium hydroxide in 250 mL of water is

(a) 12 (b) 13

(c) 14 (d) 11

J & K CET-(2016)

Ans. (a) : Molarity of solution

$= \frac{100\times10^{-3}\times1000}{40\times250}$

= 0.01 M = 10^{-2}M

pOH = –log[10^{-2}] = 2

pH + pOH = 14

∴ pH = 14 – 2 = 12

599. How much is the pH of human blood?

(a) 5.2 (b) 8.3

(c) 6.3 (d) 7.4

J & K CET-(2014)

Ans. (d) : pH range of human blood is 7.36 – 7.42.

600. The concentration of hydrogen ion in a sample of soft drink is 3.8 × 10^{-3}M. What is its pH?

(a) 3.84 (b) 2.42

(c) 4.44 (d) 1.42

J & K CET-(2014)

Ans. (b) : Given, $[H^+]$ = 3.8 × 10^{-3} m

pH= – log$[H^+]$

pH = –log [3.8 × 10^{-3}]

pH = –log3.8 + 3$\log_{10}$10

pH = – 0.5797 + 3

pH = 2.42 (pH value of soft drink)

@apna_pdf

601. What will be the pH at which precipitation of Zn $(OH)_2$ will take place from a solution containing 0.3 M Zn^{2+} ion? K_{sp} of Zn $(OH)_2$ = 1.2×10^{-12}

(a) 5.7 (b) 8.3
(c) 11.4 (d) 6.2

J & K CET-(2017)

Ans. (b) pH + pOH = 14

$Zn(OH)_2 \rightleftharpoons Zn^{2+} + 2\,OH^-$

$K_{sp} = [Zn^{2+}]\,[OH^-]^2$

$1.2 \times 10^{-12} = [0.3M]\,[OH^-]^2$

$[OH^-] = 2 \times 10^{-6}$

$pOH = -\log[OH^-] = -\log(2\times10^{-6}) = 5.699$

$pH = 14 - pOH = 14 - 5.699 = 8.3$

602. The hydroxyl ion concentration in a solution having pH value 3 will be.

(a) 10^{-11} (b) 10^{-7}
(c) 10^{-3} (d) 10^{-14}

J & K CET-(2019)

Ans. (a) :

pH = 3

pOH = 14 – pH = 14 – 3 = 11

$pOH = -\log[OH^-] \Rightarrow 11 = -\log[OH^-]$

$[OH^-] = 10^{-11}$

603. The pH of pure water at 90°C will be

(a) less than 7 (b) more than 7
(c) Equal to 7 (d) Cannot be predicted

J & K CET-(2019)

Ans. (a) : pH of water is 7 at 298 K temperature. At higher Temperature, H_2O dissociates more to give larger concentration of H^+ ions pH will be less than 7.

604. CH_3COOH is 1% ionised in its aqueous solution of 0.1M strength. Its pOH will be

(a) 11 (b) 3
(c) 13 (d) 2

J & K CET-(2019)

Ans. (a) : $CH_3COOH + H_2O \rightleftharpoons CH_3COO^- + H_3O^+$

Initial conc.	C	0	0
conc. at equi.	C–Cα	Cα	Cα

Thus, $[H^+] = C\alpha = 0.1\times0.01 = 0.001$ [α = 1%]

$= 10^{-3}M$

$= [OH^-]$

$= \frac{10^{-14}}{10^{-3}} = 10^{-11}$

= pOH = 11

605. 30 mL of 0.02 M ammonium hydroxide is mixed with 15 mL of 0.02 M HCl, what will be the pH of the solution (pK_b = 4.0)?

(a) 4 (b) 8
(c) 7 (d) 10

J & K CET-(2015)

Ans. (d) :

$$[OH^-] = \frac{M_{NaOH}\cdot V_{NaOH} - M_{HCl}\cdot V_{HCl}}{V_{NaOH} + V_{HCl}}$$

$$= \frac{(0.02\times30)-(15\times0.02)}{30+15}$$

$$= \frac{0.6-0.3}{45} = 0.0067$$

$pOH = -\log[OH^-] = -\log(0.0067) \simeq 2$

$pH = 14 - pOH = 14 - 2 = 12$

606 The $[OH]^-$ in a solution is 1 mol L^{-1}. The pH of the solution is

(a) 1 (b) 0
(c) 14 (d) 10^{-14}

J & K CET-(2013)

Ans. (c) :

$pOH = -\log[H^+] = -\log(1) = 0$

$pH = 14 - pOH = 14 - 0 = 14$

607. The pH of the solution formed by mixing 20 mL of 0.05 M H_2SO_4 with 5.0 mL of 0.45 M NaOH at 298 K is

(a) 6 (b) 2
(c) 12 (d) 7

J & K CET-(2011)

Ans. (c) : $H_2SO_4 = N_1 = M \times V_f = .05 \times 2 = .1N$

$NaOH = N_2 = 0.45\times1 = 0.45N$

$N_1V_1 = 0.1\times20 = 2$

$N_2V_2 = 0.45\times5 = 2.25$

$N_2V_2 - N_1V_1 = N(V_1+V_2)$

$2.25 - 2 = 0.25 = N\,(25)$

$N = 0.25/25 = 10^{-2}$

$[OH] = 10^{-2}$

$[H^+] = 10^{-14}/10^{-2} = 10^{-12}$

$pH = \log\,[H^+]$

pH= 12

608. What will be the resultant pH when 200 mL of an aqueous solution of HCl (pH=2.0) is mixed with 300 mL of an aqueous solution of NaOH (pH=12)?

(a) 2.699 (b) 13.30
(c) 11.3010 (d) 1.330

J & K CET-(2010)

Ans. (c) : For HCl,

$pH = 2, [H^+] = 10^{-2}$

mEq of HCl = $200\times10^{-2} = 2$

For NaOH,

$pH = 12, pOH = 2, [OH] = 10^{-2}$

mEq of NaOH = $300 \times 10^{-2} = 3$

After neutralization,

mEq of NaOH left = 3 – 2 = 1

$[OH^-] = \frac{1}{500} = 2\times10^{-3}$

$pOH = -\log[OH^-] = 3 - \log2 = 3 - 0.3010 = 2.699$

$pH = 14 - pOH = 14 - 2.699 = 11.301$

609. The solubility product of a sparingly soluble metal hydroxide $M(OH)_2$ at 298 K is 5×10^{-16} mole dm^{-9} The pH value of its aqueous and saturated solution is

(a) 5 (b) 9
(c) 11.5 (d) 2.5

J & K CET-(2009)

Ans. (b) : Given,

$K_{sp} = 5 \times 10^{-16}$

$M(OH)_2 \rightleftharpoons M^{2+} + 2\,0H^-$

@apna_pdf

We know that,

$K_{sp} = [A^+][B^-] = (S\ mol\ dm^{-3})(S\ mol\ dm^{-3})$

$= (S^2\ mol^2\ dm^{-6})$

$K_{sp} = (s)(2s)^2 = 4s^3 = 5 \times 10^{-16}$

$$\therefore s = \sqrt[3]{\frac{5\times10^{-16}}{4}} = \sqrt[3]{\frac{500\times10^{-18}}{4}} = 5 \times 10^{-6}$$

Concentration of OH^- = 2S = $2 \times 5 \times 10^{-6} = 10^{-5}$ mol dm^{-3} and pOH = $-\log[OH^-]$

$= -\log 10^{-5} = 5$

$\therefore$ pH = 14 – pOH = 14 – 5 = 9

610. Which one of the following aqueous solutions of salts has the lowest pH value?

(a) CH_3COONa (b) NaCl

(c) NH_4OOCCH_3 (d) NH_4Cl

J & K CET-(2009)

Ans. (d) : NH_4Cl is a salt of weak base (NH_4OH) and strong acid (HCl) thus undergoes cationic hydrolysis and provides H^+ ions that make the solution acidic i.e. pH is very less or less than 7.

$$NH4Cl + H2O\ \ \underset{\text{Weak base}}{NH4OH} + \underset{\text{Strong acid}}{HCl}$$

"or"

We know that,

pH = – log $[H^+]$

Strong acid will give more $[H^+]$

$$NH_4^+ + H_2O \longrightarrow NH_4OH + H^+$$

611. pH of an aqueous solution containing 10^{-8} mol/L of HCl is

(a) 8 (b) 10

(c) 6.96 (d) 12

J & K CET-(2008)

Ans. (c) : HCl is strong acid. All acids have a pH in the acid range that is to say below 7.

pH = $-\log[H^+] = -\log[10^{-8}] = 8$

Assuming an aqueous solution, have to factor in the pH of neutral water which is 7, since $[H^+]$ is 10^{-7}, as a source of protons as well.

Total proton molarity is $10^{-7} + 10^{-8} = 1.1\times10^{-7}$

pH = $-\log(1.1\times10^{-7}) = 6.96$

612. Calculate the pH of a solution in which hydrogen ion concentration is 0.005 gm equivalent/litre

(a) 2.3 (b) 2.8

(c) 2.9 (d) 2.6

J & K CET-(2007)

Ans. (a) : Given that $[H^+] = 0.005$

$$pH = -\log_{10}\left[H^+\right]$$

$$pH = -\log_{10}\left[0.005\right]$$

$$pH = -\log_{10}\left[5\times10^{-3}\right]$$

$$pH = -\log_{10}5 + 3\log_{10}10 \qquad [\because \log_{10}10 = 1]$$

$$pH = -0.6989 + 3\times1$$

$$pH = -0.6989 + 3$$

pH = 2.3

613. The pH of an aqueous solution having hydroxide ion concentration as 1×10^{-5} is

(a) 5 (b) 9

(c) 4.5 (d) 11

J & K CET-(2005)

Ans. (b) : Given,

$[OH^-] = 1 \times 10^{-5}$

pOH = $-\log[OH^-] = -\log[10^{-5}] = 5$

pH + pOH = 14

pH = 14 – 5 = 9

614. The pH of a buffer solution of 0.1 M NH_4OH [pK_b= 5.0] and 0.01 m NH_4 Cl is

(a) 1 (b) 7

(c) 10 (d) 13

TS EAMCET-2020

Ans. (c) : Buffer solution – A solution that can resist change in pH eg. Blood

From Hendesson equation,

$$pOH = pK_b + \log\frac{[NH_4Cl]}{[NH_4OH]}$$

$$pOH = pK_b + \log\frac{0.01}{0.1}$$

pOH = 5 + log (0.1) = 5 – 1 = 4

pH + pOH = 14

pH = 14 – pOH = 14 – 4 = 10

615. 50 mL of 0.1 M HCl and 50 mL of 0.2 M NaOH are mixed. The pH of the resulting solution is

(a) 1.30 (b) 4.2

(c) 12.70 (d) 11.70

J & K CET-(2004)

Ans. (c) : 50 ml of 0.1 M HCl is mixed with 50 ml of 0.2 M NaOH,

$N_1V_1 = N_2V_2$

$50 \times 0.1 = 0.2 \times x$

Therefore X = 25 ml.

Hence 25 ml of 0.2 M NaOH neutralizes 50 ml of 0.1 M HCl. Thus 25 ml of 0.2 M NaOH solution remains unreacted in the solution of the final volume of 100 ml.

Hence, conc. of NaOH in 100 ml = 0.05 M

pOH = –log (0.05)

pOH = 1.3010

pH = 14 – pOH = 14 – 1.3010 = 12.699 ≈ 12.70

616. If $[H^+]$ of a solution of pH = 6 is decreased to 100 times, the solution will be

(a) more acidic (b) basic

(c) neutral (d) of the same pH.

J & K CET-(2002)

Ans. (b) :

pH = – log $[H^+]$

$[H^+] = 10^{-pH}$

$[H^+] = 10^{-6}$

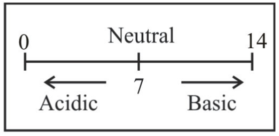
$= 1\times10^{-6}$

When $[H^+]$ is decreased by 100 times,

$$[H^+] = \frac{1\times10^{-6}}{100} = 10\times10^{-8}$$

pH = – log $[H^+]$

= – log $[10^{-8}]$ = 8



∴ The solution will be basic.

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617. Slaked lime, $Ca(OH)_2$ is used extensively in sewage treatment. What is the maximum pH that can be established in $Ca(OH)_{2(aq)}$?
$Ca(OH)_{2(s)} \Leftrightarrow Ca^{2+}_{(aq)} + 2OH^-_{(aq)},$
$K_{sp} = 5.5 \times 10^{-6}$

(a) 1.66 (b) 12.3472
(c) 7.0 (d) 14.0

J & K CET-(2001)

Ans. (b) : Given,
Ksp = 5.5×10^{-6}

$$Ca(OH)2(s) \quad \underset{S}{Ca2+}\,(aq.) + \underset{2S}{2OH-}\,(aq.)$$

$$K_{sp} = [Ca^{2+}][OH^-]^2$$
$$= (s)\,(2s)^2$$
$$K_{sp} = 4s^3$$
$$5.5 \times 10^{-6} = 4s^3$$
$$s = \sqrt[3]{\frac{5.5\times10^{-6}}{4}} = 1.1 \times 10^{-2}\,M$$
$$\therefore \quad [OH^-] = 2s$$
$$= 2 \times 1. \times 10^{-2} = 2.2 \times 10^{-2}$$
$$pOH = -[\log(OH^-)]$$
$$= -\log(2.2 \times 10^{-2}) = 2 - 0.3424$$
$$= 1.6576$$
$$pH = 14 - pOH = 14 - 1.6576$$
$$= 12.3424$$

618. The pH of 0.1 N NaOH solution will be

(a) 0 (b) 1
(c) 7 (d) 13

J & K CET-(2001)

Ans. (d) : Given, Molarity of the solution is 0.1M

$$NaOH \rightarrow Na^+ + OH^-$$
$$Na^+ = 0.1\ N = 0.1M$$
$$OH^- = 0.1\ N = 0.1M$$
$$pOH = -\log[OH^-]$$
$$= -\log[0.1] = 1$$
$$pH + pOH = 14$$
$$pH = 14 - pOH = 14 - 1 = 13$$

619. If pH value of 0.1 mol L^{-1} HCl is nearly 1, then pH value of 0.05 mol L^{-1} H_2SO_4 is

(a) 0.5 (b) 1.0
(c) 0.05 (d) 2.00

J & K CET-(2000)

Ans. (b) : Normality of $H_2SO_4 = 0.05 \times 2 = 0.1$ N

$$\therefore \quad pH = -\log[H^+]$$
$$pH = -\log[10^{-1}]$$
$$pH = 1$$

620. Hydrogen ions, H^+ concentration in 0.5 M NaOH solution will be

(a) 0.5 M (b) 2×10^{-14} M
(c) 3.5×10^{-14}M (d) 5×10^{-14}M

J & K CET-(1998)

Ans. (b) : We know that,

$$[H^+]\,[OH^-] = 10^{-14}$$
$$[H^+] = \frac{10^{-14}}{[OH^-]} = \frac{10^{-14}}{0.5} = 2\times10^{-14}$$

621. pH-scale was proposed by:

(a) Arrhenius (b) Sorensen
(c) Pierre de Coubertin (d) none of the above

JCECE-2004

Ans. (b) : pH scale was proposed by Sorensen.

- Arrhenius – gave concept of acid and base
- Pierre de Coubertin –Father of modern Olympic games.

622. If pH of a solution is 4, then H^+ is :

(a) 10^4 (b) 10^{10}
(c) 10^{-4} (d) 10^{-10}

JCECE-2006

Ans. (c) : $pH = -\log[H^+]$

$$4 = -\log[H^+]$$
$$\log_{10}[H^+] = -4$$
$$[H^+] = 10^{-4}$$

623. The pH of a 0.001 M solution of HCl is

(a) 0 (b) 3
(c) 5 (d) 10

JCECE-2007, JIPMER – 2008

Ans. (b) : We know that,
pH = log (n factor × molarity)
Where, n factor is the no. of hydrogen atoms,
n factor in HCl = 1
So, $pH = -\log(1 \times 0.001)$
$= -\log(10^{-3})$
$pH = -(-3)$
$pH = 3$

624. A solution of an acid has $[H^+] = 2\times10^{-5}$. Find out the concentration of OH^- ions.

(a) 5×10^{-10} N (b) 4×10^{-10} N
(c) 2×10^{-5} N (d) 9×10^{-4} N

JCECE-2009

Ans. (a): Given, $[H^+] = 2\times10^{-5}$ $[OH^-] = ?$

$$\because \ [H^+]\times[OH^-] = 10^{-14}$$
$$\therefore \ 2\times10^{-5}\times[OH^-] = 10^{-14}$$
$$[OH^-] = \frac{10^{-14}}{2\times10^{-5}}$$
$$[OH^-] = 0.5\times10^{-9}$$
$$[OH^-] = 5\times10^{-10}$$

625. A solution contains 10 mL 0.1 N NaOH and 10 mL 0.05 N H_2SO_4, pH of this solution is

(a) less than 7 (b) 7
(c) zero (d) greater than 7

JCECE-2010

Ans. (d) :
Milliequivalent of NaOH = 10×0.1 = 1
Milliequivalent of H_2SO_4 = 10 × 0.05 = 0.5
Left milliequivalent of NaOH = 1 – 0.5 = 0.5 M

$$\therefore \ [OH^-] = \frac{0.5}{10+10} = 2.5\times10^{-2}$$

$pOH = -\log[OH^-] = -\log(2.5\times10^{-2}) = 1.6020$
$pH = 14 - pOH = 14 - 1.6020 = 12.398$
Therefore pH of the resulting solution will be greater than seven i.e. pH > 7 .

626. 20 mL of a HCl solution exactly neutralises 40 mL of 0.005 N NaOH solution. The pH of HCl solution is

(a) 2.5 (b) 2.0
(c) 1.5 (d) 1

JCECE-2011

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Ans. (b) : For acid-base reaction,

$$\underset{\substack{\text{(acid)}\\ \text{HCl}}}{N_1V_1} = \underset{\substack{\text{(base)}\\ \text{NaOH}}}{N_2V_2}$$

$$20 \times N_1 = 40 \times 0.005$$

$$N_1 = \frac{40 \times 0.005}{20}$$

$$N_1 = 0.010 = 1 \times 10^{-2}$$

$$pH = -\log[H^+] = -\log(1 \times 10^{-2}) = 2.0$$

627. The pH value of an acid is 5 and its concentration is 1 M. What is the value of K_a for the acid?

(a) 10^{-7} (b) 10^{-5}

(c) 10^{-10} (d) 10^{-8}

JCECE-2012

Ans. (c) : Given, pH = 5 C = 1, K_a = ?

By using, $pH = -\log\sqrt{K_a.C}$

$$5 = -\log\sqrt{K_a \times 1} = -\frac{1}{2}\log K_a$$

$$\log K_a = -10$$

$$K_a = 10^{-10}$$

Hence, dissociation constant $(K_a) = 10^{-10}$.

628. Calculate pH of 1 M $NaHCO_3$. Given

$$\mathbf{H_2CO_3 + H_2O \rightleftharpoons HCO_3^- + H_3O^+;\ pK_1 = 6.38}$$

$$\mathbf{HCO_3^- + H_2O \rightleftharpoons CO_3^{2-} + H_3O^+;\ pK_2 = 10.26}$$

(a) 8.73 (b) 8.32

(c) 6.73 (d) 6.32

JCECE-2013

Ans. (b) : pH of 1 M $NaHCO_3$ is -

$NaHCO_3$ behaves as acid as well as base both because,

$$NaHCO_3 \rightleftharpoons Na^+ + HCO_3^-$$

Here HCO_3^- is behave proton accepter so act as acid and as well as HCO_3^- behaves as proton donar so act as base Hence,

$$pH = \frac{pK_1 + pK_2}{2} = \frac{6.38 + 10.26}{2} = 8.32$$

629. pH of 10^{-8} M NaOH is

(a) 8.0 (b) 6.0

(c) 6.98 (d) 7.04

JCECE - 2015

UPTU/UPSEE-2009

JIPMER-2004

Ans. (d) : For 10^{-8} M NaOH

$[OH^-] = 10^{-8} + 10^{-7}$

$= 11 \times 10^{-8}$

$pOH = -\log(OH^-)$

$= -\log 11 \times 10^{-8}$

$= 8 - 1.04 = 6.96$

$pH = 14 - 6.96 = 7.04$

630. When 750 mL of 0.5 M HCl is mixed with 250 mL of 2M NaOH solution, the value of pH will be

(a) pH = 7 (b) pH > 7

(c) pH < 7 (d) pH = 0

JIPMER-2017

Ans. (b) : $n_{HCl} = M_{HCl} \times V_{HCl}$ and $n_{NaOH} = M_{NaOH} \times V_{NaOH}$

Where, n = No. of moles, M = Molarity

V = Volume

$\therefore n_{HCl} = 0.5 \times 750 = 375$ milimoles

$n_{NaOH} = 2.0 \times 250 = 500$ milimoles

$\because n_{NaOH} > n_{HCl}$

The solution is basic and has pH > 7

631. The pK_a of acetic acid and pK_b of ammonium hydroxide are 4.76 and 4.75 respectively. Calculate the pH of ammonium acetate solution.

(a) 6.02 (b) 7.005

(c) 8 (d) 5.602

JIPMER-2013

Ans. (b) : Givne, pKa = 4.76

pKb = 4.75

When a weak acid and a weak base are mixed to form a solution, then the required solution has pH according to formula given below-

$$pH = 7 + \frac{1}{2}(pK_a - pK_b)$$

$$pH = 7 + \frac{1}{2}(4.76 - 4.75)$$

$$pH = 7 + 0.005$$

$$pH = 7.005$$

632. The pH value of 0.001 M aqueous solution of NaCl is

(a) 7 (b) 4

(c) 11 (d) unpredictable

JIPMER-2012

Ans. (a) : NaCl is salt made from the neutralization reaction of NaOH and HCl both of which are strong electrolyte. Therefore, NaCl is a neutral salt i.e. there is no acidic or basic character in the salt when dissolved in water it doesn't change the pH of the solution. Hence, it will remain neutral i.e. pH = 7.

NaCl = 0.001

$$NaCl \longrightarrow Na^+ + Cl^-$$

$$\underset{\text{Strong base}}{NaOH} + \underset{\text{Strong acid}}{HCl} \quad NaCl + H2O$$

633. Which of the following is correct?

(a) The pH of one litre solution containing 0.49 g of H_2SO_4 is 2.0

(b) The conjugate base of H_2S is S^{2-}

(c) BF_3 is a Lewis base

(d) Phenolphthalein is colourless in basic medium

JIPMER-2009

Ans. (a) : Given that, W = 0.49g

Molecular mass (M) of H_2SO_4 = 98g

Number of moles (n) = $\frac{W}{M}$

Number of moles (n) = $\frac{0.49}{98}$

Number of moles (n) = 0.005

Number of moles (n) = 5×10^{-3}

$$H_2SO_4 \rightarrow 2H^+ + SO_4^{--}$$

$$\left[H^+\right] = 2 \times 5 \times 10^{-3}$$

$$\left[H^+\right] = 10 \times 10^{-3}$$

$$[H^+] = 10^{-2}$$

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Then,

$pH = -\log 10\left[H^+\right]$

$pH = -\log_{10}\left[10^{-2}\right]$

$pH = 2\log_{10}10 \quad (\because \log_{10}10 = 1)$

$pH = 2\times 1$

$pH = 2$

634. What is the correct relationship between the pHs of isomolar solutions of sodium oxide (pH_1), sodium sulphide (pH_2), sodium selenide (pH_3) and sodium telluride (pH_4)?

(a) $pH_1 > pH_2 \approx pH_3 > pH_4$
(b) $pH_1 < pH_2 < pH_3 < pH_4$
(c) $pH_1 < pH_2 < pH_3 \approx pH_4$
(d) $pH_1 > pH_2 > pH_3 > pH_4$

JIPMER-2007

Ans. (d) : $pH_1 > pH_2 > pH_3 > pH_4$
Acidic character increases in the order
$H_2O < H_2S < H_2Se < H_2Te$
Basic character of conjugate bases will be in the order
$O^{2-} > S^{2-} > Se^{2-} > Te^{2-}$
More the basic character, more the pH
$\therefore$ pHs are in the order
$pH_1 > pH_2 > pH_3 > pH_4$.

635. Given pH of a solution A is 3 and it is mixed with another solution B having pH 2. If both mixed then resultant pH of the solution will be:

(a) 3.2 (b) 1.9
(c) 3.4 (d) 3.5

JIPMER-2006

Ans. (b) : Given,
pH of A = 3 pH of B = 2
$\therefore \quad [H^+] = 10^{-3}m,\ [H^+] = 10^{-2}m$
Total $[H^+]$
$= 10^{-3} + 10^{-2} = 10^{-3} + 10 \times 10^{-3}$
$= 11 \times 10^{-3}$
$pH = -\log_{10}[H^+] = -\log(11 \times 10^{-3})$
$= 3 - \log 11 = 3 - 1.04 = 1.96$

636. NaOH(aq), HCl(aq) and NaCl(aq) concentration of each is 10^{-3} M. Their pH will be respectively

(a) 10, 6, 2 (b) 11, 3, 7
(c) 10, 3, 7 (d) 10, 4, 7

JIPMER-2005

Ans. (b) : Given,
OH^- ion concentration is 10^{-3}M
We know that,
$[H^+][OH^-] = 10^{-14}$

$$[H^+] = \frac{10^{-14}}{10^{-3}}$$

$[H^+] = 10^{-11}$
$\because \quad pH = -\log[H^+] = [-\log 10^{-11}]$
$pH = 11$
Similarly,
pH of HCl $= -\log\ [H^+]$
$= -\log\ [10^{-3}]$
$= 3$
pH of NaCl=7

637. The pH of a 10^{-10} M–NaOH solution is

(a) 10 (b) 7.01
(c) 6.99 (d) 4

JIPMER-2005

Ans. (b) : At 25°C concentration of OH^- ions is 10^{-7} m, as present in water.
But the concentration in this case is given as of (OH^-) $(10^{-7} + 10^{-10})m = 1.001 \times 10^{-7}$
Now, $pOH = -\log[OH^-] = -\log(1.001 \times 10^{-7})$
$= 7 - \log(1.001) = 7 - 0.00043 \approx 6.99$
$pH = 14 - pOH = 14 - 6.99 \approx 7.01$

638. If 50 mL of 0.1 HBr is mixed with 50 mL 0.2 M NaOH, find pH of resulting mixture

(a) 2.7 (b) 12.7
(c) 10.7 (d) 1.3

JIPMER-2019

Ans. (b) : $N_{mix}V_{mix} = \underset{NaOH}{N1V1} - \underset{HBr}{N2V2}$
Given,
$M_1 = 0.2M,\ N_1 = 0.2$ N
$M_2 = 0.1M,\ N_2 = 0.1$ N
$V_1 = 50$ ml,
$V_2 = 50$ ml, $V_{mix} = V_1 + V_2 = 100$ ml
$N_{mix} \times 100 = 50 \times 0.2 - 50 \times 0.1$
$N_{mix} = 5 \times 10^{-2}$
$pOH = -\log[OH^-] = -\log[5\times10^{-2}]$
$= 2 - \log 5 = 1.3$
$pH + pOH = 14$
$pH = 14 - 1.3 = 12.7$

639. An aqueous solution of $CuSO_4$ is subjected to electrolysis using inert electrodes. The pH of the solution will

(a) increase
(b) remains unchanged
(c) decrease
(d) increase or decrease depending on the strength of the current

Karnataka-CET-2019

Ans. (c) :

Anode: $2H_2O \longrightarrow 4H^+ + 4e^- + O_2$

Cathode: $Cu^{2+}(aq) + 2e^- \longrightarrow Cu(s) \times 2$

Net cell reaction: $2Cu^{2+}(aq) + 2H_2O \longrightarrow 4H^+ + 2Cu(s) + O_2\uparrow$

Due to increase in $[H^+]$, pH decreases.

640. The aqueous solution which of the following salt will have the lowest pH

(a) $NaClO_3$ (b) NaClO
(c) $NaClO_2$ (d) $NaClO_4$

Karnataka-CET-2015

Ans. (d) : $NaClO_4$, on hydrolysis gives strongest acid $HClO_4$ as compared to other salts. This is strongly ionized and gives highest concentration of H^+. Therefore aqueous solution of $NaClO_4$ will have lowest pH value.

641. One mole of ammonia was completely absorbed in one litre solution each of
I. 1 M H Cl
II. 1 M CH_3COOH and
III. 1 M H_2SO_4 at 298 K

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The decreasing order for the pH of the resulting solution is (Given K_b (NH_3) = 4.74)

(a) II > III > I (b) I > II > III

(c) II > I > III (d) III > II > I

Karnataka-CET-2014

Ans. (c) : We know that,

Lowest pH is more, acidic in nature

$NaClO_3 \longrightarrow Na^+\ ClO_3^-$

$NaClO \longrightarrow Na^+\ ClO^-$

$NaClO_2 \longrightarrow Na^+\ ClO_2^-$

$NaClO_4 \longrightarrow Na^+\ ClO_4^-$

∵ ClO_4 can easily abstract protron from weaker $HClO_4$.

Acid which are weak in water will be highly acidic in NH_3

A. $HCl + NH_3 \rightleftharpoons NH_4Cl$

B. $CH_3COOH + NH_3 \rightleftharpoons CH_3COONH_4$

C. $H_2SO_4 + NH_3 \rightleftharpoons (NH_4)_2SO_4$

∴ Effect of ammonia is least in H_2SO_4 and maximum in CH_3COOH

∴ Acidic strength order of resulting solutions is $(NH_4)_2SO_4 > NH_4Cl > CH_3COONH_4$

∴ pH effect order is $CH_3COONH_4 > NH_4Cl > (NH4)_2SO_4$

So, II > I > III is correct order.

642. For $Cr_2O_7^{2-} + 14H^+ + 6e^- \longrightarrow 2Cr^{3+} + 7H_2O$ E^o = 1.33 V. At $[Cr_2O_7^{2-}] = 4.5$ millimole, $[Cr^{3+}]$ = 15 millimole, E is 1.067 V. The pH of the solution in nearly equal to

(a) 2 (b) 3 (c) 5 (d) 4

Karnataka-CET-2014

Ans. (a) : Given, E° = 1.33 V. E = 1.067 V pH = ?

$Cr_2O_7^{2-} + 14H^+ + 6e^- \longrightarrow 2Cr^{3+} + 7H_2O$

$$E = E° - \frac{0.059}{n}\log\frac{\left[Cr^{3+}\right]^2[H_2O]^7}{\left[Cr_2O_7^{2-}\right]\left[H^+\right]^{14}}$$

$$1.067 = 1.33 - \frac{0.059}{6}\log\frac{\left(15\times10^{-3}\right)^2(1)^7}{\left(4.5\times10^{-3}\right)\left(H^+\right)^{14}}$$

$$\frac{0.059}{6}\log\left[\frac{225\times10^{-6}}{(4.5\times10^{-3})(H^+)^{14}}\right] = 0.263$$

$$\log\left[\frac{225\times10^{-6}}{(4.5\times10^{-3})(H^+)^{14}}\right] = \frac{0.263}{0.059} = 26.74$$

$$\log\left[\frac{50\times10^{-3}}{[H^+]^{14}}\right] = 26.74$$

$\log(50 \times 10^{-3}) - \log[H^+]^{14} = 26.74$

$-1.3010 - 14\log[H^+] = 26.74$

$-14\log H^+ = 26.74 + 1.3010$

$14pH = 28.041$

$$pH = \frac{28.041}{14}$$

$[\because pH = -\log(H^+)] = 2$

643. The pH of the solution obtained by mixing 100 ml of a solution of pH = 3 with 400 mL of a solution of pH = 4 is

(a) 7 – log 2.8 (b) 4 – log 2.8

(c) 5 – log 2.8 (d) 3 – log 2.8

Karnataka-CET-2012

Ans. (b) : For pH = 3 $[H_3O^+] = 10^{-3}$

pH = 4, $[H_3O^+] = 10^{-14}$

Moles of H_3O^+ in 100 ml of solution pH = 3

$$= \frac{10^{-3}}{1000}\times100 = 10^{-4}$$

Moles of H_3O^+ in 400 ml of solution of pH = 4

$$= \frac{10^{-4}}{1000}\times400 = 4\times10^{-5}$$

$$[H_3O^+] = \frac{4\times10^{-5}\times1000}{500} = 2.8\times10^{-4}$$

$pH = -\log(2.8 \times 10^{-4})$

$= 4 - \log 2.8$

644. 5 mL of 0.4 N NaOH is mixed with 20mL of 0.1 N HCl. The pH of the resulting solution will be

(a) 7 (b) 8

(c) 5 (d) 6

Karnataka-CET-2012

Ans. (a) : Given, N_1 = 5mL, N_2 = 5mL

$V_1 = 0.4$, $V_2 = 0.1$

Milliequivalents of NaOH = N_1V_1

= 0.4 × 5 = 0.20

miliequivalents of HCl = N_2V_2

= 0.1 × 20 = 0.20

milliequivalents of NaOH (Base) = milliequivalents of HCl (Acid).

Thus , NaOH will be completely neutralised with HCl to form salt NaCl.

So, It's P^H will be 7.

645. On adding which of the following, the pH of 20 mL of 0.1 N HCl will not alter?

(a) 20 mL of distilled water

(b) 1 ML of 0.1 N NaOH

(c) 500 mL of HCl of pH = 1

(d) 1 mL of 1N HCl

Karnataka-CET-2012

Ans. (c) : Miliequivalents of 20 ml of 0.1 NHCl = N_1V_1

= 20 × 0.1 = 2

A. pH of distilled water = 7

$[H^+] = 10^{-pH} = 10^{-7}M$

∴ Miliequivalents = NV [For HCl N = M]

$= 10^{-7} \times 20 = 2.0 \times 10^{-6}$

B. Miliequivalents of NaOH = 0.1 × 1 = 1

C. pH of HCl = 1

∴ $[H^+] = 10^{-1} = 0.1m$

∵ miliequivlents = 0.1 × 500 = 50

D. miliequivalents of 500 ml of HCl having pH = 1 is more than that of 20 ml of 0.1 N HCl, therefore adding this pH of 0.1N HCl solution, does not alter.

646. 0.023 g of sodium metal is reacted with 100 cm^3 of water. The pH of the resulting solution is

(a) 10 (b) 8

(c) 9 (d) 12

Karnataka-CET-2011, 2010

@apna_pdf

Ans. (d) : HCl is monobasic acid its molarity is equal to its normality, Hence, 500 ml of HCl of HCl of $p^H = 1$ corresponds to 0.1 N solution.

$$\underset{\substack{(2\times23=46)\\0.023}}{2Na} + 2H_2O \longrightarrow \underset{\substack{(2\times40=80)\\0.04}}{2NaOH} + H_2$$

$$\therefore \quad [OH^-] = \frac{0.04}{40}\times10 = 10^{-2}$$

$pOH = 2$

$\because \quad pH + pOH = 14$

$pH = 14 - pOH$

$pH = 14 - 2$

$pH = 12$

647. pH value of which one of the following is not equal to one?

(a) 0.1 M CH_3 COOH

(b) 0.1 M HNO_3

(c) 0.05 M H_2SO_4

(d) 50 cm^3 0.4 M HCl + 50 cm^3 0.2 M NaOH

Karnataka-CET-2011, 2009

Ans. (a) : 0.1 M CH_3COOH is not completely dissociated. Therefore, pH will not be one.

648. A buffer solution contains 0.1 mole of sodium acetate dissolved in 1000 cm^3 of 0.1 M acetic acid. To the above buffer solution, 0.1 mole of sodium acetate is further added and dissolved. The pH of the resulting buffer is

(a) pK_a (b) $pK_a + 2$

(c) $pK_a - \log 2$ (d) $pK_a + \log 2$

Karnataka-CET-2011

Ans. (d) : According to the Henderson's equation,

$$pH = pK_a + \log\frac{[salt]}{[acid]}$$

When extra 0.1 mole sodium acetate is added

$[salt] = 0.2 \text{ mol dm}^{-3}$

$[acid] = 0.1 \text{ mol dm}^{-3}$

$$\therefore \quad pH = pK_a + \log\frac{[0.2]}{[0.1]}$$

$pH = pK_a + \log 2$

649. 10^{-6} M NaOH is diluted 100 times. The pH of the diluted base in

(a) between 7 and 8 (b) between 5 and 6

(c) between 6 and 7 (d) between 10 and 11

JIPMER-2011

Karnataka-CET, 2009

Ans. (a) : Given that,

Concentration of NaOH = 10^{-6} M

$$[OH^-] \text{ in the diluted base } \frac{10^{-6}}{10^2} = 10^{-8}$$

Total $[OH^-] = 10^{-8} + [OH^-]$ of water

$= (10^{-8} + 10^{-7})$ M

$= 10^{-8}\,[1 + 10]$ M

$= 11 \times 10^{-8}$ M

we know that,

$pOH = -\log_{10}[OH^-]$

pOH $= -\log 11 \times 10^{-8}$

$= -\log 11 + 8 \log 10$

$= 6.9586$

we know that,

$pH + pOH = 14$

$pH = 14 - pOH$

pH $= 14 - 6.9586 = 7.0414$

650. 30 cc of $\frac{M}{3}$ HCl, 20 cc of $\frac{M}{2}$ HNO_3 and 40 cc of $\frac{M}{4}$ NaOH solutions are mixed and the volume was made up to $1dm^3$. The pH of the resulting solution is

(a) 8 (b) 2 (c) 1 (d) 3

Karnataka-CET, 2009

Ans. (b) : Given that,

30 cc of $\frac{M}{3}$ HCl

20 cc of $\frac{M}{2}$ HNO_3

40 cc of $\frac{M}{4}$ NaOH

Total milliequivalents of H^+

$$= 30\times\frac{1}{3} + 20\times\frac{1}{2} = 20$$

Total milliequivalents of $[OH^-]$

$$= 40\times\frac{1}{4} = 10$$

Milli equivalence of H^+ left

$= 20 - 10 = 10$

$$\therefore \quad [H^+] = \frac{10}{1000} \text{ g ions/dm}^3 = 10^{-2}$$

$$\therefore \quad pH = -\log 10^{-2} = 2$$

651. Which one of the following salts on being dissolved in water gives pH > 7at 25°C?

(a) KCN (b) KNO_3

(c) NH_4Cl (d) NH_4CN

Karnataka-CET-2007

Ans. (a) : $KCN + H_2O \rightleftharpoons KOH + HCN$

KCN is a salt of weak acid and strong base hence, on being dissolved in water it gives basic solution i.e. pH > 7at 25°C.

652. The aqueous solution of which of the salt has pH close to 7?

(a) $FeCl_3$ (b) CH_3COONa

(c) Na_2CO_3 (d) CH_3COONH_4

(e) KCN

Kerala-CEE-2010

Ans. (d) $\underset{\text{Weak acid}}{CH_3COOH} + \underset{\text{Weak base}}{NH_4OH} \rightarrow \underset{\text{Neutral, pH = 7}}{CH_3COONH_4} + HO_2$

The aqueous solution of CH_3COONH_4 has pH close to 7 Because it is a salt of weak acid and weak base.

653. When 200 mL of aqueous solution of HCl (pH = 2) is mixed with 300 mL of an aqueous solution of NaOH (pH = 12), the pH of the resulting mixture is

(a) 10 (b) 2.7

(c) 4.0 (d) 11.3

(e) 2

Kerala-CEE-2009

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Ans. (d) : Given that, Milliequivalent of $[H^+] = 2$
pH of NaOH = 12
$[OH^-] = 10^{-2}M$
Milliequivalent of $OH^- = 3$
$HCl = NaOH = NaCl + H_2O$
M_{eq} of OH^- after reaction = 3 – 2 = 1

$$[OH^-] \text{ after reaction} = \frac{1}{500} = 2 \times 10^{-3}M$$

We know,

$$pOH = -\log_{10}[OH^-] = -\log_{10} 2\times10^{-3} = 2.7$$
$$pH = 14 - 2.7 = 11.3$$

654. The pH of a solution obtained by mixing 50 mL of 1 N HCl and 30 mL of 1 N NaOH is [log 2.5 = 0.3979]

(a) 3.979
(b) 0.6021
(c) 12.042
(d) 1.2042
(e) 0.3979

Kerala-CEE-2008

Ans. (b):
moles of HCl = M × V = $50 \times 10^{-3} \times 1 = 5 \times 10^{-2}$
moles of NaOH = M × V = $30 \times 10^{-3} \times 1 = 3 \times 10^{-2}$
as number of moles of HCl are more than NaOH the resulting solution (30 + 50 = 80 ml) will contain excess of HCl.

$$= 5 \times 10^{-2} - 3 \times 10^{-2} = 2 \times 10^{-2} \text{ mol}$$

Remainging moles of H^+ ions = 2×10^{-2} mol

$$\therefore H^+ [\text{after mixing}] = \frac{2\times10^{-2}\text{ mol}}{80\times10^{-3}\text{ L}} = \frac{1}{4}M$$
$$pH = -\log H^+ = -\log\frac{1}{4} = \log 4 = 0.6021$$

655. The pH of a neutral water is 6.5, then the temperature of water

(a) is 25°C
(b) is more than 25°C
(c) is less than 25°C
(d) can be more or less than 25°C
(e) cannot be predicted

Kerala-CEE-2007

Ans. (b) : The ionization increase with temperature. So the amount of H^+ active in solution will increase with temperature, the pH should decrease. When there is decrease in pH of neutral water, it is normally assumed that the temperature is increased from room temperature 25°C. So, when the pH of neutral water in 6.5, the temperature should greater than 25°C.

656. The dissociation constant of acetic acid K_a is 1.74×10^{-5} at 298K. The pH of a solution of 0.1 M acetic acid is:

(a) 2.88
(b) 3.6
(c) 4.0
(d) 1.0
(e) 2.0

Kerala-CEE-2004

Ans. (a) Given,
$K_a = 1.74 \times 10^{-5}$
pH = ?
According to Ostwald dilution formula

$$[H^+] = \sqrt{K_a \times C}$$
$$[H^+] = \sqrt{1.7\times10^{-5}\times0.1}$$
$$[H^+] = \sqrt{0.017\times10^{-4}}$$
$$pH = -\log_{10}[H^+]$$
$$pH = -\log_{10}\sqrt{0.017\times10^{-4}}$$
$$pH = 2.88$$

657. 0.365g of HCl gas was passed through 100 cm³ of 0.2 M NaOH solution. The pH of resulting solution would be:

(a) 1
(b) 5
(c) 8
(d) 9
(e) 13

Kerala-CEE-2004

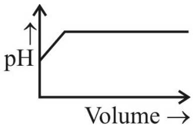
Ans. (e) Moles of HCl = $\frac{0.365}{36.5} = 10^{-2} = 0.01$ mol

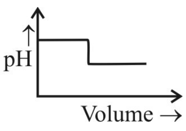
moles of NaOH = $\frac{0.2\times100}{1000} = 0.02$mol

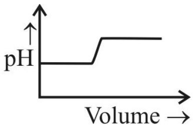
moles of NaOH left unreacted = 0.01 mol
Volume of solution = 100 cm³ = 0.1L

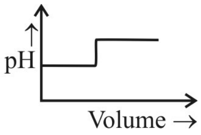
$$\therefore [NaOH] = \frac{0.01}{0.1} = 10^{-1}m$$
$$[OH^-] = 10^{-1}m$$
$$[H^+] = \frac{k_w}{[OH^-]} = \frac{10^{-14}}{10^{-1}} = 10^{-13}m$$
$$pH = 13$$

658. Which of the following plot represents the graph of pH against volume of alkali added in the titration of NaOH and HCl?

(a)


(b)


(c)


(d)


Manipal-2019

Ans. (a) : If pH is less then 7, the solution is acidic but if the pH is more than 7 the solution becomes basic.

0____7____14
Acid Base

if alkali is added in acid solution the pH increases.

659. Find the pH value of the mixture containing 50 cc M HCl and 30 cc M NaOH solution. assuming both to be completely ionised.

(a) 0.7051
(b) 0.6021
(c) 10.051
(d) 8.052

Manipal-2017

Ans. (b) : Total volume after mixing = 50+30 = 80cc

Moles of HCl after mixing = $\frac{50}{80}$M

Moles of NaOH after mixing = $\frac{30}{80}$M

Remaining number of moles of HCl after mixing

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$= \frac{50}{80} - \frac{30}{80} = 0.25M$

$[H^+]=0.25=2.5\times10^{-1}$

$pH= -\log [2.5\times10^{-1}]=1- 0.3979=0.6021$

660. What will be the pH of a solution formed by mixing 10 mL 0.1 M NaH_2PO_4 and 15 mL 0.1 M Na_2HPO_4? [Given $pK_1 = 2.12$, $pK_2 = 7.2$]

(a) 7.0 (b) 6.9 (c) 7.4 (d) 7.5

AMU-2018

Ans. (c) : Given for (NaH_2PO_4)

10 ml of 0.1 M NaH_2PO_4 and $pK_1 = 2.12$

$$\because pH_1 = pK_1 + \log\left[\frac{A^-}{H_A}\right] = \frac{[0.1\times2]}{1}$$

Here, $[H_A] = [NaH_2PO_4] = 0.1 \times 10 = 1$

$[A^-] = [H^+]$

$$\therefore\ pH_1 = 2.12 + \log\frac{[0.2]}{1}$$

$pH_1 = 2.12 + (-0.6989)$

$pH_1 = 1.421$

For Na_2HPO_4

15 ml of 0.1 M Na_2HPO_4 and $pK_2 = 7.2$

$$\because pH_2 = pK_2 + \log\left[\frac{A^-}{H_A}\right]$$

Here, $[H_A] = [NaHPO_4]$

$[A^-] = [H^+]$

$$pH_2 = 7.2 + \log\left[\frac{0.1}{1.5}\right]$$

$pH_2 = 7.2 + (-1.1739)$

$pH_2 = 6.0261$

Total $pH = pH_1 + pH_2$

$= 1.421 + 6.0261 = 7.4471$

661. What is the pH of millimolar solution of ammonium hydroxide which is 20% dissociated?

(a) 3.699 (b) 10.301

(c) 4.691 (d) 9.301

MHT CET-2014

Ans. (b): Concentration of NH_4OH solution = 0.001 M

Degree of dissociation = 20% = $\frac{20}{100} = 0.2$

Concentration of OH^- i.e. $[OH^-]$ =

Concentration of solution × degree of dissociation

$= 0.001 \times 0.02 = 2 \times 10^{-4}$

$\because$ $[H^+]\ [OH^-] = 1 \times 10^{-14}$

$$\therefore\quad H^+ = \frac{1\times10^{-14}}{2\times10^{-4}} = \frac{1}{2}\times 10^{-10}$$

Again,

$\because$ $pH = -\log[H^+]$

$$\therefore\quad pH = -\log\left(\frac{1}{2}\times10^{-10}\right)$$

$= -\log (-10 - 0.3010) = 10.3010$

662. The sum of pH and pK_b for a basic buffer solution is 13. The ratio of the concentration of the base to that of the salt is

(a) 10 (b) 1

(c) 0.05 (d) 0.1

(e) 20

Kerala-CEE-2013

Ans. (d) : Given that,

$pH + pK_b = 13$ ____(i)

$$\text{From } pOH = pK_b - \log\frac{[base]}{[salt]}$$

$$14 - pH = pK_b - \log\frac{[base]}{[salt]}$$

$$\therefore\quad 14 = pH + pK_b - \log\frac{[base]}{[salt]}\ \_\_\_\_(ii)$$

Putting the value of (i) in equation (ii)

$$\text{or}\quad 14 = 13 - \log\frac{[base]}{[salt]}$$

$$\log\frac{[base]}{[salt]} = 13 - 14 = -1$$

$$\therefore\ \frac{[base]}{[salt]} = \text{Antilog}\ (-1) = 0.1$$

663. The hydrogen ion concentration of a solution is 3.98×10^{-6} mole per liter. The pH value of this solution will be

(a) 6.0 (b) 5.8 (c) 5.4 (d) 5.9

MHT CET-2012

Ans. (c) : Given that,

$[H^+] = 3.98 \times 10^{-6}$ mole per liter

We know that,

$pH = -\log [H^+]$

$pH = -\log (3.98 \times 10^{-6})$

$pH = -\log 3.98 + (-\log 10^{-6})$

$pH = -0.5998 + 6$

$pH = 5.40$

664. An acid solution of pH = 6 is diluted 1000 times, the pH of the final solution becomes

(a) 6.01 (b) 9 (c) 3.5 (d) 6.99

MHT CET-2011

Ans. (d) : Given pH = 6

Therefore, $[H^+] = 10^{-pH} = 10^{-6}$ M

After dilution

$$[H^+] = \frac{10^{-6}}{1000}$$

$= 10^{-9}$

$\therefore$ pH of water is 7

$\because$ $[H^+] = 10^{-7}$

Total $[H^+] = 10^{-9} + 10^{-7}$

$= 10^{-7}\ (10^{-2} + 1)$

$= 10^{-7}\ (1.01)$

We know that,

$pH = -\log [H^+]$

$pH = -\log (1.01 \times 10^{-7})$

$= 7 - 0.0043$

$pH = 6.9957$

665. Ammonium acetate which is 0.01 M, is hydrolysed to 0.001 M concentration. Calculate the change in pH in 0.001 M solution, if initially $pH = pK_a$

@apna_pdf

(a) 5 (b) 10
(c) 100 (d) 1

MHT CET-2010

Ans. (d) : Given, Ammonium acetate = 0.01M
after hydrolysis concentration = 0.001M

$$\underset{0.01M}{CH_3COONH_4} + H_2O \rightarrow \underset{0.001M}{CH_3COOH} + NH_4OH$$

$$pH = pK_a + \log \frac{[CH_3COONH_4]}{CH_3COOH]}$$

$$= pK_a + \log \left[\frac{0.01}{0.001}\right]$$

$$= pK_a + \log 10$$

$$= pK_a + 1$$

$\therefore$ change in pH = 1

666. In a solution, 0.02 M acetic acid is 4% dissociated. The [OH⁻] in the solution is

(a) 8×10^{-4} (b) 2×10^{-14}
(c) 8×10^{10} (d) 1.25×10^{-11}

MHT CET-2009

Ans. (d) : Given, acetic acid = 0.02M

$$[H^+] = \sqrt{a^2c^2} = \sqrt{(0.02)^2\cdot(0.04)^2} = 8\times10^{-4}$$

$$[H^+][OH^-] = 10^{-14}$$

$$\therefore \quad [OH^-] = \frac{10^{-14}}{8\times10^{-4}}$$

$$= 1.25\times10^{-11}\ M$$

667. The pH of a 0.1 M solution of NH_4OH (having $k_b = 1.0\times10^{-5}$) is equal to

(a) 10 (b) 6
(c) 11 (d) 12

MHT CET-2008

Ans. (c) : NH_4OH in a strong base. As the value of K_b is also given ($K_b = 1.0\times10^{-5}$), So we can find out concentration of OH^-

$$[OH^-] = \sqrt{K_b \times NH_4OH}$$

$$= (10^{-5}\times10^{-1})^{\frac{1}{2}} = 1\times10^{-3}$$

$$[H^+] = \frac{10^{-14}}{10^{-3}} = 10^{-11}$$

$$pH = -\log 10^{-11} = 11$$

668. When ammonium chloride is added to ammonia solution, the pH of the resulting solution will be

(a) increased (b) seven
(c) decreased (d) unchanged

MHT CET-2007

Ans. (c) : Due to common ion, effect rate of ionization of NH_4OH decreases. So lower $[OH^-]$ is obtained. Common ion effect is observed when a solution of ewak electrolyte is mixed with a solution of strong electrolyte which sharing a common ion to weak electrolyte.
Hence, pH value decrease.

669. The correct order of pH of solutions of $CuSO_4$, NaCN, NaCl and water is

(a) $CuSO_4 < NaCN < NaCl = H_2O$
(b) $CuSO_4 > NaCN = H_2O > NaCl$
(c) $CuSO_4 = H_2O > NaCN > NaCl$
(d) $CuSO_4 < NaCl = H_2O < NaCN$

AP - EAMCET(MEDICAL) - 2009

Ans. (d) : NaCl is a salt of strong base (NaOH) and strong acid (HCl), hence it will be neutral in nature. Therefore, pH of its solution will be 7. Similarly, H_2O is neutral itself in nature therefore its pH also will be 7. Copper sulphate is a salt of weak base $[Cu(OH)_2]$ and strong acid H_2SO_4, hence it will be acidic in nature. Therefore, pH of its solution must be less than 7. As we know, NaCN is a salt of strong base (NaOH) and weak acid (HCN), So its solution must be basic in nature showing pH greater than 7. Hence, the correct order of pH will be–

$$CuSO_4 < NaCl = H_2O < NaCN$$

670. The pH of a 10^{-8} molar solution of HCl in water is

(a) 8 (b) between 7 and 8
(c) between 6 and 7 (d) None of these

MHT CET-2007

Ans. (c) : From H_2O, $[H_2] = 1\times10^{-7}M$
From HCL, $[H^+] = 1\times10^{-8}$ m
Total $[H^+] = (1\times10^{-7} + 1\times10^{-8})$ M
$= (1\times10^{-7} + 0.1\times10^{-7})$ M
$= 1.1\times10^{-7}$ M
$pH = -\log(1.1\times10^{-7}) = 6.96$

671. The Compound whose water solution has the highest pH is

(a) NaCl (b) $NaHCO_3$
(c) Na_2CO_3 (d) NH_4Cl

NEET-2002, 1988

Ans. (c) : • NaCl is a salt of strong acid (HCl) and strong base (NaOH) which have the pH value 7 when dissolved in water.

- $NaHCO_3$ is a acidic salt in water with NaOH and H_2CO_3. Thus, the pH value of $NaHCO_3$ solution is less than 7.
- Na_2CO_3 in water gives strong base (NaOH) and weak acid (H_2CO_3) which makes the solution alkline with the pH of greater than 7.
- NH_4Cl gives the strong acid (HCl) and a weak base (NH_4OH) when dissolved in water solution and make the solution acidic in nature with the pH less than 7.

672. The pH value of N/10 NaOH solution is

(a) 12 (b) 13
(c) 10 (d) 11

NEET-1995

Ans. (b) : Given,

The concentration of $[OH^-]$ ions in NaOH solution $= \frac{1}{10}$

$$\therefore pOH = -\log[OH^-] = -\log\frac{1}{10} = -\log 10^{-1} = 1\log 10 = 1$$

Hence, pH = 14 – pOH = 14 – 1 = 13
Thus, the pH value of N/10 sodium hydroxide solution is 13.

673. The pH value of a 10 M solution of HCl is

(a) equal to 1 (b) equal to 2
(c) less than 0 (d) equal to 0

NEET-1995

Ans. (c) : Given that, Concentration of H^+ ion = $[H^+]$ = 10M
then, $pH = -\log[H^+] = -\log[10] = -1$
Hence, the pH value of a 10M solution of HCl is less then zero (which is –1).

@apna_pdf

674. Which statement is wrong about pH and H^+ ?

(a) pH of neutral water is not zero

(b) Adding 1 N solution of CH_3COOH and 1 N solution of NaOH, pH will be seven

(c) $[H^+]$ of dilute and hot H_2SO_4 is more than concentration and cold H_2SO_4

(d) Mixing solution of CH_3COOH and HCl, pH will be less than 7

NEET-2000

Ans. (b) : After mixing 1N solution of CH_3COOH (Weak Acid) and 1N NaOH (Strong Base) the resulting solution will have free OH^- ions which makes the solution alkaline in nature. Thus, pH value of solution will be higher than 7.

675. The concentration of $[H^+]$ and concentration of $[OH^-]$ of a 0.1 aqueous solutions of 2% ionised weak acid is [ionic product of water = 1×10^{-14}]

(a) 2×10^{-3} M and 5×10^{-12} M

(b) 1×10^{-3} M and 3×10^{-11} M

(c) 0.02×10^{-3} M and 5×10^{-11} M

(d) 3×10^{-2} M and 4×10^{-13} M

NEET-1999

Ans. (a) : Concentration of $[H^+]$ ions

$$= 1 \times 0.1 \times \frac{2}{100} \text{ M} = 2\times10^{-3} \text{ M}$$

But $[H^+][OH^-] = 10^{-14}$

$[2 \times 10^{-3}][OH^-] = 10^{-14}$

or $$[OH^-] = \frac{10^{-14}}{2\times10^{-3}} = 5 \times 10^{-12} \text{ M}$$

676. The hydride ion H^- is stronger base than its hydroxide ion OH^-. Which of the following reaction will occur if sodium hydride (NaH) is dissolved in water ?

(a) $H^- + H_2O \rightarrow$ no reaction

(b) $H^-(aq) + H_2O \rightarrow H_3O^-$

(c) $H^-(aq) + H_2O(l) \rightarrow OH^- + H_2$

(d) None of these

NEET-1997

Ans. (c) : As hydride ion is stronger base, solt with react with water which acts as an acid. The reaction occurring is as follows :

$$NaH + H_2O \rightarrow NaOH + H_2$$

or , $H(aq) + H_2O(l) \rightarrow OH^- + H_2\uparrow$

677. Calculate the pOH of a solution at 25ºC that contains 1×10^{-10} M hydronium ions, i.e. H_3O^+

(a) 4.000 (b) 9.000

(c) 1.000 (d) 7.000

NEET-2007

Ans. (a) : Given that,

$H_3O^+ = 1 \times 10^{-10}$M

$[H_3O^+] = [H^+] = 10^{-10}$M

We know that,

pH+ pOH = 14.............(i)

pH = – log $[H^+]$

pH= –log 10^{-10}

pH = 10

From equation (i)

pOH + 10 = 14

pOH = 14 – 10 = 4

678. The hydrogen ion concentration of a 10^{-8}M HCl aqueous solutions at 298 K ($K_w = 10^{-14}$) is

(a) 1.0×10^{-8} M (b) 1.0×10^{-6} M

(c) 1.0525×10^{-7} M (d) 9.525×10^{-8} M

NEET-2006

Ans. (c) : Given that,

$K_w = 10^{-14}$

Hydrogen ion concentration =

$[H^+] = 10^{-8}$ M

Due to dilute solution,

$[H^+] = 10^{-8} + 10^{-7}$ M

$= 10^{-7}$ [0.1 + 1]M

$= 1.1 \times10^{-7}$ M

$\simeq 1.0525\times10^{-7}$M

679. At 25°C, the dissociation constant of base, BOH is 1.0×10^{-12} M. The concentration of hydroxyl ions in 0.01 M aqueous solution of the base would be

(a) 1.0×10^{-5} mol L^{-1} (b) 1.0×10^{-6} mol L^{-1}

(c) 2.0×10^{-6} mol L^{-1} (d) 1.0×10^{-7} mol L^{-1}

NEET-2005

Ans. (d) :

$BOH \rightarrow B^+ + OH^-$

$K_b = [B^+][OH^-] / [BOH]$

At equilibrium $[B^+] = [OH^-]$

$\therefore K_b = [OH^-]^2 / [BOH]$

$\therefore K_b = 1.0\times10^{-12}$ and [BOH] = 0.01 M

Thus,

$1.0\times10^{-12} = [OH^-]^2 / 0.01$

$[OH^-]^2 = 1\times10^{-14}$

$[OH^-] = 1.0\times10^{-7}$ mol L^{-1}

680. Ionisation constant of CH_5COOH is 1.7×10^{-5} and concentration of H^+ ions is 3.4×10^{-4}. Then find out initial concentration of CH_3COOH molecules.

(a) 3.4×10^{-4} (b) 3.4×10^{-3}

(c) 6.8×10^{-4} (d) 6.8×10^{-3}

NEET-2001

Ans. (d) : Given that,

Ionisation constant (K_a) of $CH_3COOH = 1.7\times10^{-5}$

Concetration of H^+ ion = 3.4×10^{-4}

$$CH_3COOH \rightleftharpoons CH_3COO^- + H^+$$

$$K_a = \frac{[CH_3COO^-][H^+]}{[CH_3COOH]}$$

$[CH_3COO^-] = [H^+] = 3.4 \times 10^{-4}$ M

K_a for $CH_3COOH = 1.7 \times 10^{-5}$

CH_3COOH is weak acid and its ionization constant = 3.4×10^{-4} is very less.

Hence,

$$1.7 \times 10^{-5} = \frac{(3.4\times10^{-4})(3.4\times10^{-4})}{[CH_4COOH]}$$

$$[CH_3COOH] = \frac{3.4\times10^{-4} \times 3.4\times10^{-4}}{1.7\times10^{-5}}$$

$= 6.8 \times 10^{-3}$ M.

@apna_pdf

681. At 100ºC the K_w of water is 55 times its value at 25ºC. What will be the pH of neutral solution ? (log 55 = 1.74)

(a) 7.00 (b) 7.87
(c) 5.13 (d) 6.13

Karnataka NEET-2013

Ans. (d) : We know that , Ionisation constant of water at 25°C

$$K_w = 1 \times 10^{-14}$$

And At 100°C $K_w = 55 \times 10^{-14}$

At 100°C $K_w = [H^+]\,[OH^-] = 55 \times 10^{-14}$

$[H^+] = \sqrt{55\times10^{-14}}$

pH = – log $[H^+]$

pH = – log $\left[\sqrt{\left(55\times10^{-14}\right)}\right]$

$= \frac{1}{2}\,[-\log(55 \times 10^{-14})] = \frac{1}{2}(-\log 55 + 14 \log 10)$

$= \frac{1}{2}\,[-1.74 + 14] = \frac{1}{2}[12.26] = 6.13$

682. Equimolar solutions of the following substances were prepared separately. Which one of these will record the highest pH value ?

(a) $BaCl_2$ (b) $AlCl_3$
(c) LiCl (d) $BeCl_2$

NEET-2012

Ans. (a) : Barium chloride ($BaCl_2$) is a salt of strong acid and strong base which is neutral in nature. Thus have pH value of 7.

Rest of all being salt of strong acid and weak base are hydrolysed to give pH less than 7.

683. What is $[H^+]$ in mol/L of a solution that is 0.20 M in CH_3COONa and 0.10 M in CH_3COOH? (K_a for $CH_3COOH = 1.8 \times 10^{-5}$)

(a) 3.5×10^{-4} (b) 1.1×10^{-5}
(c) 1.8×10^{-5} (d) 9.0×10^{-6}

NEET-2010

Ans. (d) : Given that,

Concentration of CH_3COONa = 0.20M
Concentration of CH_3COOH = 0.10M
K_a for $CH_3COOH = 1.8 \times 10^{-5}$

CH_3COOH (Weak acid), CH_3COONa (Conjugated Salt) form acidic buffer.

For acidic buffer–

According to the Henderson's equation–

$pH = pK_a + \log\left[\frac{\text{salt}}{\text{acid}}\right]$ and

$[H^+] = -$ antilog pH

$pH = -\log K_a + \log\left[\frac{\text{salt}}{\text{acid}}\right]$ $[pK_a = -\log K_a]$

$= -\log(1.8 \times 10^{-5}) + \log\frac{0.20}{0.10}$

= 4.74 + log2

= 4.74 + 0.3010 = 5.041

Now $[H^+]$ = Antilog (– 5.045)

$= 9 \times 10^{-6}$ mol/L

684. What is the pH of the resulting salution when equal volumes of 0.1 M NaOH and 0.01 M HCl are mixed ?

(a) 2.0 (b) 7.0
(c) 1.04 (d) 12.65

NEET-2015

Ans. (d) : Given that,

Concentration of NaOH = 0.1M
Concentration of HCl = 0.01M

According to law of equivalent: To neutralize the whole solution there should be equal the normality (N_1) of acid and its volume (V_1) to normality (N_2) of base and its volume (V_2)

So, we can consider that–

$N_1V_1 - N_2V_2$ = equivalents of unreacted hydroxyl ions

$0.1 \times 1 - 0.01 = [OH^-]$

$[OH^-] = N_R = \frac{0.09}{2} = 0.045N$

pOH = – log (0.045) = 1.35

But we know, pH + POH = 14

⇒ pH = 14 – pOH = 14 – 1.35 = 12.65

685. Which of the following salts will give highest pH in water ?

(a) KCl (b) NaCl
(c) Na_2CO_3 (d) $CuSO_4$

NEET-2014

Ans. (c) : Na_2CO_3 which is a salt of NaOH (strong Base) and H_2CO_3 (weak acid) will produce a basic solution with pH greater than 7. NaCl and KCl are the salts of a strong acid and strong base. Their aqueous solutions are neutral.

686. Following solutions were prepared by mixing different volumes of NaOH and HCl of different concentration :

(a) 60 mL $\frac{M}{10}$ HCl + 40 mL $\frac{M}{10}$ NaOH

(b) 55 mL $\frac{M}{10}$ HCl + 45 mL $\frac{M}{10}$ NaOH

(c) 75 mL $\frac{M}{5}$ HCl + 25 mL $\frac{M}{5}$ NaOH

(d) 100 mL $\frac{M}{10}$ HCl + 100 mL $\frac{M}{10}$ NaOH

pH of which one of them will be equal to 1 ?

NEET-2018

Ans. (c) : pH = 1 , So $[H^+] = 10^{-1}$

for acid base mixture: $N_1V_1 - N_2V_2 = N_3V_3$

(For NaOH and HCl, normality = molarity)

(a) $M_1\,(H^+) = \frac{60\times\frac{1}{10}-40\times\frac{1}{10}}{100} = 20\times10^{-3}$M i.e. pH = 2.7

(b) $M_2\,(H^+) = 55 \times \frac{55\times\frac{1}{10}-45\times\frac{1}{10}}{100} = \frac{1}{100} = 10^{-2}$M i.e. pH = 2

(c) $M_3\,(H^+) = \frac{75\times\frac{1}{5}-25\times\frac{1}{5}}{100} = 10^{-1}$M i.e. pH = 1

(d) $M_4\,(H^+) = \frac{100\times\frac{1}{10}-100\times\frac{1}{10}}{200} = 0$ M i.e. pH = 7

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687. The pK_b of dimethylamine and pK_a of acetic acid are 3.27 and 4.77 respectively at T(K). The correct option for the pH of dimethylammonium acetate solution is

(a) 6.25 (b) 8.50
(c) 5.50 (d) 7.75

NEET-2021

Ans. (d) : Acetic acid is a weak acid & dimethylamine is a weak base and after neutralization they form dimethylammonium acetate salt.

For a salt of weak acid and weak base pH does not depend on concentration of salt.

$$pH = 7 + \frac{1}{2}[pK_a - pK_b]$$

$$= 7 + \frac{1}{2}[4.77 - 3.27]$$

$$= 7.75$$

688. How much NaOH is to be dissolved in 1 lit water to obtain the solution having pH=12?

(a) 0.4 gm (b) 40 gm
(c) 4 gm (d) 0.04 gm

Tripura JEE-2021

Ans. (a) : Given, pH = 12

but, $pH + pOH = 14$

$pOH = 14 - pH$

$= 14 - 12$

$= 2$

$\therefore [OH^-] = 10^{-2}$

Therefore, mass of NaOH required to prepare 1L NaOH Solution of strength, pH = 12, is $10^{-2} \times 40 = 0.40$ gm.

689. The dissociation constant of a substituted benzoic acid at 25°C is 1.0×10^{-4}. The pH of 0.01 M solution of its sodium salt is

(a) 7 (b) 8
(c) 9 (d) 10

UP CPMT-2012

Ans. (b) : Given that,

K_a for benzoic acid at 25°C = 1.0×10^{-4}

Concentration of sodium salt = 0.01M

The hydrolysis reaction of conjugate base of acid is

$$A^-(aq) + H_2O \rightarrow HO^- + HA$$

$$K_h = \frac{K_W}{K_a} = \frac{10^{-14}}{10^{-4}} = 10^{-10}$$

Since, degree of hydrolysis is negligible

$C = 0.01M$

$C = 10^{-2}M$

$$\therefore [OH^-] = \sqrt{K_h C}$$

$$OH^- = \sqrt{10^{-10} \times 10^{-2}}$$

$$OH^- = \sqrt{10^{-12}}$$

$$OH^- = 10^{-6}$$

$$\therefore pOH = -\log[OH^-]$$

$$pOH = -\log\left[10^{-6}\right]$$

$$\therefore pOH = 6$$

$pH + pOH = 14$

$pH = 14 - 6 = 8$

690. The pK_b value of ammonium hydroxide is 4.75. An aqueous solution of ammonium hydroxide is treated with HCl. The pH of the solution at the point where half of ammonium hydroxide has been neutralised will be

(a) 9.25 (b) 8.25
(c) 7.50 (d) 4.75

UP CPMT-2011

Ans. (a) : When half of NH_4OH is neturalised,

$[NH_4OH] = [NH_4Cl]$

$$pOH = pK_b + \log\frac{[salt]}{[base]}$$

$pOH = pK_b = 4.75$

$pH + pOH = 14$

$pH = 14 - pOH$

$= 14 - 4.75 = 9.25$

691. The pH value of 0.01 N NaOH solution is

(a) 2 (b) 6
(c) 12 (d) 11

Odisha NEET-2019
UP CPMT-2010

Ans. (c) : Given, Normality of NaOH = 0.01 N

Normality = Molarity × Acidity of NaOH

$0.01 = M \times 1$

$M = 0.01 = 10^{-2}M$

$[OH^-] = 0.01M$

$= 1 \times 10^{-2}$

$pOH = -\log[OH^-]$

$= -\log(1 \times 10^{-2})$

$= 2$

$pH + pOH = 14$

$pH + 2 = 14$

$\therefore pH = 12$

692. What will be the pH value of 0.05 M $Ba(OH)_2$ solution?

(a) 12 (b) 13
(c) 1 (d) 12.96

UP CPMT-2004

Ans. (b) : Normality = Molarity × Acidity of $Ba(OH)_2$

$N = 0.05 \times 2 = 0.1$

$[OH^-] = N = 2 \times 0.05 = 0.1$

$pOH = -\log[OH^-] = -\log(0.1) = 1$

$pH = 14 - pOH = 14 - 1 = 13$

693. 0.005 M acid solution has 5 pH. The percentage ionization of acid is

(a) 0.8% (b) 0.6 %
(c) 0.4 % (d) 0.2 %

UP CPMT-2003

Ans. (d) : Given, pH= 5

Concentration of acid= 0.005 M

$pH = -\log[H^+]$

or $[H^+] = 10^{-pH}$

$= 10^{-5}$

$$\alpha = \frac{\text{actual concentration}}{\text{molar concentration}} = \frac{10^{-5}}{0.005} = 0.2 \times 10^{-2}$$

$\therefore$ Percentage ionization $= (0.2 \times 10^{-2}) \times 100$

$= 0.2\%$

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694. The pH of a solution obtained by mixing 5 g of CH_3COOH and 7.5 g of CH_3COONa and making the volume equal to 500 mL is [K_a for $CH_3COOH = 1.80 \times 10^{-5}$]

(a) 2.8854 (b) 4.7882
(c) 6.1975 (d) 3.9494

UP CPMT-2001

Ans. (b) : pH of the solution is calculated by using following formula

$$pH = pK_a + \log\frac{[salt]}{[acid]}$$

Before using this formula, calculate pK_a, [salt] and [acid] from given data.

Given, $K_a = 1.80 \times 10^{-5}$
Mass of CH_3COOH = 5g
Mass of CH_3COONa = 7.5g
Volume of CH_3COOH = 500 mL
Volume of CH_3COONa = 500 mL

$pK_a = -\log [K_a] = -\log [1.8 \times 10^{-5}] = 4.7447$

$$[Acid] = \frac{mass}{volume} = \frac{5g}{500mL} = \frac{10g}{1000mL}$$

$$10g/L = \frac{10}{60} = 0.1666\ mol/L$$

($\because$ mol. wt. of CH_3COOH = 60)

$$[Salt] = \frac{mass}{volume} = \frac{7.5g}{500mL} = \frac{15g}{1000mL} = 15g/L$$

$$15\ g/L = \frac{15}{82} = 0.1829\ mol/L$$

($\because$ mol. wt. of CH_3COONa = 82)

$$\therefore \quad pH = pK_a + \log\frac{[salt]}{[acid]}$$

$$= 4.7447 + \log\frac{0.1829}{0.1666}$$

$= 4.7447 + 0.0435$
$= 4.7882$

695. A solution of pH 9.0 is 1000 times as basic as a solution. The pH of this solution is

(a) 9 (b) 8
(c) 7 (d) 6

UP CPMT-2001

Ans. (d) : $pH = -\log [H^+]$

$\because$ pH of solution = 9

$\therefore$ $[H^+] = 10^{-9}$

This solution is 1000 (or 10^3) times more basic than solution whose, $[H^+] = 10^{-9} \times 10^3 = 10^{-6}$

$pH = -\log [H^+]$
$= -\log [10^{-6}] = 6$

696. The pH value of 1/1000 N-KOH solution is:

(a) 3 (b) 10^{-11} (c) 2 (d) 11

UPTU/UPSEE-2006

Ans. (d) : In $\frac{1}{1000}$ N KOH solution, concentration of $[OH^-]$ is 10^{-3}. Hence, as we know that-

$pH + pOH = 14$ …..(i)

and $pOH = -\log [10^{-3}]$

$pOH = 3$ ….. (ii)

Put the value of pOH in equation (i) so we get

$pH + 3 = 14$
$pH = 14 - 3$
$pH = 11$

697. 100 mL of 0.04 N HCl aqueous solution is mixed with 100 mL of 0.02 N NaOH solution. The pH of the resulting solution is:

(a) 1.0 (b) 1.7 (c) 2.0 (d) 2.3

UPTU/UPSEE-2004

Ans. (c) : $N_1V_1 = 0.04 \times 100 = 4$
$N_2V_2 = 0.02 \times 100 = 2$
$N_1V_1 - N_2V_2 = N_3V_3$
$4 - 2 = N_3 \times 200$
$N_3 = 10^{-2}M$
$pH = -\log_{10} 10^{-2} = 2$

698. pH scale was introduced by:

(a) Arrhenius (b) Sorensen
(c) Lewis (d) Lowery

UPTU/UPSEE-2004

Ans. (b) : In 1909 Sorensen, a Danish chemist, introduced the concept of pH as a convenient way of expressing acidity. pH stands for potential of hydrogen, which refers to the concentration of hydrogen ion in a solution.

699. pH of 0.1 M NH_3 aqueous solution is : ($K_b = 1.8 \times 10^{-5}$)

(a) 11.13 (b) 12.5
(c) 13.42 (d) 11.55

UPTU/UPSEE-2004

Ans. (a) : $NH_3 + H_2O \rightleftharpoons NH_4 + OH^-$

$$K_b = \frac{[NH_4^+][OH^-]}{[NH_3]}$$

$$1.8 \times 10^{-5} = \frac{x^2}{0.1} \Rightarrow x = \sqrt{1.8\times10^{-6}} = 1.34 \times 10^{-3}$$

$pOH = -\log [OH^-] = -\log [1.33\times10^{-3}]$
$= 2.87$

$\therefore$ $pH = 14 - pOH = 14 - 2.87 = 11.13$

700. If the pK_a of acetic acid and pK_b of NH_4OH are 4.76 and 4.75 respectively, what will be the pH of ammonium acetate solution?

(a) 9.51 (b) 7.005
(c) 7.00 (d) 6.9

UPTU/UPSEE-2018

Ans. (b) : When a weak acid (acetic acid) and weak base (NH_4OH) are mixed to form a solution, pH of the solution is then determined by following formula:

$$pH = 7 + \frac{1}{2}[pK_a - pK_b]$$

But given that,

$pK_a = 4.76$, $pK_b = 4.75$

Then, $pH = 7 + \frac{1}{2}[pK_a - pK_b]$

$$pH = 7 + \frac{1}{2}[4.76 - 4.75]$$

$$= 7 + \frac{1}{2}[.01]$$

$pH = 7 + 0.005$
$pH = 7.005$

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701. What is pH of 2 × 10^{-4} molar HCl solution? Here, log 2=0.301 and log 3 = 0.477

(a) 6.92 (b) 9.5
(c) 5.4 (d) 7.7

UPTU/UPSEE-2016

Ans. (a) As solution is very dilute

$\therefore [H^+] = [H^+]_{water} + [H^+]_{HCl}$

$= 10^{-7} + 2 \times 10^{-8} = 12 \times 10^{-8}$

$\therefore pH = -\log [12 \times 10^{-8}]$

$= -\log [2^2 \times 3 \times 10^{-8}]$

$= -[2\log(2) + \log(3) + \log(10^{-8})] = 6.92$

702. NaOH is a strong base. What will the be pH of 5.0 × 10^{-2} M NaOH solution? (log 2 = 0.3)

(a) 14.00 (b) 13.70
(c) 13.00 (d) 12.70

UPTU/UPSEE-2015

Ans. (d) : Given $[OH^-] = 5 \times 10^{-2}$, log2 = 0.3

$\therefore pOH = -\log [OH^-] = -\log [5 \times 10^{-2}]$

$= -\log 5 + 2\log 10 = 1.30$

But, pH + pOH = 14

pH = 14 – pOH

pH = 14 – 1.30 = 12. 70

703. Hydrogen ion concentration in mol/L in a solution of pH 5.4 will be

(a) 3.98×10^{8} (b) 3.88×10^{6}
(c) 3.68×10^{-6} (d) 3.98×10^{-6}

UPTU/UPSEE-2014

Ans. (d) : $pH = -\log [H^+]$

$5.4 = -\log [H^+]$

$\Rightarrow -5.4 = \log [H^+]$

$[H^+]$= Antilog (–5.4)

$[H^+] = 3.98 \times 10^{-6}$

704. 1 mL of 0.01 N HCl is added to 999 mL solution of 0.1 N Na_2SO_4. The pH of the resulting solution will.

(a) 2 (b) 7
(c) 5 (d) 1

UPTU/UPSEE-2013

Ans. (c) : As Na_2SO_4 solution is neutral, it simply dilutes the HCl solution from 1 ml to 1000 ml

$$\text{Now } [H^+] = \frac{0.01}{1000} = 10^{-5}$$

$pH = -\log [H^+]$

$pH = -\log [10^{-5}]$

pH = [5 log 10]

pH = 5

705. A chemist wishes to prepare a buffer solution of pH = 2.90 that efficiently resists a change in pH yet contains only small concentration of buffering agents. Which one of the following weak acid along with its salt would be best to use

(a) m-chlorobenzoic acid (pK_a = 3.98)
(b) Acetoacetic acid (pK_a = 3.58)
(c) 2.5-dihydrobengoic acid (pK_a = 2.97)
(d) p-chlorocimanic acid (pK_a = 4.41)

UPTU/UPSEE-2013

Ans. (c) : Buffer solution to be made should effectively resist a change in pH, i.e should have high buffer capacity.

$$\text{Buffer capacity}(\phi) = \frac{\text{no. of moles of acid or base added to } 1l}{\text{Change in pH}}$$

by one of any two way's , we can obtain it

(i) The higher the concentration of the components of a buffer mixture , the greater will be buffer capacity. But the condition is to maintain a small concentration of buffering components.

(ii) Buffer capacity of a buffer is maximum when the concentration of weak acid and its salt are equal i.e [salt] = [acid]

$$pH = pK_a + \log \frac{[salt]}{[acid]}$$

$= pK_a + \log 1$ (as [salt] = [acid])

$pH = pK_a = 2.9$

As 2.5 Dihydrobenzoic acid has pK_a value = 2.97

Hence it is the best choice for chemist to prepare buffer solution.

706. Which of the following represents the correct pH of 10^{-7} M HCl in doubly distilled air-free water?

(a) 6.6990 (b) 7.0000
(c) 7.3010 (d) 6.3980

UPTU/UPSEE-2011

Ans. (a) : pH of 10^{-7} M HCl–

Here, $[H^+]$ ions from $H_2O = 10^{-7}$M cannot be neglected in comparison to 10^{-7}M

$\therefore$ Total $[H^+] = 10^{-7} + 10^{-7} = 2 \times 10^{-7}$M

$\therefore pH = -\log [H^+]$

$= -\log (2 \times 10^{-7}) = [-\log 2 + \log 10^{-7}]$

$= -[0.3010 - 7] = 6.6990$

707. pH of a 0.000 1M HCl solution is

(a) 4.0 (b) 2.0
(c) 6.0 (d) 7.0

UPTU/UPSEE-2008

Ans. (a) : pH of a 0.0001 M HCl –

$pH = -\log [H^+]$

$pH = -\log(0.0001)$

$pH = -\log [1 \times 10^{-4}]$

pH = 4

708. Addition of sodium acetate to 0.1M acetic acid will cause

(a) Increase of pH
(b) Decrease in pH
(c) No change in pH
(d) Change in pH that cannot be predicted

WB-JEE-2008

Ans. (a) : Addition of sodium acetate in acetic acid solution, due to common ion NH_4^+ , the suppressed, ionization of acetic acid so concentration of $[H^+]$ decreases.

Hence pH of solution Increases.

709. Which of the following will decrease the pH of a 50 mL solution of 0.01 M HCl?

(a) Addition of 5 mL of 1 M HCl
(b) Addition of 50 mL of 0.01 M HCl
(c) Addition of 50 mL of 0.002 M HCl
(d) Addition of Mg

WB-JEE-2009

Ans. (a) : Addition of 5mlof 1 M HCL will decrease the pH, because only this will increase the H^+ ion concentration in the solution.

@apna_pdf

710. A weak acid of dissociation constant 10^{-5} is being litrated with aqueous NaOH solution. The pH at the point of one-third neutralisation of the acid will be.

(a) 5+log2-log3 (b) 5-log2

(c) 5-log3 (d) 5-log6

WB-JEE-2010

Ans. (b) : $K_a = 10^{-5} \Rightarrow pK_a = -\log K_a$

$-\log 10^{-5} = 5$

	Initial HA	+ NaOH →	NaA	+ H_2O
	1 mol	0	0	0
Final	$\left(1-\frac{1}{3}\right)$ mol		$\frac{1}{3}$ mol	$\frac{1}{3}$ mol
=	$\frac{2}{3}$ mol		$\frac{1}{3}$ mol	

Assumed weak acid to be monoprotic, since only dissociation constant value is provided final solution acts as an acidic buffer.

$$pH = pK_a + \log\left[\frac{\text{salt}}{\text{acid}}\right] \text{ or } pH = 5 + \log\frac{\frac{1}{3}}{\frac{2}{3}} = 5 + \log\frac{1}{2}$$

$\therefore$ pH = 5 – log 2

711. 0.1M HCL and 0.1M H_2SO_4 each of volume 2mL are mixed and the volume is made up to 6 mL by adding 2 mL of 0.1 N NaCl solution. The pH of the resulting mixture is

(a) 1.17 (b) 1.0

(c) 0.3 (d) log 2-log3

WB-JEE-2010

Ans. (b) : Given,

HCl = 0.1 M, H_2SO_4 = 0.1 M

V = 2 mL, V = 2 mL, V_T = 6 mL

NaCl = 0.01 N, V = 2 mL

$$[H^+]_{total} = \frac{\text{Total moles of } H^+}{V_T}$$

$$= \frac{0.1\times2 + 0.1\times2\times2}{6}$$

$[H^+]_T = 0.1$

pH = –log(0.1)

pH = 1

712. The pH of an aqueous solution of CH_3COONa of concentrated C(M) is given by

(a) $7 - \frac{1}{2}pK_a + \frac{1}{2}\log C$

(b) $\frac{1}{2}pK_w + \frac{1}{2}pk_b + \frac{1}{2}\log C$

(c) $\frac{1}{2}pK_w - \frac{1}{2}pK_b - \frac{1}{2}\log C$

(d) $\frac{1}{2}pK_w + \frac{1}{2}pK_a + \frac{1}{2}\log C$

WB-JEE-2011

Ans. (d) :

$$CH_3COONa + H_2O \rightleftharpoons \underset{\text{(Weak acid)}}{CH_3COOH} + \underset{\text{(Strong base)}}{NaOH}$$

As sodium acetate is a salt of weak acid and strong base, in Hydrolysis of sodium acetate the pH is given by

$$pH = \frac{1}{2}pK_w + \frac{1}{2}pKa + \frac{1}{2}\log c$$

713. 20 mL 0.1 (N) acetic acid is mixed with 10 mL 0.1(N) solution of NaOH. The pH of the resulting solution is [pKa of acetic acid is 4.74]

(a) 3.74 (b) 4.74

(c) 5.74 (d) 6.74

WB-JEE-2012

Ans. (b) : $CH_3COOH + NaOH \rightarrow CH_3COONa + H_2O$

Initial moles of acetic acid = 0.02 × 0.1 = 0.002 moles

Initial moles of NaOH = 0.01 × 0.1 = 0.001 moles

Moles after reaction–

Moles of acetic acid = 0.002 – 0.001 = 0.001 moles

Moles of CH_3COONa = 0.001 moles

From Henderson's equation,

$$pH = pKa + \log\frac{[CH_3COONa]}{[CH_3COOH]}$$

$$= 4.74 + \log\frac{1}{1} = 4.74$$

714. A 100 mL 0.1 = (M) solution of ammonium acetate to diluted by adding 100 mL of water the pH of the resulting solution will be (pk_a of aceticac acid is nearly equal to pk_b of NH_4OH)

(a) 4.9 (b) 5.0

(c) 7.0 (d) 10.0

WB-JEE-2012

Ans. (c): Ammonium acetate is a salt of weak acid and weak base. When solutions of such salts diluted resulting pH solution is calculated from following relationship

$$pH = 7 + \frac{1}{2}pK_a - \frac{1}{2}pK_b$$

$\because$ $pK_a = pK_b$ (given)

$\therefore$ pH of diluted solution = 7.0

715. 1×10^{-3} mole of HCl is added to a buffer solution made up of 0.01 M acetic acid and 0.01 M sodium acetate. The final pH of the buffer will be (given, pK_a of acetic acid is 4.75 at 25°C)

(a) 4.60 (b) 4.66

(c) 4.75 (d) 4.8

WB-JEE-2013

Ans. (b) : $CH_3COO^- + H^+ \longrightarrow CH_3COOH$

	CH_3COO^-	H^+	CH_3COOH
Initially	0.01	0.001	0.01
at equation	0.01 – 0.001		0.01 + 0.001
	= 0.009		= 0.011

$$pH = pKa + \log\left[\frac{\text{salt}}{\text{acid}}\right] = 4.75 + \log\left[\frac{0.009}{0.011}\right] = 4.66$$

716. At 25°C, pH of a 10^{-8} M aqueous KOH solution will be

(a) 6.0 (b) 7.02

(c) 8.02 (d) 9.02

WB-JEE-2013

@apna_pdf

Ans. (b) : KOH $\rightleftharpoons$ $K^+ + OH^-$, $[OH^-] = 10^{-8}M$

$H_2O \rightleftharpoons H^+ + OH^-$, $[OH^-] = 10^{-7}M$

$\therefore [OH^-]$ total $= (10^{-8} + 10^{-7})$ M

$= 10^{-7} (1.1) = 1.1 \times 10^{-7}$

$\therefore$ pOH = log $(1.1 \times 10^{-7}) \simeq 6.98$

$\therefore$ pH = 14 – 6.98 = 7.02

717. The pH of 10^{-4} M KOH solution will be

(a) 4 (b) 11

(c) 10.5 (d) 10

WB-JEE-2014

Ans. (d) : Given,

10^{-4} M KOH = 10^{-4}M $[OH^-]$

We know that,

$[H^+] [OH^-] = 1 \times 10^{-14}$

$[H^+] \times 10^{-4} = 1 \times 10^{-14}$

$$[H^+] = \frac{1\times10^{-14}}{10^{-4}} = 1 \times 10^{-10} \text{ M}$$

$\therefore$ pH = – log (H^+) = – log (1×10^{-10})

= 10

718. In which of the following mixed aqueous solutions, pH=pK$_a$ at equilibrium?

(a) 100 mL fo 0.1 M CH_3COOH+100 mL of 0.1 M CH_3 COONa

(b) 100 mL fo 0.1 M CH_3COOH+50 mL of 0.1 M NaOH

(c) 100 mL fo 0.1 M CH_3COOH+100 mL of 0.1 M NaOH

(d) 100 mL fo 0.1 M CH_3COOH+100 mL of 0.1 M NH_3

WB-JEE-2016

Ans. (a, b) : pH of buffer solution is given by

$$pH = pK_a + \log\left[\frac{\text{salt}}{\text{acid}}\right]$$

(a) CH_3COOH and CH_3CONa

100 × ·1 100 × ·1

no. of milimoles = 10 10

$[salt] = [acid] = 10, pH = pK_a + \log\frac{10}{10}$

pH = Pk$_a$

(b) $CH_3COOH + NaOH \rightarrow CH_3COOHNa + H_2O$

100×.1 50×.1

Initial 10 5 0 0

Final 0 0 5 5

$[Salt] = [acid] = 5, pH = pK_a + \log\frac{5}{5}$

pH = pK$_a$

(c) $CH_3COOH + NaOH \rightarrow CH_3COONa + H_2O$

100× 0.1 100×0.1

Initial 10 10 0 0

Final 0 0 10 10

Salt = 10 and acid = 0

$pH = pK_a + \log\frac{10}{0}$

pH ≠ pK$_a$

(d) $CH_3COOH + NH_3 \rightarrow CH_3COONH_4$

Initial 10 10 → No bufter action

Final due to work CH_3COONH_4 salt

pH ≠ pK$_a$

719. Dissolving NaCN in de-ionised water will result in a solution having

(a) pH < 7 (b) pH = 7

(c) pOH = 7 (d) pH > 7

WB-JEE-2017

Ans. (d) :

∵ On dissolving NaCN in de-ionized water following reaction takes place

$CN^- + H_2O \rightleftharpoons HCN + OH^-$

∵ CN^- ions come from the salt of strong base and weak acid

∴ The solution becomes basic and pH >7

720. The desirable range of pH for drinking water is

(a) 6.5 to 8.5 (b) 5.0 to 6.5

(c) 6.5 to 7.0 (d) 7.0 to 8.5

NDA (II)-2017

Ans. (a) : In general, a water with a pH<7 is considered acidic and with a pH>7 is considered basic. The normal range for pH for drinking water from 6.5 to 8.5

721. The solution of which of the following will have pH less than 7?

(a) NaOH (b) KCl

(c) $FeCl_3$ (d) NaCl

NDA (II)-2018

Ans. (c) : The constituent of $FeCl_3$ is a strong acid (HCl) salt and weak base Fe(OH). So, Ferric chloride is an acidic salt whose pH less than 7.

722. Which of the following mixtures will have the lowest pH at 298 K?

(a) 10 mL 0.05 N CH_3COOH + 5 mL 0.1 N NH_4OH

(b) 5 mL 0.2 N NH_4Cl + 5 mL 0.2 N NH_4OH

(c) 5 mL 0.1N CH_3COOH + 10 mL 0.05 N CH_3COONa

(d) 5 mL 0.1 N CH_3COOH + 5 mL 0.1 N NaOH

WB-JEE-2019

Ans. (c) : Option(a) Produces CH_3COONH_4 considering pK$_a$ of CH_3COOH and pK$_b$ of NH_4OH same, pH of solution the solution is 7 since it will completely neutralize.

Option(b) is an example of a basic buffer so pH is more than 7

Option(c) is an example of an acidic buffer so pH is less than 7

Option(d) an aqueous solution of CH_3COONa that Hydrolysis to form a basic solution.

So, pH is more than 7

6. Common Ion Effect

723. Which pair of the following will not show common ion effect?

(a) $H_2S + HNO_3$ (b) $H_2S + HCl$

(c) $NH_4Cl + NH_4OH$ (d) KCN + HCN

CG PET-22.05.2022

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Ans. (a) : Common ion effect is shown when weak electrolyte and strong electrolyte is mixed.

H_2S + HNO_3 not shown common ion effect because these are not weak and strong electrolyte.

Rest of all are weak and strong electrolyte hence they shows common ion effect.

724. When common salt is added to a saturated solution of soap, soap is precipitated. This is based on the principle of

(a) common ion effect
(b) solubility product
(c) adsorption form solution
(d) peptisation.

COMEDK-2018

Ans. (a) : The saturated solution of soap (RCOONa), show precipitation addition of NaCl, because an increase in Na^+ concentration helps in crossing over ionic product to their K_{sp} values.

$$C_{17}H_{35}COONa(s) \rightleftharpoons C_{17}H_{35}COO^-(aq) + Na^+(aq)$$

When NaCl is added, $[Na^+]$ increases due to which ionic product, $[RCOO^-]$ $[Na^+]$ also increases which results in precipitation of soap. It can also be explained on the basis of common ion effect.

Among the given compound the NH_3 is the most basic. Hence has highest proton affinity.

725. Assertion (A) : Sb_2S_3 is not soluble in yellow ammonium sulphide.

Reason (R) : The common ion effect due to S^{2-} ions reduces the stability of Sb_2S_3.

(a) Both A and R are true and R is the correct explanation of the A.
(b) Both A and R are true but R is not the correct explanation of the A.
(c) A is true, but R is false.
(d) Both A and R are false statements.

SRMJEEE – 2014

Ans. (d) :

(A) Sb_2S_3 is soluble in yellow ammonium sulphide.

$$Sb_2S_3 + 3(NH_4)_2S \longrightarrow 2(NH_4)_3 SbS_3$$

Hence, the statement is false.

(R) This is due to the fact that when the colour changes from white to yellow the number of sulphur increases. therefore the ions of the sulphur atoms increases i.e. S^{2-} ions. So, as the amount of the sulphur ions increases the common ion effect also increases. Therefore, we can say that as the common ion effect increases the solubility will also increases. Hence, the reason is also false.

Hence, both A and R are false statement.

726. The common ion effect is shown by which one of the following set solution

(a) $NH_4OH + NH_4Cl$ (b) $AgCN + KCN$
(c) $BaCl_2 + BaNO_3$ (d) $NaCl + HCl$

AMU–2001

Ans. (a) : $NH_4OH + NH_4Cl$ shows common ion effect NH_4OH is a weak base and undergoes ionisation to a limited extent as follows:

$$NH_4OH \rightleftharpoons NH_4^+ + OH^-$$

NH_4Cl is strong electrolyte

$$NH_4Cl \longrightarrow NH_4^+ + Cl^-$$

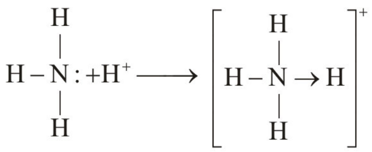
Due to the addition of NH_4Cl, the conc. of NH_4^+ ion in NH_4OH solution increases and equilibrium shift towords left. So, due to NH_4^+(common ion) dissociation of NH_4OH is suppressed.

727. Which one of the following substances has the highest proton affinity?

(a) H_2O (b) H_2S
(c) NH_3 (d) PH_3

[AIEEE-2003]

Ans. (c) : NH_3 is a Lewis base, accepting proton to form ammonium ion as it has tendency to donate an electron pair.



728. Assuming that $Ba(OH)_2$ is completely ionised in aqueous solution under the given conditions the concentration of H_3O^+ ions in 0.005 M aqueous solution of $Ba(OH)_2$ at 298 K is........ $\times 10^{-12}$ mol L^{-1}. (Nearest integer)

[JEE Main 2021, 25 July Shift-II]

Ans. (10^{-12}) : $Ba(OH)_2 \rightarrow Ba^+ + 2OH^-$

$$2 \times 0.005 = 0.01 = 10^{-2}$$

At 298K in aq. solution $[H_3O^+]$ $[OH^-] = 10^{-14}$

$$[H_3O^+] = \frac{10^{-14}}{10^{-2}} = 10^{-12}$$

729. The pH of the resultant solution obtained by mixing 20 mL of 0.01M HCl and 20mL of 0.005M $Ca(OH)_2$ is

(a) 2 (b) 0
(c) 1 (d) 7
(e) 5

Kerala-CEE-2020

Ans. (d) : Total no. of moles present in 20 ml of 0.01 M HCl.

$= 20 \times 0.01$
$= 20 \times 1 \times 10^{-2}$
$= 2 \times 10^{-1}$
$= 0.2$ moles

Similarly, Total no. of moles present in 20 ml of 0.005 M

$Ca(OH)_2 = 20 \times 0.005 \times 2$
$= 40 \times 0.005$
$= 4 \times 5 \times 10^{-2}$
$= 20 \times 10^{-2}$
$= 0.2$ moles.

So, pH of the resultant solution will be 7.

730. Which is not an example of common ion effect?

(a) $NaCl + AgCl$ (b) $H_2S + HCl$
(c) $CH_3COOH + NaOH$ (d) $NH_4OH + NH_4Cl$

MHT CET-2010

Ans. (c) : Among the given, $CH_3COOH + NaOH$ has no common ion, thus does not exhibit common ion effect.

Common ion effect is the suppression of degree of dissociation of weak electrolyte in the presence of a strong electrolyte having common ion.

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731. **Correct relation between dissociation constant of a dibasic acid is**

(a) $K_{a_1} = K_{a_2}$ (b) $K_{a_1} > K_{a_2}$

(c) $K_{a_1} < K_{a_2}$ (d) $K_{a_1} = \frac{1}{K_{a_2}}$

NEET-2000

Ans. (b) :

(i) $H_2A \underset{}{\overset{Ka_1}{\rightleftharpoons}} HA^- + H^+$

(ii) $HA^- \underset{}{\overset{Ka_2}{\rightleftharpoons}} A^{2-} + H^+$

In the 1st step H^+ ion comes from neutral molecule, while in the 2nd step the H^+ ion comes from negatively charged ions.

The presence of –ve charge makes the removal of H^+ ion difficult

Thus $K_{a_1} > K_{a_2}$

732. **The ionization constant of ammonia hydroxide is 1.77×10^{-5} at 298 K. Hydrolysis constant of ammonium chloride is**

(a) 6.50×10^{-12} (b) 5.65×10^{-13}

(c) 5.65×10^{-12} (d) 5.65×10^{-10}

NEET-2009

Ans. (d) : NH_4Cl is a salt of strong acid and weak Base, so hydrolysis constant is

$$K_h = \frac{K_w}{K_b}$$

Given - K_b (NH_4OH) = 1.77×10^{-5}

$K_w = 10^{-14}$

$$\therefore \quad K_h = \frac{10^{-14}}{1.77 \times 10^{-5}} = 0.565 \times 10^{-9}$$

or $K_h = 5.65 \times 10^{-10}$

733. **What is the $[OH^-]$ in the final solution prepared by mixing 20.0 mL of 0.050 M HCl with 30.0 of 0.10 M $Ba(OH)_2$?**

(a) 0.40 M (b) 0.0050 M

(c) 0.12 M (d) 0.10 M

NEET-2009

Ans. (d) : Milimoles of H^+ produced

= 20 × 0.05 = 1

milimoles of OH^- produced = 30 × 0.1 × 2 = 6

$\because Ba(OH)_2 \rightleftharpoons Ba^{2+} + 2OH^-$

$\therefore$ Milimoles of OH^- remaining in solution

6 – 1 = 5

Total volume of solution = 20 + 30 = 50 mL

$$\therefore \quad [OH^-] = \frac{5}{50} = 0.1 \text{ M}$$

734. **Equal volumes of three acid solutions of pH 3, 4 and 5 are mixed in a vessel. What will be H^+ ion concentration in the mixture ?**

(a) 3.7×10^{-3} M (b) 1.11×10^{-3} M

(c) 1.11×10^{-4} M (d) 3.7×10^{-4} M

NEET-2008

Ans. (d) : We know that, pH=– log $[H^+]$ $[H^+] = 10^{-pH}$

Given,

$[H^+]$ of soln. $1 = 10^{-3}$

$[H^+]$ of soln. $2 = 10^{-4}$, $[H^+]$ of soln. $3 = 10^{-5}$

Total concentration of

$[H^+] = 10^{-3}(1 + 1 \times 10^{-1} + 1 \times 10^{-2})$

$$10^{-3}\left(\frac{1}{1} + \frac{1}{10} + \frac{1}{100}\right) \Rightarrow 10^{-3}\left(\frac{10+10+1}{100}\right)$$

$= 1.11 \times 10^{-3}$

So, H^+ ion concentration in mixture of equal volume of these acid solution.

$$= \frac{1.11 \times 10^{-3}}{3} = 3.7 \times 10^{-4} \text{M}$$

735. **A weak acid, H*A* has a K_a of 1.00×10^{-5}. If 0.100 mol of this acid is dissolved in one litre of water, the percentage of acid dissociated at equilibrium is closest to**

(a) 1.00% (b) 99.9%

(c) 0.100% (d) 99.0%

NEET-2007

Ans. (a) : For a weak acid degree of dissociation -

$$\alpha = \sqrt{\frac{K_a}{C}} = \sqrt{\frac{1 \times 10^{-5}}{0.1}} = 10^{-2} = 0.01 = 1\%$$

736. **Which of the following pairs of ions cannot be separated by H_2S in dilute HCl?**

(a) Bi^{3+}, Sn^{4+} (b) Al^{3+}, Hg^{2+}

(c) Cu^{2+}, Zn^{2} (d) Ni^{2+}, Cu^{2+}

UPTU/UPSEE-2013

Ans. (a) : Bi^{3+} (IIA), Sn^{4+} (IIB) can't be separated by H_2S in dilute hydrochloric acid. Both the radicals are precipitated as their sulphides Bi_2S_3 (Black) and SnS_2 (yellow)

737. **When common salt is dissolved in water,**

(a) the melting point of the solution increases

(b) the boiling point of the solution increases

(c) the boiling point of the solution decreases

(d) both the melting and boiling point of the solution decrease

UPTU/UPSEE-2010

Ans. (b) : Boiling point of solution increases common salt in a non vocative solute which lower the vapour pressure of the solution and eventually increases boiling points of solution.

738. **Which of the following pairs will show common ion effect?**

(a) barium chloride + barium sulphate

(b) silver cyanide + potassium nitrite

(c) ammonium hydroxide + ammonium chloride

(d) sodium chloride + hydrogen chloride

UPTU/UPSEE-2010

Ans. (c) : Common ion effect is show when weak electrolyte and strong electrolyte is mixed. NH_4OH is weak base to which NH_4Cl is added which provides common NH_4 ion dissociation of NH_4OH is suppressed. Since NH_4OH is a weak electrolyte whereas NH_4Cl is a strong electrolyte it shows the common ion effect.

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09.

Redox Reactions

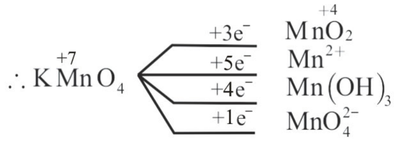
1. Oxidation Number and Oxidation State

1. Number of electrons transferred in each case when $KMnO_4$ acts as an oxidising agent to give MnO_2, Mn^{2+}, $Mn(OH)_3$, MnO_4^{2-} are respectively-

(a) 3, 5, 4, 1　　(b) 4, 3, 1, 5
(c) 1, 3, 4, 5　　(d) 5, 4, 3, 1

CG PET-22.05.2022

Ans. (a) : Oxidation state of Mn in $KMnO_4$ is +7



∴ Correct answer is 3, 5, 4, 1

2. Statement-I : Leaching of gold with cyanide ion in absence of air/O_2 leads to cyano complex of Au(III).
Statement-II : Zinc is oxidized during the displacement reaction carried out for gold extraction. In the light of the above statements, choose the correct answer from the options given below.
(a) Both statement-I and statement-II are correct
(b) Both statement-I and statement-II are incorrect
(c) Statement-I is correct but statement-II is incorrect
(d) Statement-I is incorrect but statement-II is correct

JEE Main-27.06.2022, Shift-II

Ans. (d) : Statement – I :–
Cyanide process/Mac Arthur Process:–

$$4M(s)+8CN^-(aq)+2H_2O(aq)+O_2(g)\rightarrow 4[M(CN)]^-(aq)+4OH^-(aq)$$

[M = Ag or Au]

∴ For $[M(CN)_2]^{-1}$, x – 2 = –1
x = –1 + 2 = 1

∴ Cyanide complex has oxidation no. +1.

Statement – II :–

$$2[M(CN)_2]^-(aq) + \overset{0}{Zn}(s)\rightarrow\left[\overset{+2}{Zn}(CN)_4\right]^{2-}(aq)+2M(s)$$

x – 4 = –2
x = +2
∴ Zn get oxide from 0 to +2

3. The number of terminal oxygen atoms present in the product B obtained from the following reactions is ———.
$FeCr_2O_4+Na_2CO_3+O_2\rightarrow A + Fe_2O_3 + CO_2$
$A +H^+\rightarrow B + H_2O +Na^+$

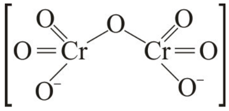
JEE Main-29.06.2022, Shift-I

Ans. (6) :

$$FeCr_2O_4+Na_2CO_3+O_2\rightarrow \underset{(A)}{Na_2CrO_4}+Fe_2O_3+CO_2$$

$$\therefore\ 2\underset{(A)}{Na_2CrO_4}+2H^+\rightarrow \underset{(B)}{Cr_2O_7^{2-}}+H_2O+4Na^+$$

$B = Cr_2O_7^{2-}\rightarrow$



So, number of terminal oxygen atom in B = 6.

4. The difference in oxidation state of chromium in chromate and dichromate salts is ______.

JEE Main-24.06.2022, Shift-I

Ans. (0) : Dichromate $\rightarrow \overset{x\ \ -2}{Cr_2O_7^{2-}}$
x × 2 + (–2) × 7= –2
x = +6

Chromate $\rightarrow \overset{y\ \ -2}{Cr_2O_4^{2-}}$
y + (–2) (4) = –2
y – 8 = –2
y = +6

∴ Difference in oxidation state (x – y) = 6 – 6 = 0.

5. The oxidation number of chromium in potassium dichromate is

(a) +2　　(b) +4
(c) +6　　(d) +8

MHT-CET-2012, BITSAT-2008
BCECE-2007, CG PET -2004

Ans. (c) : Chemical formula of potassium dichromate is $K_2Cr_2O_7$.
Consider, $K_2Cr_2O_7$
Let, x be the oxidation state of Cr.
⇒ 2(+1)+2x+7(–2)=0
2+2x–14=0
2x=12
x= +6

6. The oxidation state of sulphur in the anions SO_3^{2-}, $S_2O_4^{2-}$ and $S_2O_6^{2-}$ follow the order

(a) $S_2O_4^{2-} < SO_3^{2-} < S_2O_6^{2-}$
(b) $SO_3^{2-} < S_2O_4^{2-} < S_2O_6^{2-}$
(c) $S_2O_4^{2-} < S_2O_6^{2-} < SO_3^{2-}$
(d) $S_2O_6^{2-} < S_2O_4^{2-} < SO_3^{2-}$

BITSAT-2009, CG PET-2007, NEET-2003

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Ans. (a) : Sulphur in $SO_3^{2-}, S_2O_4^{2-}$, and $S_2O_6^{2-}$ has +4, +3 and +5 oxidation state respectively.
So, the order is–

$$S_2O_4^{-2} < SO_3^{2-} < S_2O_6^{-2}$$

7. Which of the following species do not show disproportionation reaction?

(a) $HClO$ (b) $HClO_2$
(c) $HClO_3$ (d) $HClO_4$

TS EAMCET 10.08.2021, Shift-I
AP-EAMCET (Engg.)-21.09.2020, Shift-I
COMEDK-2014

Ans. (d) :

$H\overset{+1}{Cl}O$, $H\overset{+3}{Cl}O_2$, $H\overset{+5}{Cl}O_3$, $H\overset{+7}{Cl}O_4$

In $HClO_4$, chlorine has +7 oxidation state which is its maximum oxidation state.
To reduce other compound it has to gain e^-.
But $HClO_4(ClO_4^-)$ cannot gain e^- in disportionation. It is necessary that ClO_4^- get oxidized as well as reduced which is not possible in $HClO_4$.

8. What are the oxidation numbers of nitrogen in NH_4NO_3?

(a) +3, -5 (b) -3, +5
(c) +3, -6 (d) +2, +2

SRMJEEE – 2013, AP EAMCET- 2001
AP EAMCET (Engg.), 2001

Ans. (b) : NH_4NO_3 exists as NH_4^+ and NO_3^-.
Let, the oxidation state of N is x in NH_4^+.

$$x + 4 \times (+1) = +1$$
$$x = -3$$

And, NO_3^-

$$x + 3(-2) = -1$$
$$x = +5$$

Hence, the correct option is (b).

9. When hydrogen peroxide is added to acidified solution of dichromate to $Cr_2O_7^{2-}$, a deep blue coloured complex of chormic peroxide CrO_5 is formed. Oxidation state of Cr in CrO_5 is

(a) +5 (b) +3
(c) +6 (d) –10

JIPMER-2018
Odisha NEET-2019-2014

Ans. (c) : When H_2O_2 is added to an acidified solution of a dichromate $Cr_2O_7^{-2}$ a deep blue coloured complex, of CrO_5 formed.

$$Cr_2O_7^{-2} + 2H^+ + 4H_2O \rightarrow 2CrO(O_2)_2 + 5H_2O$$

$\Rightarrow x+(-2)+(-1)\ 4=0$
$x-6=0$
$x = +6$

10. For the redox reaction

$$MnO_4^- + C_2O_4^{2-} + H^+ \rightarrow Mn^{2+} + CO_2 + H_2O.$$

The correct coefficients of the reactions for the balanced equation are

	MnO_4^-	$C_2O_4^{2-}$	H^+
(a)	16	5	2
(b)	2	5	16
(c)	2	16	5
(d)	5	16	2

NEET-2018
BITSAT-2006

Ans. (b) : Let the two half reactions oxidation half and reduction half are as follows,

Reduction: $MnO_4^- \rightarrow Mn^{2-}$

Oxidation: $C_2O_4^- \rightarrow CO_2$

Balance all atom other than O and H.

$MnO_4^- \rightarrow Mn^{2-}$

$C_2O_4^{2-} \rightarrow 2CO_2$

Now, balance the oxygen atom by adding H_2O molecule.

$MnO_4^- \rightarrow Mn^{2+} + 4H_2O$

$C_2O_4^{2-} \rightarrow 2CO_2$

Now, balance hydrogen atom by adding H^+ ion

$MnO_4^- + 8H^+ \rightarrow Mn^{2+} + 4H_2O$

$C_2O_4^{2-} \rightarrow 2CO_2$

Balance the charge

$MnO_4^- + 8H^+ + 5e^- \rightarrow Mn^{2+} + 4H_2O$

$C_2O_4^{2-} \rightarrow 2CO_2 + 2e^-$

Now, multiply oxidation half reaction by 2 & reduction half reaction by 5, and adding, we get

$$2MnO_4^- + 5C_2O_4^{2-} + 16H^+ \rightarrow 2Mn^{2+} + 10CO_2 + H_2O$$

11. $CH_4(g) + 4Cl_2(g) \rightarrow CCl_4(l) + 4\ HCl(g)$
In the above reaction, the change of oxidation state of carbon is

(a) from + 4 to –4 (b) from +1 to + 4
(c) from – 4 to + 4 (d) from –1 to + 1
(e) from – 4 to – 1

Kerala-CEE-2020
NEET-2020

Ans. (c) : $CH_4(g) + 4Cl_2(g) \rightarrow CCl_4\ (l) + 4HCl(g)$
Oxidation State of C in $CH_4(g) = x + 4 \times (+1) = 0$
$\Rightarrow x = -4$
Oxidation state of C in $CCl_4 = x + 4 \times (-1) = 0$
$\Rightarrow x - 4 = 0$
$\Rightarrow x = +4$
So, change in oxidation state = – 4 to + 4

12. The oxidation states of sulphur in S_8, S_2F_2, H_2S respectively, are

(a) 0,+1 and –2 (b) +2,+1 and –2
(c) 0,+1 and +2 (d) +7,+1 and –2

(AIIMS-2012, 2010)

Ans. (a): In $S_8 \Rightarrow$ Oxidation number of S is 0.
$S_2F_2 \Rightarrow$ F is in –1 oxidation state. Hence, S is in +1 oxidation state.
$H_2S \Rightarrow$ H is in +1 oxidation state.
Hence, S is in –2 oxidation state.
=0,+1,–2

@apna_pdf

13. What is the oxidation state of chlorine in hypochlorous acid?

(a) +1 (b) +3

(c) +5 (d) +7

AP EAMCET (Medical), 2001
AP EAMCET- 2000

Ans. (a) : The molecular formula of hypochlorous acid is HClO.

Let, the oxidation state of Cl is x.

∴ +1 + x – 2 = 0

x = +1

Hence, the correct option is (a).

4. Oxidation states of Cr in $K_2Cr_2O_7$ and CrO_5 are, respectively

(a) +6,+5 (b) +6,+10

(c) +6,+6 (d) None of these

WB-JEE-30.04.2022

Ans. (c) : Oxidation no. of Cr in $K_2Cr_2O_7$

$\Rightarrow 2(+1)+2(x)+7(-2)=0$

$2+2x+(-14)=0$

$x = +6$

And oxidation no. of Cr in CrO_5 or $CrO(O_2)_2$

$\Rightarrow x+4(-1)+1(-2)=0$

$x-4-2=0$

$x = +6$

So, option (c) is correct.

15. Dichromate ion is treated with base, the oxidation number of Cr in the product formed is............

JEE Main 26.02.2021, Shift-I

Answer - 6

$$Cr_2O_7^{2-} + 2OH^- \rightleftharpoons 2CrO_4^{2-} + H_2O$$

Let, oxidation state of Cr in chromate ion is x.

$CrO_4^{2-} \Rightarrow x + (-2)4 = -2$

$\Rightarrow x=6$

Hence, the oxidation state of Cr in CrO_4^{2-} is +6.

16. The sum of oxidation states of two silver ions in $[Ag(NH_3)_2]$ $[Ag(CN)_2]$ complex is............

JEE Main- 01.09.2021, Shift-II

Answer - 2

$[Ag(NH_3)_2]$ $[Ag(CN)_2]$ complex is dissociates into $[Ag(NH_3)_2]^+$ and $[Ag(CN)_2]^-$.

∵ $[Ag(NH_3)_2]^+$

Let, oxidation state of Ag is x_1.

∴ $x_1 + 2(0) = +1$

Or $x_1 = +1$

And $[Ag(CN)_2]^-$

Let, oxidation state of Ag is x_2.

∴ $x_2 + 2(-1) = -1$

Or $x_2 = +1$

∴ $x_1 + x_2 = 1 + 1 = 2$

17. In Pb_3O_4, the different oxidation states of Pb is/are

(a) 2.66 only (b) 2 only

(c) 2 and 4 only (d) 2, 4 and 1

TS-EAMCET (Engg.), 07.08.2021, Shift-II

Ans. (a) : Pb_3O_4 is considered to be mixture of 2PbO, PbO_2. Oxidation number of Pb in PbO is +2 while in PbO_2 is +4. So that the average oxidation state is 8/3 = 2.66.

18. Dichromate ion is treated with base, the oxidation number of Cr in the product formed is ______.

JEE Main 26.02.2021, Shift-I

Ans. (6) : $Cr_2O_7^{2-} + 2OH^- \rightleftharpoons 2CrO_4^{2-} + H_2O$

Let, oxidation state of Cr in CrO_4^{2-} is x

∴ $x + 4(-2) = -2$

$x - 8 = -2$

$x = +6$

19. The oxidation number of phosphorous in orthophosphorous acid is

(a) +1 (b) +2

(c) +5 (d) +3

Assam CEE-2021

Ans. (d) : The chemical formula of orthophosphorus acid is H_3PO_3.

H_3PO_3

Let, the oxidation state of P is x.

$+3 + x - 6 = 0$

$x = +3$

20. Which of the following is correct for all elements from Sc to Cu ?

(a) The lowest oxidation state shown by them is +2

(b) 4s orbital is completely filled in the ground state

(c) 3d orbital is not completely filled in the ground state

(d) The ions in +2 oxidation states are paramagnetic

Kerala-CEE-29.08.2021

Ans. (d) : (A) All elements from Sc to Cu shows the lowest oxidation state i.e. +2 except Sc. Hence the statement is false.

(B) In 3d-series of transition metal from Sc to Cu, 4s orbital is completely filled in ground state except Cr and Cu. Thus, statement is false.

(C) Cu has the completely filled 3d-orbital. Hence the statement is false.

(D) The given statement is true because all metal i.e. Sc to Cu have the unpaired electron with +2 oxidation state which shows the paramagnetic behaviour.

21. Which of the following reactions is the metal displacement reaction? Choose the right option.

(a) $2Pb(NO_3)_2 \rightarrow 2PbO + 4NO_2 + O_2\uparrow$

(b) $2KClO_3 \xrightarrow{\Delta} 2KCl + 3O_2$

(c) $Cr_2O_3 + 2Al \xrightarrow{\Delta} Al_2O_3 + 2Cr$

(d) $Fe + 2HCl \rightarrow FeCl_2 + H_2\uparrow$

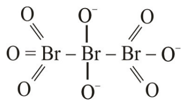
NEET-2021

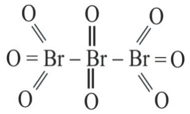
Ans. (c) : $Cr_2O_3 + 2Al \xrightarrow{\Delta} Al_2O_3 + 2Cr$.

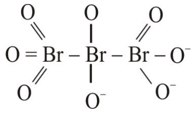
Reaction (1) & (2) are examples of decomposition reactions. Reaction (3) & (4) are the example of displacement reaction. While reaction (3) is metal displacement reaction.

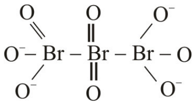
@apna_pdf

22. The correct structure of tribromooctaoxide is

(a)


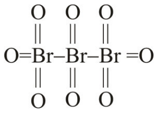
(b)


(c)


(d)


NEET-2020

Ans. (b) : The structure of tribromooctaoxide is-



It's the tribromooctaoxide.

23. The oxidation states of transition metal atoms in $K_2Cr_2O_7$, $KMnO_4$ and K_2FeO_4, respectively, are x, y and z. The sum of x, y and z is

[JEE Main 2020, 2 Sep Shift-II]

Answer - 19

$K_2Cr_2O_7 \Rightarrow 2(+1)+2x+7(-2)=0$

oxidation state $\Rightarrow x=6$

$KMnO_4 \Rightarrow 1+y+4(-2)=0$

$y=7$

$K_2FeO_4 \Rightarrow 2(1)+z+4(-2)=0$

$z=6$

So, $x+y+z=6+7+6=19$

24. On heating, lead (II) nitrate gives a brown gas (A). The gas (A) on cooling changes to a colourless solid/liquid (B). (B) on heating with No changes to a blue solid (C). The oxidation number of nitrogen in solid (C) is

(a) +5 (b) +4
(c) +2 (d) +3

[JEE Main 2020, 4 Sep Shift-I]

Ans. (d): Given that, according to question lead(II) nitrate on heating gives a brown gas 'A' therefore, gas 'A' must nitrogen dioxide (NO_2).

(i) $2Pb(NO_3) \rightarrow 2PbO + \underset{\text{(gas A)}}{4NO_2} + O_2$

(ii) B must be N_2O_4 (dinitrogen tetroxide)

$$2NO_2 \rightleftharpoons \underset{\text{(Colourless solid B)}}{N_2O_4}$$

(iii) Since colourless solid 'B' on heating with NO, gives a blue solid 'C' therefore 'C' must be dinitrogen trioxide

$$2NO + N_2O_4 \rightarrow \underset{\text{(Blue solid C)}}{2N_2O_3}$$

Here, $N_2O_3 \Rightarrow 2(x)+3(-2)=0$

$2x=6$

$x=+3$

25. The oxidation number of nitrogen atoms in NH_4NO_3 are

(a) +5, +5 (b) – 3, + 5
(c) +3, – 5 (d) –3, –3

Karnataka-CET-2020

Ans. (b) : The oxidation state of nitrogen atom in NH_4NO_3.

First, we get–

NH_4^+

$x+1\times4=1$

$\boxed{x=-3}$

Similarly, NO_3^-

$x+3(-2)=-1$

$x=+5$

26. Oxidation number of potassium in K_2O, K_2O_2 and KO_2, respectively, is

(a) +1, +4 and +2 (b) +1, +2 and +4
(c) +1, +1 and +1 (d) +2, +1 and $+\frac{1}{2}$

[JEE Main 2020, & Jan Shift-I]

Ans. (c) : The given species are K_2O, K_2O_2 and KO_2. Let oxidation state of potassium (K) in all species is x.

$\therefore \quad \underset{\substack{2x-2=0\\x=+1}}{K_2O} \quad \underset{\substack{2x+2(-1)=0\\x=+1}}{K_2O_2} \quad \underset{\substack{x+2(-0.5)=0\\x=+1}}{KO_2}$

27. The number of elements among O, Cl, F, N, P, Sn, Ti, K, Sc, which show more than one non-zero oxidation state is

(a) 2 (b) 3
(c) 6 (d) 8

AP EAMCET (Engg.) 21.09.2020, Shift-I

Ans. (c) : Sodium (+1), scandium (+3) and fluorine (–1) show only one non-zero oxidation state. The oxidation states of oxygen are –1, –2 and +2. The oxidation states of chlorine range from –1 to +7. The oxidation states of nitrogen and phosphorus range from –3 to +5.

The oxidation states of tin range from +2 to +4. The oxidation states of scandium is +3. Scandium (Z = 21) does not exhibit variable oxidation states and yet it is regarded as a transition element because scandium has partially filled d-orbitals in the ground state.

The oxidation states of titanium are +2, +3, +4 respectively.

Hence, the correct option is (c).

28. The oxidation number of an element in a compound is evaluated on the basis of certain rules. Which of the following rules is not correct?

1. **The oxidation number of hydrogen is always +1.**
2. **The algebraic sum of all the oxidation numbers of all elements in a compound is zero.**
3. **An element in the free or the uncombined state bears oxidation number zero.**
4. **In all its compounds, the oxidation number of fluorine is -1.**

(a) 1 (b) 2
(c) 3 (d) 4

AP EAMCET (Engg.) 18.09.2020, Shift-I

Ans. (a) : Oxidation number of hydrogen is usually +1 compounds with more electronegative atoms (as in H_2O) is +1. But in alkali metal hydride like lithium hydride of the molecule where the oxidation state of hydrogen atom = -1.

@apna_pdf

29. When a current of 0.5 A is passed for 2 hours through a molten metal salt, 3.88 g of the metal was deposited. If atomic mass of the metals is 208 units, the oxidation state of the metal in the salt is ....

(a) +1
(b) +2
(c) +3
(d) +4

AP EAMCET (Engg.) 18.9.2020 Shift-I

Ans. (b) : $w = \frac{Eit}{F} = \frac{\frac{A}{n} \times i \times t}{F}$

$\Rightarrow n = \frac{A \times i \times t}{w \times F} = \frac{208 \times 0.5 \times (2 \times 3600)}{388 \times 96500} = 1.999 \simeq 2$

[$\because$ A = atomic mass of the metal = 208 unit

i = current = 0.5 A

t = time = 2 hrs = 2 × 3600 s

$E = \frac{A}{n}$ = Equivalent mass of the metal

n = Valency of the metal in the salt

So, oxidation state of the metal in the salt = +2.

30. H_2O_2 reduces MnO_4^- ion to

(a) Mn^{3+}
(b) Mn^{2+}
(c) Mn^-
(d) Mn^+

COMEDK-2020

Ans. (b) :

$2MnO_4^- + 5H_2O_2 + 6H^+ \rightarrow 2Mn^{2+} + 8H_2O + 5O_2$.

Thus, in this reaction, H_2O_2 reduces the MnO_4^- ion to Mn^{2+} ion.

31. Assertion: Oxidation state of Cr in CrO_5 is + 10 by conventional method is wrong.

Reason: Because the maximum oxidation state of Cr can't be more than +6 since it has 5 electron in 3d orbital and one electron in 4s orbital.

(a) If both Assertion and Reason are correct and Reason is the correct explanation of Assertion.
(b) If both Assertion and Reason are correct but Reason is not the correct explanation of Assertion.
(c) If Assertion is correct but Reason is incorrect.
(d) If both the Assertion and Reason are incorrect.

AIIMS 25 May 2019 (Morning)

Ans. (a): Since chromium Cr has an electronic configuration of [Ar] $3d^5$ $4s^1$. Its maximum oxidation state can be +6, reason being it has only six electrons in (n–1) d and ns orbitals.

32. The ionic charges on chromate ion and dichromate ion respectively is

(a) –2, –2
(b) –3, –2
(c) –2, –4
(d) –4, –2

MHT CET-02.05.2019, SHIFT-III

Ans. (a): Chromate salts contain the chromate anion, CrO_4^{2-} with –2 ionic charge. Dichromate salts contain the dichromate anion, CrO_7^{2-} with –2 ionic charge. They are oxoanion of chromium in the +6 oxidation state.

33. In the reaction,

$MnO_4^{-1}(aq) + Br^{-1}(aq) \longrightarrow MnO_2(s) + BrO_3^{-1}(aq)$, the correct change in oxidation number of the species involved is

(a) Br^{+5} to Br^{-1}
(b) Mn^{+7} to Mn^{+2}
(c) Mn^{+7} to Mn^{+3}
(d) Br^{-1} to Br^{+5}

MHT CET-02.05.2019, SHIFT-III

Ans. (d) : $\overset{+7}{Mn}O_4^{-1}(aq) + Br^{-1}(aq) \longrightarrow$

$\overset{+4}{Mn}O_2(s) + \overset{+5}{Br}O_3^{-1}(aq)$

In the above reaction, oxidation number of Mn in MnO_4^{-1} (aq) decreases from + 7 to +4 in MnO_2(s) and oxidation number of Br increase from–1(in Br^-(aq.)) to + 5 (in BrO_3^{-1}(aq)). Thus, the correct option is (d).

34. Which element can have oxidation state from range +4 to +6?

(a) Fe
(b) Mg
(c) Co
(d) Cr

AIIMS 25 May 2019 (Morning)

Ans. (d): Fe oxidation state range → +2 to +6 (but +6 is less stable).

Mg oxidation state +2

Co oxidation state range → +2 to +4

Cr oxidation state range → +2 to +6 (But +6 is more stable).

35. The oxidation state of potassium in KO_2 is

(a) +2
(b) +4
(c) +1
(d) –1

COMEDK-2019

Ans. (c) : In superoxides like KO_2, each oxygen atom is assigned an oxidation number of –1/2.

Let, oxidation state of K be x.

$\Rightarrow x + 2(-1/2) = 0 \Rightarrow x + (-1) = 0 \Rightarrow x = +1$

36. Which one of the following compounds does not exhibit a different oxidation number of the same element?

(a) Pb_3O_4
(b) Fe_3O_4
(c) Fe_2O_3
(d) Mn_3O_4

NDA (II)-2019

Ans : (c) The compound Fe_2O_3 does not exhibit different oxidation number of Fe.

In Fe_2O_3,

Let x be the oxidation number of Fe.

$\therefore 2(x) + 3(-2) = 0$

$x = +3$

Hence, Fe is only +3 oxidation state in Fe_2O_3 among all.

37. Which of the following reactions are disproportionation reactions ?

(i) $2Cu^+ \rightarrow Cu^{+2} + Cu^0$

(ii) $3MnO_4^{2-} + 4H^+ \rightarrow 2MnO_2^{2-} + MnO_2 + H_2O$

(iii) $2KMnO_4 \xrightarrow{\Delta} K_2MnO_4 + MnO_4 + O_2$

(iv) $2MnO_4^- + 3Mn^{2+} + H_2O \rightarrow 5MnO_2 + 4H^+$

Select the correct option from the following.

(a) (i) and (iv) only
(b) (i) and (ii) only
(c) (i), (ii) and (iii)
(d) (i), (iii) and (iv)

NEET-2019

@apna_pdf

Ans. (b) : Disproportionation reaction are the reactions in which the same element compound get oxidized and reduced.
Since, I and II reactions are as follows

$$2Cu^+ \rightarrow Cu^{2+} + Cu^o$$

$$3\,MnO_4^{2-} + 4H^+ \rightarrow 2MnO_4^- + MnO_2 + 2H_2O$$

So, (I) & (II) reaction is correct and belong to disproportionation reaction.

38. The correct order of N-compounds is its decreasing order of oxidation states is
(a) HNO_3, NO, N_2, NH_4Cl
(b) HNO_3, NO, NH_4Cl, N_2
(c) HNO_3, NH_4Cl, NO, N_2
(d) NH_4Cl, N_2, NO, HNO_3

NEET-2018

Ans. (a) : Oxidation state of N in HNO_3= +5
Oxidation state of N in NO = +2
Oxidation state of N in N_2 = 0
Oxidation state of N in NH_4Cl = –3
HNO_3, NO, N_2, NH_4Cl

39. Oxidation state of phosphorus in orthophosphoric acid is
(a) +5 (b) +4
(c) +3 (d) +2

JCECE - 2018

Ans. (a) : The molecular formula of orthophosphoric acid is H_3PO_4.
H_3PO_4

$$\Rightarrow \quad 3 \times 1 + x + 4(-2) = 0$$
$$3 + x - 8 = 0$$
$$x = 8 - 3$$
$$x = +5$$

The oxidation state of phosphorus in orthophosphorus acid is +5.

40. Valence electrons in the element X are 3 and that in element Y is 6. Most probable compound formed from X and Y is
(a) X_2Y (b) XY_2
(c) X_6Y_3 (d) X_2Y_3

JIPMER-2018

Ans. (d) : Same number of electrons is denoted.
So, 3×X = (8–6) ×Y

$$\frac{X}{Y} = \frac{2}{3}$$

Hence, X_2Y_3.

41. When $KMnO_4$ acts as an oxidising agent and ultimately forms $MnO_4^{2-}, MnO_2, Mn_2O_3$ and Mn^{2+}, then the member of electrons transferred in each case respectively is ?
(a) 4, 3, 1, 5 (b) 1, 5, 3, 7
(c) 1, 3, 4, 5 (d) 3, 5, 7, 1

[AIIMS-27 May 2018(M)]

Ans. (c): According to the question –

$$KMnO_4 \xrightarrow{+1e^-} MnO_4$$

$$KMnO_4 \xrightarrow{+3e^-} MnO_2$$

$$KMnO_4 \xrightarrow{+4e^-} Mn_2O_3$$

$$KMnO_4 \xrightarrow{+5e^-} Mn^{2+}$$

Then, the member of electrons transferred in each case respectively is = 1,3,4,5

42. A metal ion M^{3+} loses 3 electrons, its oxidation number will be
(a) +3 (b) +6
(c) 0 (d) –3

COMEDK-2018

Ans. (b) : When M^{3+} loses 3 electron then its oxidation no. increases +3 to +6.

$$M^{3+} \longrightarrow M^{+6} + 3e^-$$

43. The coefficients of I^-, IO_3^- and H^+ in the redox reaction,

$$\mathbf{I^- + IO_3^- + H^+ \rightarrow I_2 + H_2O}$$

in the balanced form respectively are :
(a) 5, 1, 6 (b) 1, 5, 6
(c) 6, 1, 5 (d) 5, 6, 1

Manipal-2018

Ans. (a) : Balanced the redox reaction, we get

$$6H^+ + 5I^- + IO_3^- \rightarrow 3I_2 + 3H_2O$$

The coefficient of I^-, IO_3^- and H^+ are 5, 1 and 6 respectively

44. Out of the following outer electronic configurations of atoms, the highest oxidation state is achieved by which one?
(a) $(n-1)d^8ns^2$ (b) $(n-1)d^5ns^2$
(c) $(n-1)d^3ns^2$ (d) $(n-1)d^5ns^1$

WB-JEE-2018

Ans. (b) : The outer electronic configurations of atoms $(n-1)\,d^5ns^2$ is [Mn]
Thus, Mn showing the highest oxidation state =+7

45. In view of $\Delta_r G^o$ for the following reactions

$$\mathbf{PbO_2 + Pb \longrightarrow 2PbO, \Delta_r G^o < 0}$$

$$\mathbf{SnO_2 + Sn \longrightarrow 2SnO, \Delta_r G^o > 0}$$

Which oxidation state is more characteristic for lead and tin?
(a) For lead +2, for tin +2
(b) For lead +4, for tin +4
(c) For lead +2, for tin +4
(d) For lead +4, for tin +2

UPTU/UPSEE-2017

Ans. (c) : The given reaction,

$$\overset{+4}{PbO_2} + \overset{0}{Pb} \rightarrow 2\overset{+2}{PbO}, \quad \Delta_r G^o < 0$$

Spontaneous +2 is more stable

$$\overset{+4}{SnO_2} + \overset{0}{Sn} \rightarrow 2\overset{+2}{SnO}, \quad \Delta_r G^o > 0$$

Non spontaneous +2 less stable
So, for lead +2 and for Sn+4

46. In the conversion of Br_2 to BrO_3^-, the oxidation number of Br changes from
(a) 0 to +5 (b) +1 to +5
(c) 0 to –3 (d) +2 to +5

COMEDK-2017

@apna_pdf

Ans. (a) : $Br_2 \rightarrow BrO_3^-$

Any free (unattached) element with no charge has the oxidation state of zero.

Let, the oxidation number of Br in BrO_3^- be x.

Hence, x+3×(–2)= –1 or, x–6=–1, x = +5

Hence, conversion of Br_2 to BrO_3^- the oxidation no. changes from 0 to +5.

47. Which of the following is an energy releasing process?

(a) $X(s) \longrightarrow X(g)$

(b) $O^-(g) \xrightarrow{e^-} O^{2-}(g)$

(c) $O(g) \longrightarrow O^+(g) + e^-$

(d) $O(g) \xrightarrow{e^-} O^-(g)$

BCECE-2017

Ans. (d) : $O(g) \xrightarrow{e^-} O^-(g)$

It represents the first electron gain enthalpy of oxygen which has value –141 kJ/mol.

When an electron is added to a neutral gaseous atom, the energy is released. Option A & C represents ionization enthalpy.

The option B represents the electron gain enthalpy of oxygen which equal to +780 kJ/mole.

So, energy is required to odd electron to gaseous ion in order to overcome the electrostatic force of repulsion between negatively charged ion and electron.

48. Which among the following compounds does not act as reducing agent?

(a) H_2O (b) H_2S

(c) H_2Se (d) H_2Te

MHT CET-2017

Ans. (a) : $H_2O\rightarrow$ has H–Bonding which is strong and cannot be broken easily. So, H_2O does not act as reducing agent.

49. What is the change in the oxidation state of Mn in the reaction of MnO_4^- with H_2O_2 in acidic medium?

(a) $7 \rightarrow 4$ (b) $6 \rightarrow 4$

(c) $7 \rightarrow 2$ (d) $6 \rightarrow 2$

TS-EAMCET-2016

Ans. (c) : The change in oxidation state of Mn in the reaction of MnO_4^- with H_2O_2 in acidic medium is 7 → 2.

$$2\overset{+7}{Mn}O_4^-(aq) + 5H_2O_2(aq) + 6H_3O^+(aq) \rightarrow 2Mn^{2+}(aq) + 5O_2(g) + 14H_2O(l)$$

x + 4(-2)=-1
x = +7

x = 2

50. Which of the following species can function both as oxidizing as well as reducing agent ?

(a) Cl^- (b) ClO_4^-

(c) ClO^- (d) MnO_4^-

(AIIMS-2016)

Ans. (c): $\overset{x}{Mn}\overset{-2}{O}{}_4^{2-} \Rightarrow x + 4(-2) = -1$

$x - 8 = 1$

$\boxed{x = +7}$

So, can't lose e^- (oxidizing agent)

$\overset{x}{Cl}\overset{-2}{O}{}_4^{-1} \Rightarrow x + 4(-2) = -1$

$x = +7$

Cl⇒ (–1 to +7)

So, can't lose e^-

$\overset{x}{Cl}\overset{-2}{O}{}^- \Rightarrow x + (-2) = -1$

x=+1

Hence, ClO^- has both oxidising as well as reducing character.

51. A compound of Xe and F is found to have 53.5% of Xe. What is oxidation number of Xe in this compound ?

(a) – 4 (b) 0

(c) + 4 (d) + 6

BITSAT 2016

Ans. (d) : Given, Xe = 53.5%

∴ F = 46.5%

Relative number of atoms Xe

$$= \frac{53.5}{131.2} = 0.4 \text{ and } F = \frac{46.5}{19} = 2.4$$

Simple ratio Xe = 1 and F = 6,

∵ Molecular formula is XeF_6.

∴ O.N. of Xe is +6.

52. Hot concentrated sulphuric acid is a moderately strong oxidizing agent. Which of the following reactions does not show oxidizing behaviour ?

(a) $Ca + 2H_2SO_4 \rightarrow CuSO_4 + SO_2 + 2H_2O$

(b) $S + 2H_2SO_4 \rightarrow 3SO_4 + 2H_2O$

(c) $C + 2H_2SO_4 \rightarrow CO_2 + 2SO_2 + 2H_2O$

(d) $CaF_2 + H_2SO_4 \rightarrow CuSO_4 + 2HF$

NEET-2016

Ans. (d) : Given,

$CaF_2+H_2SO_4\rightarrow CaSO_4+2HF$

In this reaction, the oxidation no. of Ca, H, S and O are not changed.

Hence, H_2SO_4 is not acting as an oxidising and reducing agent.

53. Potassium dichromate is a good oxidising agent in acidic medium, the oxidation state of chromium changes by

(a) 2 (b) 3

(c) 4 (d) 5

MHT CET-2015

Ans. (b) : Dichromate oxidized to Cr^{+3} from CrO_7^{-2} in acidic medium to the reaction

$$CrO_7^{-2} + 14H^+ + 6e^- \rightarrow 2Cr^{+3} + 7H_2O$$

Chromium is in +6 oxidation state and on the RN_5, we get Cr in +3 state.

So, oxidation state change by 3 units.

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54. Oxidation numbers of P in PO_4^{3-}, of S in SO_4^{2-} and that of Cr in $Cr_2O_7^{2-}$ are respectively

(a) +3,+ 6 and + 5 (b) +5,+ 3 and + 6

(c) -3,+ 6 and + 6 (d) +5,+ 6 and + 6

(AIIMS-2015)

Ans. (d): The given species are PO_4^{3-}, SO_4^{2-} and $Cr_2O_7^{2-}$.

$$PO_4^{-3} \Rightarrow x + 4(-2) = -3$$
$$x = -3 + 8 = +5$$
$$SO_4^{2-} \Rightarrow x + 4(-2) = -2$$
$$x = +6$$
$$Cr_2O_7^{2-} \Rightarrow 2x + 7(-2) = -2$$
$$2x = +12$$
$$x = +6$$

The oxidation no. of P, S and Cr are +5, +6 and +6 respectively.

55. The oxidation numbers of phosphorous in Ba $(H_2PO_2)_2$ and xenon in Na_4XeO_6 respectively are

(a) +3 and +4 (b) +2 and +6

(c) +1 and +8 (d) –1 and – 6

UPTU/UPSEE-2015

Ans. (c) : $Ba(H_2PO_2)_2 \rightleftharpoons Ba^{2+} + H_2PO_2^-$

Oxidation state of P in $Ba(H_2PO_2)_2$

$\Rightarrow 2+4(+1)+2x+4(-2)=0$

$2+4+2x-8=0$

$2x+6-8=0$

$x = +1$

And $H_2PO_2^- \Rightarrow 1\times2+x+2(-2) = -1$

$\Rightarrow 2+x-4 = -1$

$\Rightarrow x= +1$

And Oxidation state of Xe in Na_4XeO_6

$\Rightarrow +1\times4+x+(-2)6 = 0$

$4+x-12 = 0$

$x = 12-4$

$x = 8$

56. The non existence of PbI_4 and $PbBr_4$ is due to

(a) highly oxidizing nature of Pb^{4+} ions

(b) highly reducing nature of I^- and Br^- ions

(c) larger size of Pb^{4+}, Br^- and I^- ions

(d) both (a) and (b)

COMEDK-2014

Ans. (d) : The non-existence of PbI_4 and $PbBr_4$ is probably due to the strong oxidizing power of Pb^{4+} ions and strong reducing power of I^- and Br^- ions.

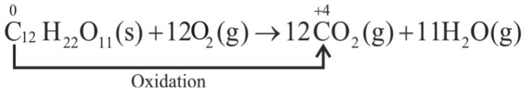
57. When sugar $C_{12}H_{22}O_{11}$ is burned to give carbon dioxide CO_2, the increase in oxidation number of carbon atoms is

(a) +4 (b) +2

(c) +1 (d) 0

SCRA-2014

Ans. (a) : The complete combustion reaction given as follows– :



$$\overset{0}{C}_{12}H_{22}O_{11}(s) + 12O_2(g) \rightarrow 12\overset{+4}{C}O_2(g) + 11H_2O(g)$$

Hence, the oxidation no. of carbon atom is +4.

58. Which one of the following oxidation states is not possible in metal carbonyls?

(a) +1 (b) 0

(c) –1 (d) +2

AMU-2014

Ans. (d) : Metal carbonyl are defined as the metal attached to the carbonyl group. The oxidation state of metal carbonyl is not possible +2 because for the formation of π-back bond between metal and the carbonyl carbon.

59. The ratios of oxidation states of Cl in potassium chloride to that in potassium chlorate is

(a) $\frac{+1}{5}$ (b) $\frac{-1}{5}$

(c) $\frac{-2}{5}$ (d) $\frac{+3}{5}$

BITSAT-2014

Ans. (b) :

Chemical formula of potassium chloride = KCl

Chemical formula of potassium chlorate = $KClO_3$

$$K\overset{+5}{Cl}O_3 \rightarrow K\overset{-1}{Cl} + O_2$$

$$\text{Ratio} = \frac{\text{Oxidation state of Cl in KCl}}{\text{Oxidation state of Cl in } KClO_3}$$

$$= \frac{-1}{5}$$

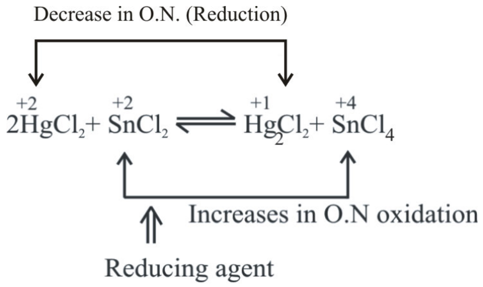
60. A reagent which lowers the oxidation number of an element in a given substance is known as

(a) Oxidising agent (b) Reduction

(c) Reducing agent (d) Oxidation.

J & K CET-(2014)

Ans. (c) : An oxidixing agent decreases the oxidation no. of an element where a reducing agent increases the oxidation no. of an element e.g.



$$2\overset{+2}{Hg}Cl_2 + \overset{+2}{Sn}Cl_2 \rightleftharpoons \overset{+1}{Hg_2}Cl_2 + \overset{+4}{Sn}Cl_4$$

61. Addition of oxygen to an element or a compound is termed as

(a) oxidation (b) reduction

(c) ionisation (d) redox reaction.

J & K CET-(2014)

@apna_pdf

Ans. (a) : Addition of oxygen to an element or a compound it termed as oxidation.

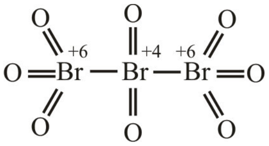
e.g. $C + O_2 \rightarrow CO_2$

62. In Br_3O_8 compound, oxidation number of bromine is

(a) 16/13 (b) 26/3
(c) 24/3 (d) 16/3

J & K CET-(2014)

Ans. (d) : The given species is Br_3O_8. Let, oxidation state of Br is x.



(i) Oxidation state of Ist Br-

$x_1 + 3 \times (-2) = 0$ or $x_1 = +6$

(ii) Oxidation state of IInd Br-

$x_2 + 2 \times (-2) = 0$ or $x_2 = +4$

(iii) Oxidation state of IIIrd Br-

$x_3 + 3 \times (-2) = 0$ or $x_3 = +6$

$$\because \text{ Oxidation state of Br} = \frac{\text{Sum of all O.S. of Br}}{\text{No.of Br}}$$

$$\therefore \quad x = \frac{x_1 + x_2 + x_3}{3} = \frac{6+4+6}{3} = \frac{16}{3}$$

$$x = \frac{16}{3}$$

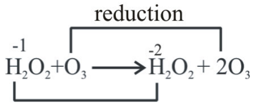
So, answer is 16/3.

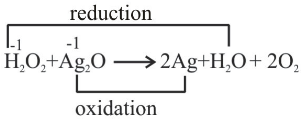
63. (I) $H_2O_2 + O_3 \rightarrow H_2O + 2O_2$
(II) $H_2O_2 + Ag_2O \rightarrow 2Ag + H_2O + O_2$
role of hydrogen peroxide in the above reactions is respectively

(a) Oxidizing in (I) and reducing (II)
(b) Reducing in (I) and oxidizing (II)
(c) Reducing in (I) and (II)
(d) Oxidizing in (I) and (II)

NEET-2014

Ans. (c) : By Given equation,





64. The pair compound that can exist together is

(a) $FeCl_3$, $SnCl_2$ (b) $HgCl_2$, $SnCl_2$
(c) $FeCl_2$, $SnCl_2$ (d) $FeCl_3$, KI

NEET-2014

Ans. (c) : The compounds with lower oxidation number and those which cannot be reduced by one another can exist together.

So, $FeCl_2$ and $SnCl_2$ can exist together as Fe^{2+} cannot be reduced by Sn^{2+}.

65. If Cl_2 is passed through hot aqueous NaOH, the products formed have Cl in different oxidation states. These are indicated as

(a) –1 and +1 (b) –1 and +5
(c) +1 and +5 (d) –1 and +3

WB-JEE-2014

Ans. (b) : Reaction is,

$$3\overset{0}{Cl_2} + 6NaOH \xrightarrow{\Delta} 5Na\overset{-1}{Cl} + Na\overset{+5}{Cl}O_3 + 3H_2O$$

So, $\underbrace{3\overset{0}{Cl_2} \rightarrow 5Na\overset{-1}{Cl}}_{\text{Reduction}}$

& $\underbrace{3\overset{0}{Cl_2} \rightarrow Na\overset{+5}{Cl}O_3}_{\text{Oxidation}}$

Therefore, option (b) correct.

66. The oxidation state of sulphur in $Na_2S_4O_6$ is

(a) + 6 (b) $\frac{+3}{2}$
(c) $\frac{+5}{2}$ (d) – 2

BITSAT-2013

Ans. (c) : Let, oxidation state of S is x.

$\because$ Oxidation state of Na is +1

Oxidation state of O is –2

$\therefore$ $Na_2S_4O_6$

$2(+1)+4x+6(-2)=0$

$2 + 4x - 12 = 0$

$4x=12-2$

$$x = \frac{10}{4} = +\frac{5}{2}$$

Oxidation state of sulphur is $= +\frac{5}{2}$

67. Consider the following statements for the reaction,

$KIO_3 + 5KI + 6HCl \rightarrow 3I_2 + 6KCl + 3H_2O$

1. I^- is reduced to I_2
2. IO^-_3 is oxidized to I_2
3. IO^-_3 is reduced to I_2
4. Oxidation number of I increases from –1 (in KI) to zero (in I_2)

The correct statements are

(a) 1, 2 and 4 (b) 3 and 4
(c) 1 and 4 (d) 1, 3 and 4

AP EAMCET (Medical) - 2013

Ans. (b) : For the reaction-

$$KIO_3 + 5KI + 6HCl \longrightarrow 3I_2 + 6KCl + 3H_2O$$

(i) $2I^- \xrightarrow{\text{oxidation}} I_2$

$x = -1$ $\quad$ $x = 0$

Hence, the statement is false.

(ii) $IO_3^- \xrightarrow{\text{reduction}} I_2$

$x+3(-2) = -1$ $\quad$ $x = 0$

$x = +5$

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Thus, the statement is false

(iii) $KI \longrightarrow I_2$

$+1+x = 0 \qquad x = 0$

$x = -1$

The oxidation number increases from –1 to 0, Thus statement is true.

68. The oxidation number of C atom in CH_2Cl_2 and CCl_4 are respectively

(a) –2 and –4 (b) 0 and –4
(c) 0 and 4 (d) 2 and 4

MHT CET-2012

Ans. (c) : Let, Oxidation number of C be x.

In CH_2Cl_2, the oxidation state of C atom is

$x+2(+1)+2(-1) = 0$
$x+2-2=0$
$x = 0$

In CCl_4, the oxidation state of C atom is,

$x+4(-1)=0$
$x-4=0$
$x=4$

69. A mixture of potassium chlorate oxalic acid and sulphuric acid is heated. During the reaction which element undergoes maximum change in the oxidation number ?

(a) S (b) H
(c) Cl (d) C

NEET-2012

Ans. (c) :

$$KClO_3 + H_2C_2O_4 + H_2SO_4 \xrightarrow{\Delta} K_2SO_4 + KCl + CO_2$$

Oxidation no. of 'S' in $H_2SO_4 \Rightarrow 2+x+4(-2)=0$
$\Rightarrow \quad x= +6$

Oxidation no. of 'S' in $K_2SO_4 \Rightarrow 2+x+(-8)=0$
$x = +6$

Change in O.N = 0

Oxidation no. of 'C' in $H_2C_2O_4 \Rightarrow 2+2x+(-8)= 0$
$2x = +6$
$x = +3$

Change in O.N = 0

Oxidation no. of 'C' in $CO_2 \Rightarrow x + 2(-2) = 0$
$x = +4$

Change oxidation no. of 'C' = 1

Oxidation no. of Cl in $KClO_3 = 1+x+3(-2)=0$
$x = +5$

Oxidation no. of Cl in $KClO_3 \Rightarrow 1+x+3(-2)=0$
$x= +5$

Oxidation no. of Cl in $KCl \Rightarrow 1+x = 0$
$x = -1$

Change in O.N = 5 – (–1) = +6

Maximum change in oxidation number is undergone by 'Cl'.

70. The oxidation number of oxygen is –1 in

(a) NO_2 (b) PbO_2
(c) Na_2O_2 (d) MnO_2

COMEDK-2012

Ans. (c) : The oxidation number of oxygen in most of the compounds is –2 except in sodium peroxides (–1). Na_2O_2 is a peroxides hence, it show –1 oxidation state. Superoxides (–1/2), oxygendifluoride (+2).

71. The oxidation state of chromium in potassium chromate is

(a) +7 (b) +5
(c) +4 (d) +6

COMEDK-2012

Ans. (d) : Let, oxidation state of Cr in K_2CrO_4 be x.

$\Rightarrow +2 + x + 4(-2) = 0$
$\Rightarrow +2 + x - 8 = 0$
$\Rightarrow x = +6$

72. A common metal used for the extraction of metals from their oxides by reduction is

(a) Al (b) Fe
(c) Cr (d) Co

CG PET- 2012

Ans. (a) : Al is electropositive which have more binding affinity to O and having more reducing nature.

$Al + Fe_2O_3 \rightarrow 2Fe + Al_2O_3$

73. The number of electrons transferred when $KMnO_4$ acts as an oxidising agent to give MnO_2 and Mn^{2+} respectively are

(a) 2,3 (b) 1,5
(c) 3,5 (d) 1,3

CG PET- 2012

Ans. (c) : When $KMnO_4$ acts as an oxidising agent to give MnO_2–

$$K\overset{+7}{Mn}O_4 \rightarrow \overset{+4}{Mn}O_2$$

Here, no. of electron transferred = 3

When $KMnO_4$ acts as an oxidising agent to give Mn^{2+} –

$$K\overset{+7}{Mn}O_4 \rightarrow \overset{2+}{Mn}$$

Here, no. of electron transferred = 5

74. The process of oxidation involve

(a) Loss of electron (b) Gain of electron
(c) Loss of proton (d) Loss of neutron

CG PET- 2012

Ans. (a) : Oxidation involves lose of electrons while reduction involves gain of electrons i.e. oxidation⇒ Loss of electron.

75. In which of the following compounds, carbon exhibits a valency of 4 but oxidation state –2 ?

(a) CH_3Cl (b) $CHCl_3$
(c) CH_2Cl_2 (d) HCHO

J & K CET-(2011)

Ans. (a) : In CH_3Cl.

Carbon exhibits a valency of 4 but oxidation state –2.

$x+3-1=0$
$x+2=0$
$x=-2$

76. Iron nails are dipped into blue copper sulphate solution. After some time iron nails are:

(a) dissolved and blue colour is discharged.
(b) dissolved but blue colour is not discharged.
(c) not dissolved and blue colour is not discharged.
(d) not dissolved but blue colour is discharged.

NDA (I)-2011

@apna_pdf

Ans. : (a) When iron nails are dipped into blue copper sulpahte solution after some time iron nails are dissolved and blue colour is discharged.

$Fe + CuSO_4 \rightarrow FeSO_4 + Cu$
(discharge)

Fe is more reactive than copper.

77. In chromite ore, the oxidation number of iron and chromium are respectively

(a) +3, +2 (b) +3, +6
(c) +2, +6 (d) +2, +3

Karnataka-CET-2011

Ans. (d) : The chemical formula of chromite ore is CrO_4^{2-}

Oxidation state of Fe in FeO –
$x + (-2) = 0$
$x = +2$

Let, oxidation state of Cr is x in Cr_2O_3.
$\therefore \quad 2x + (-2) \times 3 = 0$
$2x = 6$
$x = +3$

78. When a manganous salt is fused with a mixture of KNO_3 and solid NaOH the oxidation number of Mn changes from +2 to

(a) +4 (b) +3
(c) +6 (d) +7

WB-JEE-2010

Ans. (c) :
$MnO + NaOH + KNO_3 \rightarrow Na_2MnO_4 + KNO_2 + H_2O$

Let, the oxidation no. of Mn is x.
In MnO, the oxidation no. Mn is–
$x + (-2) = 0$
$x = +2$

In Na_2MnO_4 the oxidation state of Mn is–
$2 \times 1 + x + 4(-2) = 0$
$x = +6$

Thus, can be written as

$$\overset{+2}{Mn}O + NaOH + KNO_3 \rightarrow Na_2\overset{+6}{Mn}O_4 + KNO_2 + H_2O$$

When a manganous salt (MnO)is fused with a mixture of KNO_3 and solid NaOH the oxidation number of Mn changes from +2 to +6.

79. The oxidation number of sulphur atoms in peroxomonosulphuric acid (H_2SO_3) and peroxodisulphuric acid ($H_2S_2O_8$) are respectively

(a) +8 and +7 (b) +3 and +3
(c) +6 and +6 (d) +4 and +6

J & K CET-(2009)

Ans. (c) : Both the peroxomonosulphuric acid (H_2SO_3) and $H_2S_2O_8$ have peroxide linkage. The oxidation state of S in H_2SO_3 is x.

$2(+1) + x + 3(-2) + 2(-1) = 0$
$2 + x - 6 - 2 = 0$
$x = +6$

$H_2S_2O_8 \Rightarrow 2(+1) + 2x + 6(-2) + 2(-1) = 0$
$2 + 2x - 14 = 0$
$x = +6$

80. Oxidation numbers of P in PO_4^{3-}, of S in SO_4^{2-}, and that of Cr in $Cr_2O_7^{2-}$ are respectively

(a) + 3, + 6 and + 5 (b) + 5, + 3 and + 6
(c) + 3, + 6 and + 6 (d) + 5, + 6 and + 6

NEET-2009

Ans. (d): The oxidation number –

(1) $PO_4^{3-} \Rightarrow x + 4(-2) = -3$
$x = +5$

Oxidation of P= +5

(2) $SO_4^{2-} \Rightarrow x + 4(-2) = -2$
$x = +6$

Oxidation no. of S = +6

(3) $Cr_2O_7^{2-} = 2x + 7(-2) = -2$
$2x = -2 + 14$
$x = \frac{12}{2} = +6$
$x = +6$

Oxidation number of Cr = +6.

81. Number of moles of MnO_4^- required to oxidize one mole oxalate completely in acidic medium will be

(a) 7.5 moles (b) 0.2 moles
(c) 0.6 moles (d) 0.4 moles

NEET-2008

Ans. (c) : No. of moles MnO_4^- required oxidize one mole of FeC_2O_4 completely in acidic medium.

$$3MnO_4^- + 24H^+ + 5FeC_2O_4 \rightarrow 3Mn^{2+} + 12H_2O + 10CO_2 + 5Fe^{3+}$$

5 mole of FeC_2O_4 reacts with 3 mole of MnO_4^-

5 mole of $FeC_2O_4 \rightarrow$ 3 mole of MnO_4^-

1 mole of $FeC_2O_4 \rightarrow \frac{3}{5}$ mole of MnO_4^-

$\therefore$ The number of mole of MnO_4^- required to oxidize one mole of ferrous oxalate completely in the acidic medium will be 0.6 mole.

It means option (c) is correct.

82. When chlorine reacts with dil. NaOH under cold conditions, the oxidation state of chlorine changes from zero to

(a) –1 and +5 (b) +1 and +4
(c) +5 and +3 (d) –1 and +1

J & K CET-(2008)

Ans. (d) : According to question

$2NaOH + 2Cl_2 \rightarrow NaCl + NaClO + H_2O$

Let oxidation state of Cl in NaCl is x

$NaCl \Rightarrow +1 + x = 0$
$x = -1$

$NaClO \Rightarrow +1 + x + (-2) = 0$
$x - 1 = 0$
$x = +1$

$\therefore$ oxidation state of chlorine changes from –1 and +1.

83. The oxidation states of iodine in HIO_4, H_3IO_5 and H_5IO_6 are respectively

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(a) + 1,+ 3,+7 (b) + 7,+ 7,+3
(c) + 7,+ 7,+7 (d) + 7,+ 5,+3

(AIIMS-2008)

Ans. (c): An oxidation state is a number that is assigned to an element in a chemical combination. This number represents the no. of electrons that an atom can gain, lose, or share electron.

The oxidation state of H is +1 in a compound. The oxidation state of O is –2 in a compound calculating the oxidation state of I, we get,

$H_5IO_6 \Rightarrow 5+x-12=0$

$x=+7$

$H_3IO_5 \Rightarrow 3+x-10=0$

$x=+7$

$HIO_4 \Rightarrow 1+x-8=0$

$x=+7$

So, = $\boxed{+7,+7,+7}$

84. Which of the following molecules can act as an oxidizing as well as a reducing agent?

(a) H_2S (b) SO_3
(c) H_2O_2 (d) F_2

(AIIMS-2008)

Ans. (c): A substance can act as oxidizing as well as reducing agent when it is present in its intermediate oxidation state.

$H_2S \Rightarrow$ S is present in –2 oxidation state
i.e. minimum oxidation state
So, it can't acts as oxidizing agent

$SO_3 \Rightarrow$ S is present in +6 oxidation state
i.e. maximum oxidation state
So, it can't acts as reducing agent

$H_2O_2 \Rightarrow$ Oxygen is +1 oxidation state so it can acts as both oxidizing as well as reducing agent.

F_2 cannot acts as reducing agent.

85. The oxidation number of oxygen in KO_3, Na_2O_2 is

(a) 3, 2 (b) 1, 0
(c) 0, 1 (d) –0.33, –1

VITEEE- 2008

Ans. (d) : To find the oxidation number of a given compound we have to equal the charge on the overall compound with the charge on individual atom of which the compound is made of.

In KO_3, K is an alkali metal.

KO_3

Suppose oxidation number of O = x

$\Rightarrow 1 + 3x = 0$

$3x = -1 \Rightarrow x = -0.33$

Na_2O_2

Suppose oxidation number of O is x

$2 \times 1 + 2x = 0$

$2 + 2x = 0$

$x = -1$

86. For the reaction,

$$MnO_4^- + C_2O_4^{2-} + H^+ \rightarrow Mn^{2+} + CO_2 + H_2O$$

Which of the following is correct?

	Mn^{2+}	$C_2O_4^{2-}$	CO_2	H^+
(a)	5	2	4	10
(b)	2	5	10	16
(c)	6	8	16	18
(d)	10	12	24	12

CG PET -2008

Ans. (b) : Given that,

$MnO_4^- +$ $C_2O_4^{-2}$ $+H^+ \rightarrow Mn^{2+} + CO_2 + H_2O$

Write the reaction in two half reaction-

Reduction: $MnO_4^- \rightarrow Mn^{2+}$

Oxidation: $C_2O_4^{2-} \rightarrow CO_2$Balance all atoms other than O &H

$MnO_4^- \rightarrow Mn^{2+}$

$C_2O_4^- \rightarrow 2CO_2$

Now, balance the oxygen atoms by adding H_2O molecules

$MnO_4^- \rightarrow Mn^{2+} 4H_2O$

$C_2O_4^{2-} \rightarrow 2CO_2$

Now, balance hydrogen atoms by adding H^+ ions.

$MnO_4^- + 8H^+ \rightarrow Mn^{2+} + 4H_2O$

$C_2O_4^{2-} \rightarrow 2CO_2$

To balance the charge, add electrons to a more positive side of the half reaction.

$MnO_4^- + 8H^+ + 5e^- \rightarrow Mn^{2+} + 4H_2O$

$C_2O_4^{2-} \rightarrow 2CO_2 + 2e^-$

Now multiply oxidation half reaction by 5 and reduction half –reaction by 2. Add both reactions we will get-

$$2MnO_4^- + 5C_2O_4^{2-} + 16H^+ \rightarrow 2Mn^{2+} + 10CO_2 + 8H_2O$$

87. Acidic $K_2Cr_2O_7$ reacting with H_2S the oxidation number of chromium is changed

(a) from+3 to +6 (b) from+6 to +3
(c) from+6 to +2 (d) remains unchanged

CG PET -2008

Ans. (b): When acidic $K_2Cr_2O_7$ reacts with H_2S then chromium sulphate is formed during the reaction.

$K_2Cr_2O_7 + H_2S + H_2SO_4 \rightarrow$
$Cr_2(SO_4)_3 + K_2SO_4 + S + H_2O$

$K_2Cr_2O_7$

$1 \times 2 + 2x + (-2)7 = 0$

$x = 6$

And

$Cr_2(SO_4)_3$

$2x + 3(-2) = 0$

$x = +3$

88. In which of the following compound the oxidation number of oxygen is +2?

(a) H_2O_2 (b) CO_2
(c) H_2O (d) OF_2

CG PET -2008

Ans. (d) : Let, the oxidation state of O is x.

F_2O

$\therefore$ $2(-1) + x = 0$

$x = +2$

So, oxidation state of oxygen in F_2O is +2.

@apna_pdf

89. The oxidation state of sulphur in sodium tetrathionate ($Na_2S_4O_6$) is

(a) 2 (b) 0

(c) 2.5 (d) 3.5

J & K CET-(2008)

Ans. (c) : The given species is $Na_2S_4O_6$ or $S_4O_6^{2-}$

Let, oxidation state of S is x in $S_4O_6^{2-}$

$\therefore \quad 4x + 6(-2) = -2$

$x = \frac{10}{4}$

$x = 2.5$

90. In which of the following the oxidation number of oxygen has been arranged in increasing order?

(a) $OF_2 < KO_2 < BaO_2 < O_3$

(b) $BaO_2 < KO_2 < O_3 < OF_2$

(c) $BaO_2 < O_3 < OF_2 < KO_2$

(d) $KO_2 < OF_2 < O_3 < BaO_2$

(e) $OF_2 < O_3 < KO_2 < BaO_2$

Kerala-CEE-2008

Ans. (b): Let, Oxidation state of O is x.

(1) OF_2

$x + 2(-1) = 0$

$x = +2$

(2) KO_2

$1 + 2(x) = 0$

$2x = -1$

$x = -1/2$

$x = -0.5$

(3) BaO_2

$(+2) + 2(x) = 0$

$2x = -2$

$x = -1$

(4) O_3

$3x = 0$

$x = 0$

Hence, $BaO_2 < KO_2 < O_3 < OF_2$

91. Oxidation state of oxygen in F_2O is

(a) +1 (b) –1

(c) +2 (d) –2

UP CPMT-2008

Ans. (c): Let the oxidation state of oxygen in F_2O is x.

F_2O

$2(-1) + x = 0$ (F is more electronegative)

$-2 + x = 0$

$x = +2$

92. The brown complex obtained in the detection of nitrate radical is formulated as $[Fe(H_2O)_5NO]SO_4$. What is the oxidation number of Fe in this complex?

(a) +1 (b) +2

(c) +3 (d) 0

WB-JEE-2008

Ans. (a) : The brown colour complex obtained in the detection of nitrate radical is formulated as $[Fe(H_2O)_5NO]SO_4$. In this complex, oxidation state of iron is +1.

The univalent character of Iron in the complex is justified by the presence of a coordinated NO^+ group. The oxidation number of Fe in the complex is +1.

93. If equal volumes of 1 M $KMnO_4$ and 1 M $K_2Cr_2O_7$ solutions are allowed to oxidize Fe (II) to Fe (III) in acidic medium, then Fe (II) oxidized will be

(a) More by $KMnO_4$

(b) More by $K_2Cr_2O_7$

(c) Equal in both the cases

(d) Cannot be determined

AP - EAMCET (Medical) - 2007

Ans. (b) : The redox half cell reactions are written below–

$$Fe^{2+} \rightarrow Fe^{3+} + 1e^{\ominus}$$

$$MnO_4^{\ominus} + 8H^{\oplus} + 5e^{\ominus} \rightarrow Mn^{2+} + 4H_2O$$

$$Cr_2O_7^{2-} + 14H^{\oplus} + 6e^{-} \rightarrow 2Cr^{3+} + 7H_2O$$

Using the concept of mole–

$$1\ \text{mol}\ MnO_4^{-} = 5\text{mol}\ Fe^{2+}$$

And $\quad 1\text{mol}\ Cr_2O_7^{2-} = 6\text{mol}\ Fe^{2+}$

So, $K_2Cr_2O_7$ will oxidize more Fe^{2+} to Fe^{3+}.

94. What is an oxidation number of carbonyl carbon in Methanal?

(a) + 3 (b) + 2

(c) + 4 (d) zero

GUJCET-2007

Ans. (d) : As we know methanal (HCHO) is the neutral compound. We can also calculate the oxidation number by mathematical way –

The charge of hydrogen = +1

Let, oxidation state of carbon = x

Oxidation state of oxygen = –2

$\therefore\ 2(+1) + x - 2 = 0$

or $x = 0$

95. In which of the following pairs, there is greatest difference in the oxidation number of the underlined elements?

(a) $\underline{N}O_2$ and $\underline{N}_2O_4$ (b) $\underline{P}_2O_5$ and $\underline{P}_4O_{10}$

(c) $\underline{N}_2O$ and $\underline{N}O$ (d) $\underline{S}O_2$ and $\underline{S}O_3$

BITSAT-2007

Ans. (d) : Oxidation no. of elements have been mentioned in brackets as shown below –

(a) $NO_2(x=4)$ & $N_2O_4\ [x=4]$

Difference in oxidation state of N=0

(b) $P_2O_5\ (x = +5)$ & $P_4O_{10}\ (x = +5)$

Difference in oxidation state of P = 0

(c) $N_2O\ (x=1)$ & $NO\ (x = 2)$

Difference in oxidation state of N =1

(d) $SO_2\ (x = 4)$ & $SO_3\ (x = 6)$

Difference in oxidation state of S = 2

Hence, the difference in oxidation states of underlined elements is greater in SO_2.

96. H_2O_2 on oxidation gives

(a) O^{2-} (b) OH^-

(c) O_2^- (d) O_2

CG PET -2007

@apna_pdf

Ans. (d) : H_2O_2 gives oxygen gas (O_2) on oxidation.

$H_2O_2 \rightleftharpoons O_2 + 2H^+ + 2e^-$

97. In which of the following compounds, the oxidation number of iodine is fractional ?

(a) IF_3 (b) IF_5

(c) I_3^- (d) IF_7

BCECE-2006

Ans. (c) : Oxidation no. of Iodine in –

$IF_3 \Rightarrow x+3(-1)=0, x=3$

$IF_5 \Rightarrow x+5(-1)=0, x=5$

$I_3^- \Rightarrow x(3)=-1, x=-1/3$

$IF_7 \Rightarrow x + 7(-1) = 0, x = +7$

So, oxidation no. of I is fraction form in I_3^- .

98. $Cu^{2+} + Ag \longrightarrow Cu + Ag^+$ oxidation half reaction is :

(a) $Cu^{2+} \rightarrow Cu$ (b) $Ag \rightarrow Ag^+$

(c) $Cu \rightarrow Cu^{2+}$ (d) all of these

JCECE - 2006

Ans. (b) : Oxidation means loss of electrons.
In the reaction

$Cu^{2+} + Ag \rightarrow Cu + Ag^+$

$Ag - e^- \rightarrow Ag^+$

Silver loses electron to becomes silver ion. So

$\boxed{Ag \rightarrow Ag^+}$

99. Oxidation number of S in SO_4^{2-} :

(a) + 6 (b) + 3

(c) + 2 (d) – 2

BCECE-2005

Ans. (a) : The given species is SO_4^{2-}.

SO_4^{2-}

Let, oxidation state of S is x.

$\therefore$ $x+4(-2)=-2$

$x = -2 + 8$

$x = +6$

100. The oxidation state of chromium in the final product formed by the reaction between KI and acidified potassium dichromate solution is

(a) + 3 (b) + 2

(c) + 6 (d) + 4

[AIEEE 2005]

Ans. (a): When potassium iodide reacts with acidified $K_2Cr_2O_7$ then following products are formed-

$K_2Cr_2O_7+7H_2SO_4+6KI \rightarrow 4K_2SO_4+Cr_2(SO_4)_3+7H_2O + 3I_2$

$\because$ $Cr_2(SO_4)_3$

Let oxidation state of Cr is x

$\therefore$ $2x + 3(-2) = 0$

$x = +3$

101. The oxidation number of xenon in $XeOF_2$ is

(a) zero (b) 2

(c) 4 (d) 3

J & K CET-(2005)

Ans. (c): Oxidation state of xenon in $XeOF_2$

$\Rightarrow 1(x) + 1(-2) + 2(-1) = 0$

$x-2-2=0$

$x = 4$

102. When $K_2Cr_2O_7$ is converted into K_2CrO_4, the change in oxidation number of chromium is:

(a) 0 (b) 5

(c) 7 (d) 9

UPTU/UPSEE-2005

Ans. (a) : For the equation,

$K_2\overset{+6}{Cr_2}O_7 \rightarrow K_2\overset{+6}{Cr}O_4$

No change in oxidation state of chromium in this equation. When $K_2Cr_2O_7$ is converted into K_2CrO_4. Both have same oxidation number that is 6. So, the oxidation number change is zero.

103. The compound having the lowest oxidation state of iron is:

(a) $K_4Fe(CN)_6$ (b) K_2FeO_4

(c) Fe_2O_3 (d) $Fe(CO)_5$

UPTU/UPSEE-2005

Ans. (d) : $K_4[Fe(CN)_6] \Rightarrow 4\times1+x+6(-1)=0$

$x = +2$

Similarly, K_2FeO_4 and Fe_2O_3 is highest

And $Fe(CO)_5 \Rightarrow x + 0 \times 5 = 0$

$x=0$

So, the oxidation state of Fe is zero in $Fe(CO)_5$ is lowest.

104. The oxidation state of sulphur is +4 in

(a) Sulphurous acid

(b) Sulphuric acid

(c) Peroxomonosulphuric acid

(d) Dithionic acid

AMU-2004

Ans. (a) : In sulphurous acid (H_2SO_3), oxidation state of S is +4.

H_2SO_3

$2+x-6=0$

$\Rightarrow$ $x=+4$

105. What will be the oxidation numbers of carbon in C_6H_6 and CH_2Cl_2?

(a) +4 in both

(b) –4 in both

(c) –1 and 0, respectively

(d) +1 and +4, respectively

AMU-2004

Ans. (c) : The given species are C_6H_6 and CH_2Cl_2.

$\overset{x}{C_6}\overset{+1}{H_6} \Rightarrow x(6)+(+6)=0$

$6x = -6$

$x = -1$

CH_2Cl_2

Let the oxidation of C = x

And, H=+1

Cl= –1

$CH_2Cl_2 \Rightarrow x+(+2)+(-2)=0$

$x=0$

So, $\boxed{-1 \text{ \& } 0, \text{ respectively}}$

@apna_pdf

106. Arrange the following as increase in oxidation number :

(i) Mn^{2+} **(ii) MnO_2**
(iii) $KMnO_4$ **(iv) K_2MnO_4**

(a) (i) > (ii) > (iii) > (iv)
(b) (i) < (ii) < (iv) < (iii)
(c) (ii) < (iii) < (i) < (iv)
(d) (iii) > (i) > (iv) > (ii)

BCECE-2004

Ans. (b) : Oxidation state of given compounds is as follows–

$$\overset{+2}{Mn}<\overset{+4}{Mn}O_2<K_2\overset{+6}{Mn}O_4<K\overset{+7}{Mn}O_4$$

107. In potassium manganate, the oxidation state of manganese is

(a) +5 (b) +6
(c) +7 (d) +8

CG PET -2004

Ans. (b) : The chemical formula of potassium manganate is K_2MnO_4.

K_2MnO_4

Let, oxidation state of Mn is x.

$\therefore$ 2(1) + x + 4(–2) = 0

Or x = +6

108. Which is the best description of the behaviour of bromine in the reaction given below ?

$H_2O + Br_2 \rightarrow HOBr + HBr$

(a) Proton acceptor only
(b) Both oxidised and reduced
(c) Oxidised only
(d) Reduced only

NEET-2004

Ans. (b) : In the given reaction,

$$H_2O+\underset{0}{Br_2}\rightarrow HO\underset{+1}{Br}+H\underset{-1}{Br}$$

Here, Br is oxidized from 0 to 1 in HOBr and reduced from 0 to –1 in HBr. Thus, it is oxidised as well as reduced.

109. Which of the following reaction involves oxidation and reduction?

(a) $NaBr + HCl \rightarrow NaCl + HBr$
(b) $HBr + AgNO_3 \rightarrow AgBr + HNO_3$
(c) $H_2 + Br_2 \rightarrow 2HBr$
(d) $Na_2O + H_2SO_4 \rightarrow Na_2SO_4 + H_2O$

UP CPMT-2004

Ans. (c) : The reaction in which oxidation number of elements change will involve oxidation and reduction.

Write oxidation number of each of the element in reactant and product molecules to find the answer.

(a) $\overset{+1}{Na}\,\overset{-1}{Br}+\overset{+1}{H}\,\overset{-1}{Cl}\longrightarrow\overset{+1}{Na}\,\overset{-1}{Cl}+\overset{+1}{H}\,\overset{-1}{Br}$

$\because$ Oxidation number are changed.

$\therefore$ It is not a redox reaction.

(b) $\overset{+}{H}\,\overset{-}{Br}+\overset{+1}{Ag}\,\overset{-1}{NO_3}\longrightarrow\overset{+1}{Ag}\,\overset{-1}{Br}+\overset{+1}{H}\,\overset{-1}{NO_3}$

$\because$ Oxidation number remain same.

$\therefore$ It is not oxidation reduction reaction.

(c) $\overset{0}{H_2}+\overset{0}{Br_2}\rightarrow 2\overset{+1}{H}\overset{-1}{Br}$

Oxidation number of H_2 changes from 0 to +1 and oxidation number of Br_2 changes from 0 to -1.

$\therefore$ It is oxidation- reduction reaction.

(d) $\overset{+1}{Na_2}\,\overset{-2}{O}+\overset{+1}{H_2}\overset{+6}{S}\,\overset{-2}{O_4}\longrightarrow\overset{+1}{Na_2}\overset{+6}{S}\,\overset{-2}{O}+\overset{+1}{H_2}\overset{-2}{O}$

$\therefore$ Oxidation number remain same.

$\therefore$ It is not oxidation-reduction reaction.

110. In the chemical reaction $Cl_2 + H_2S \rightarrow 2HCl + S$. The oxidation number of sulphur changes from

(a) 0 to 2 (b) 2 to 0
(c) –2 to 0 (d) –2 to –1

CG PET -2004

Ans. (c) : The oxidation state of sulphur in H_2S is –2 while it is zero in S i.e. in this reaction oxidation of sulphur and reduction of chlorine is taking place.

111. In which of the following reactions, hydrogen is acting as an oxidising agent?

(a) With Li to form LiH (b) With I_2 to give HI
(c) With S to give H_2S (d) None of the above

BCECE-2003

Ans. (a) : An oxidising agent itself undergoes reduction. Its oxidation no. decreases. When H_2 is converted to hydride ion (H^-), it itself is reduced and acts as oxidizing agent. In the following reaction, hydrogen is acting as an oxidising agent with lithium to give lithium hydride.

$$H_2+2Li\rightarrow 2LiH$$

112. Oxidation number of nitrogen is highest in

(a) N_3H (b) N_2H_4
(c) NH_2OH (d) NH_3

J & K CET-(2003)

Ans. (a) : (i) $N_3H \Rightarrow$ oxidation state $\Rightarrow$ 3x+1=0

x= –1/3

(ii) $N_2H_4 \Rightarrow$ oxidation state $\Rightarrow$ 2x+4=0

x = – 2

(iii) NH_2 OH$\Rightarrow$ oxidation state $\Rightarrow$ x+2–2+1=0

x= –1

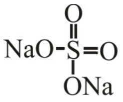
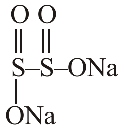
(iv) $NH_3 \Rightarrow$ oxidation state $\Rightarrow$ x+3=0

x = –3

$\therefore$ The highest oxidation state of nitrogen is in N_3H.

113. The oxidation number of sulphur is –1 in

(a) FeS (b) FeS_2

(c)  (d) 

J & K CET-(2002)

Ans. (b) : Oxidation state of S in FeS is-

$\overset{2}{Fe}S \Rightarrow x+2 = 0$

x = –2

$FeS_2 \Rightarrow 2+x(2)=0$

2x = –2

x = –1

@apna_pdf

114. In which of the following compounds manganese has oxidation number equal to that of iodine in KIO_4?

(a) Potassium manganate
(b) Potassium permanganate
(c) Manganous chloride
(d) Manganese chloride

J & K CET-(2002)

Ans. (b) : Oxidation state of Iodine in KIO_4

$1+x+4(-2)=0$

$x=8-1$

$\boxed{x=7}$

Now, we will find the oxidation no. of Mn in the given compounds.

(a) potassium manganate (K_2MnO_4)

$\Rightarrow 2(+1)+x+4(-2)=0$

$\Rightarrow 2+x-8=0$

$\boxed{x=+6}$

(b) potassium permanganate ($KMnO_4$)

$\Rightarrow 1+x+4(-2)=0$

$\Rightarrow x=8-1$

$x=+7$

This is the equal of KIO_4 oxidation no.

115. When ammonium nitrate is gently heated, an oxide of nitrogen is formed. What is the oxidation state of nitrogen in this oxide?

(a) +4 (b) +2
(c) +3 (d) +1

AP-EAMCET (Medical), 2002

Ans. (d) : When ammonium nitrate is gently heated, nitrous oxide (N_2O) of nitrogen is formed which is also known as laughing gas.

$NH_4NO_3 \rightarrow N_2O + H_2O$

The oxidation state of nitrogen in N_2O given below :

$\overset{x}{N}_2\overset{-2}{O}$

Let, oxidation state of N = x

$\therefore$ $2x-2=0$

or $x=+1$

116. Oxidation state of Fe in Fe_3O_4 is:

(a) $\frac{3}{2}$ (b) $\frac{5}{4}$
(c) $\frac{4}{5}$ (d) $\frac{8}{3}$

(AIIMS-2002), NEET-1999

Ans. (d): Fe_3O_4 is basically a mixture of Fe_2O_3 and FeO. In Fe_2O_3, the two Fe atom has 3 oxidation state–

$2x-6=0$

$\boxed{x=+3}$

In FeO, Fe has 2 oxidation state

$x-2=0$

$\boxed{x=+2}$

Average oxidation state of

$$Fe=\frac{3+3+2}{3}=\frac{8}{3}$$

117. Oxidation state of nitrogen is correctly given for

	Compound	**Oxidation state**
(a)	Mg_3N_2	–3
(b)	NH_2OH	+1
(c)	$(N_2H_5)_2SO_4$	+2
(d)	$[Co(NH_3)_5Cl]Cl_2$	0

AMU 2002

Ans. (a) : Let, the oxidation number of nitrogen in different compound is x.

Checked by option–

(A) Mg_3N_2

$3(2)+2x=0$

or $x=-3$

(B) NH_2OH

$x+2(1)-2+1=0$

or $x=-1$

(C) $(N_2H_5)_2SO_4$

$x=-2$

(D) $[Co(NH_3)_5Cl]Cl_2$

$+3+5(NH_3)-1=+2$

or $NH_3=0$

$x+3=0$

$x=-3$

118. Oxidation number of Cl in $CaOCl_2$ (bleaching powder) is

(a) Zero, since it contains Cl_2
(b) –1, since it contains Cl^-
(c) +1, since it contains ClO^-
(d) +1 and –1, since it contains ClO^- and Cl^-

[AIEEE 2002]

Ans. (d) : The chemical name of the bleaching powder is calcium oxychloride.

$\because$ $[CaOCl_2]$

Or $[Ca(OCl)Cl]$

Here, two Cl or present in different oxidation state.

$Cl \rightarrow -1$

$OCl^- \rightarrow -2+x=-1 \Rightarrow x=+1$

So, the chlorine atom present in two oxidation state i.e. +1 and –1.

119. Consider the following reaction.

$6NaOH + 3Cl_2 \rightarrow 5NaCl + A + 3H_2O$

What is the oxidation number of chlorine in A?

(a) +5 (b) –1
(c) +3 (d) +1

AP-EAMCET (Medical), 2001

Ans. (a) : For the reaction-

$$6NaOH+3Cl_2 \rightarrow 5NaCl+\underset{\substack{\text{Sodium}\\\text{Chlorate}\\\text{(A)}}}{NaClO_3}+3H_2O$$

Oxidation number of chlorine in sodium chlorate is:-

For, $NaClO_3$

$(+1)+x+3(-2)=0$

$1+x-6=0$

Or $x=+5$

@apna_pdf

120. What is the oxidation number of C in CH_3Cl?

(a) –3 (b) 0
(c) –2 (d) –4

J & K CET-(2001)

Ans. (c) : Oxidation state of carbon in CH_3Cl

$\Rightarrow$ x+3 (1) +(–1)=0

x+3–1=0

Oxidation no. of C, x = –2

121. The oxidation number of sulphur in $H_2S_2O_7$ is :

(a) +2 (b) +6
(c) +4 (d) +8

(AIIMS-2000)

Ans. (b): Let, the oxidation no. of sulphur be x.
Oxidation no. of H & O are +1 and –2 respectively.

$\therefore$ 2(+1)+2x+7(-2)=0

2+2x–14=0

2x=+12

$\boxed{x = +6}$

122. What is the oxidation number of chromium in potassium dichromate?

(a) +7 (b) +5
(c) +6 (d) +4

AP-EAMCET (Med.)-1999

Ans. (c) : The molecular formula of potassium dichromate is $K_2Cr_2O_7$. The calculation of oxidation number of chromium is given below-

$K_2Cr_2O_7$

Let, x be the oxidation number of Cr.

$\therefore$ 2(1)+2(x)+7(–2)=0

or 2+2x – 14=0

or x = +6

123. The oxidation number of nitrogen in HN_3 is

(a) $+\frac{1}{3}$ (b) 0
(c) $-\frac{1}{3}$ (d) 1

AP EAMCET- 1999

Ans. (c) : The oxidation number of nitrogen in HN_3 is-

1+3x=0

x= –1/3

Hence, the correct option is (c).

124. Oxidation number of Os in OsO_4 is:

(a) +2 (b) +6
(c) +8 (d) +10

(AIIMS-1999)

Ans. (c): We know that, the most common oxidation state of O is–2, which is the case here also.
If x is the oxidation number of O.S. then

x+4(-2)=0

x = +8 Ans.

125. Chlorine is passed into dilute cold KOH solution. What are the oxidation number of chlorine in the products formed?

(a) –1, +5 (b) –1, +3
(c) +1, +7 (d) –1, +1

AP EAMCET- 1999

Ans. (d) : When chlorine is passed into dilute cold KOH then following product is formed-

$$2KOH + Cl_2 \rightarrow KCl + KOCl + H_2O$$

$\therefore$ KCl KOCl

+1+x=0 1+(–2) + x=0

x=–1 X=+1

Hence, the correct option is (d).

126. The number of moles of acidified $KMnO_4$ required to oxidize one mole of ferrous oxalate (FeC_2O_4) is

(a) 5 (b) 3
(c) 0.6 (d) 1.5

J & K CET-(1999)

Ans. (c) : The reaction between MnO_4^- with FeC_2O_4 is given as

$$MnO_4^- + 24H^+ + 5FeC_2O_4 \rightarrow 3Mn^{+2} + 12H_2O + 10CO_2 + 5Fe^{3+}$$

From this, we can see 5 mole of $5FeC_2O_4$ react with 3 moles of MnO_4^-.

So, 1 mole of $5FeC_2O_4$ react with 3/5 moles of MnO_4.

$\therefore$ 0.6 mole of MnO_4^- are required to oxidize one mole of ferrous sulphate.

127. A 2.5 mol sample of N_2H_4 loses 25 mole of electrons in being converted to a new compound X, assuming that all of the nitrogen appears in the new compound, what is the oxidation state of nitrogen in the compound?

(a) –1 (b) –2
(c) +3 (d) +4

J & K CET-(1998)

Ans. (c) : Let oxidation no. in new compound be x.

$$N_2^{+6}H_4 \rightarrow 2N^{+x} + ne^-$$

n=2x+4

No. of electron lost per mole

= 2(x+2)

25 mol = 2.5×(x+2) ×2

5×(2+x)=25

x= +3

128. Which one of the following halogens does not exhibit positive oxidation state in its compounds?

(a) I (b) Br
(c) Cl (d) F

AP EAMCET- 1997

Ans. (d) : Fluorine does not exhibit positive oxidation state in its compound because fluorine is highly electronegative element with highest oxidation power.

129. Which of the following sequence is correct with reference to the oxidation number of iodine?

(a) $I_2 < ICl < HI < HIO_4$
(b) $HIO_4 < ICl < I_2 < HI$
(c) $I_2 < HI < ICl < HIO_4$
(d) $HI < I_2 < ICl < HIO_4$

AP – EAMCET - (Medical)-1997

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Ans. (d) The oxidation number of Iodine is calculated as –

(i) I_2
$x = 0$

(ii) ICl
$x - 1 = 0$
$x = +1$

(iii) HI
$+1 + x = 0$
$x = -1$

(iv) HIO_4
$+1 + x - 8 = 0$
$x - 7 = 0$
$x = +7$

The correct order of oxidation no. of iodine compound is– $HI < I_2 < ICl < HIO_4$

130. In the reactions: $2P_2O_5 + 2HNO_3 \rightarrow P_4O_{10} + x$, the term x is

(a) N_2O_4
(b) H_2O only
(c) N_2O_5
(d) PNO_3

AIIMS-1996

Ans. (c): In this reactions– phosphorus pentaoxide acts as a dehydration agent and desiccant to remove water molecules.

$$2P_2O_5 + 2HNO_3 \longrightarrow P_4O_{10} + H_2O + N_2O_5 \uparrow$$

So, x = dinitrogen pentaoxide

$= \boxed{N_2O_5}$

131. Reaction of sodium thiosulphate with iodine gives

(a) Tetrathionate ion
(b) Sulphide ion
(c) Sulphate ion
(d) Sulphite ion

NEET-1996

Ans. (a) : $\underset{\text{Sodium thiosulphate}}{2Na_2S_2O_3} + \underset{\text{(Iodine)}}{I_2} \rightarrow 2NaI + Na_2S_4O_6$

132. The oxide which cannot act as a reducing agent is

(a) CO_2
(b) ClO_2
(c) NO_2
(d) SO_2

NEET-1995

Ans. (a) : A substance can acts as the reducing agent when it can increase its oxidation state by losing electrons. In CO_2, carbon is present in +4 oxidation state which is its maximum oxidation state so it can't acts as a reducing agent.

133. Which substance is serving as a reducing agent in the following reactions ?

$$\mathbf{14H^+ + Cr_2O_7^{2-} + 3Ni \rightarrow 7H_2O + 2Cr^{3+} + 3Ni^{2+}}$$

(a) H^+
(b) $Cr_2O_7^{2-}$
(c) H_2O
(d) Ni

NEET-1994

Ans. (d) : In the given reaction,

$$14H^+ + \overset{+6}{Cr_2}O_7^{2-} + 3\overset{0}{Ni} \rightarrow 2\overset{+3}{Cr^{3+}} + 7H_2O + 3\overset{+2}{Ni^{2+}}$$

As, Ni is oxidized form 0 to +2 it will acts as reducing agent.

134. The oxidation state of 1 in $H_4IO_6^-$ is

(a) + 1
(b) – 1
(c) + 7
(d) + 5

NEET-1994

Ans. (c) : Oxidation state of I in $H_4IO_6^-$

$\Rightarrow 1(4) + x + 6(-2) = -1$
$4 + x - 12 = -1$
$x = 12 - 5$
$x = +7$

135. In the reaction,

$NO_2^- + OCl^- \rightarrow NO_3^- + Cl^-$, the oxidation state of chorine

(a) Does not change
(b) Changes from +1 to –1
(c) Changes from –2 to –1
(d) Changes from 0 to –1

AP EAMCET- 1994

Ans. (b) : Given the reaction-

$NO_2^- + OCl^- \rightarrow NO_3^- + Cl^-$

$\therefore$ The oxidation state of OCl^- and Cl^- are-

(i) OCl^-
$-2 + x = -1$
$x - 2 = -1$
$x = -1 + 2$
$x = +1$

(ii) Cl^-
$x = -1$

Hence, the oxidation state of chlorine is changes from +1 to –1.

136. Among the SO_2, H_2SO_4 and sodium thiosulphate, sulphur has the highest oxidation state in

(a) SO_2
(b) H_2SO_4
(c) Sodium thiosulphate
(d) Same in all

AP EAMCET- 1991

Ans. (b) : Let, x be the oxidation state (O.S) of S in all species.

(i) SO_2
$x + 2(-2) = 0$
$x = +4$

(ii) H_2SO_4
$2 + x + 4(-2) = 0$
$x = +6$

(iii) $Na_2S_2O_3$
$2 + 2x + 3(-2) = 0$
$x = +2$

In H_2SO_4, sulphur has highest oxidation state.

137. Acidified potassium dichromate is treated with hydrogen sulphide. In the reaction, the oxidation number of chromium

(a) Increases from + 3 to +6
(b) Decreases from +6 to +3
(c) Remains unchanged
(d) Decreases from +6 to +2

VITEEE- 2019

Ans. (b) : Acidified $K_2Cr_2O_7$ is treated with H_2S then cromate sulphate and potassium sulphate are formed.

$$K_2\overset{+6}{Cr_2}O_7 + 4H_2SO_4 + 3H_2S \rightarrow K_2SO_4 + \overset{+3}{Cr_2}(SO_4)_3 + 7H_2O + 3S$$

$\because K_2Cr_2O_7$
$2(+1) + 2x + 7(-2) = 0$
or $x = +6$

$\because Cr_2(SO_4)_3$
$2x + 3(-2) = 0$
$x = +3$

Oxidation number of chromium decreases from +6 to +3.

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138. In the reaction,

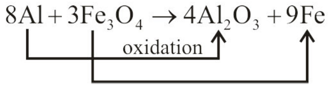
$$8Al + 3Fe_3O_4 \longrightarrow 4Al_2O_3 + 9Fe$$

the number of electrons transferred from the reductant to the oxidant is

(a) 8 (b) 4
(c) 16 (d) 24

VITEEE- 2014

Ans. (d) : Given the reaction


$$8Al + 3Fe_3O_4 \rightarrow 4Al_2O_3 + 9Fe$$

Oxidation state of Al in transition state = O
Oxidation no. of Al in Al_2O_3 = +3
∴ No. of e^- transferred by 1 Al atom =3

Therefore, No. of e^- transferred by 8 Al atoms = 8×3 = 24 electrons. Hence, 24 electrons are transferred from reductant to oxidant.

2. Redox Reaction, Types of Redox Reactions

139. In the neutral of faintly alkaline medium, $KMnO_4$ oxidises iodide into iodate. The change in oxidation state of manganese in this reaction is from

(a) + 6 to + 5 (b) + 7 to + 4
(c) + 6 to + 4 (d) + 7 to + 3

NEET-17.07.2022

Ans. (b) : In neutral alkaline solution,

$$2\overset{+7}{Mn}O_4^- + H_2O + I^- \rightarrow 2\overset{+4}{Mn}O_2 + 2OH^- + \overset{+5}{I}O_3^-$$

The oxidation state of Mn decreases from +7 to +4.

140. Which one of the following is an example of disproportionation reaction?

(a) $3MnO_4^{2-} + 4H^+ \rightarrow 2MnO_4^- + MnO_2 + 2H_2O$
(b) $MnO_4^- + 4H^+ + 4e^- \rightarrow MnO_2 + 2H_2O$
(c) $10I^- + 2MnO_4^- + 16H^+ \rightarrow 2Mn^{2+} + 8H_2O + 5I_2$
(d) $8MnO_4^- + 3S_2O_3^{2-} + H_2O \rightarrow 8MnO_2 + 6SO_4^{2-} + 2OH^-$

JEE Main-26.06.2022, Shift-II

Ans. (a) : $3\overset{+6}{Mn}O_4^{2-} + 4H^+ \longrightarrow 2\overset{+7}{Mn}O_4^- + \overset{+4}{Mn}O_2 + 2H_2O$

Disproportionation reaction is a reaction in which a compound (MnO_4^{2-}) undergoes oxidation as well as reduction.

Here, MnO_4^{2-} is an intermediate oxidation state and is converted into compounds having higher and lower oxidation state.

141. The reaction, $3ClO^-(aq) \rightarrow ClO_3^-(aq)+2Cl^-(aq)$ is an example of

(a) oxidation reaction
(b) reduction reaction
(c) disproportionation reaction
(d) decomposition reaction

Karnataka CET-2017
CG PET- 2013, SCRA - 2009

Ans. (c) : The reaction is a disproportionation reaction.

$3ClO^-(aq) \rightarrow ClO_3^-(aq)+2Cl^-(aq)$

Disproportionation reaction is a specific type of redox reaction in which a species is simultaneously reduced and oxidised from two different products.

$$3\overset{+1}{Cl}O^-(aq) \rightarrow \overset{+5}{Cl}O_3^-(aq) + 2\overset{-1}{Cl^-}(aq)$$

So, Cl is oxidised as well as reduced.

142. In the following reaction

$$3Br_2 + 6CO_3^{2-} + 3H_2O \rightarrow 5Br^- + BrO_3^- + 6HCO_3^-$$

(a) Bromine is reduce and carbonate is oxidised
(b) Bromine is oxidized and carbonate is reduce
(c) Bromine is neither oxidized nor reduced
(d) Bromine is reduced and oxidised

Assam CEE-2021
BITSAT-2005

Ans. (d) : In the reaction -

$$3Br_2 + 6CO_3^{2-} + 3H_2O \rightarrow 5Br^- + BrO_3^- + 6HCO_3^-$$

Here Br_2 reduced from 0 to –1 as well as oxidised from 0 to +5.

143. Which of the following involves transfer of five electrons ?

(a) $MnO_4^- \rightarrow Mn^{2+}$ (b) $CrO_4^{2-} \rightarrow Cr^{3+}$
(c) $MnO_4^- \rightarrow MnO_2$ (d) $Cr_2O_7^{2-} \rightarrow 2Cr^{3+}$

JEE Main-25.07.2021, Shift-II
(AIIMS-2014)

Ans. (a): $MnO_4^- \rightarrow Mn^{2+}$

The oxidation state of Mn in MnO_4^- is

$x + 4(-2) = -1$
$x - 8 = -1$
$x = 7$

The oxidation state of Mn in Mn^{2+} is +2

Hence, $MnO_4^- \rightarrow Mn^{2+}$ involve transfer of five electron.

144. Which of the following changes does not involve any electron transfer?

(a) $Na \rightarrow Na^+$ (b) $Zn^{2+} \rightarrow Zn$
(c) $Cr_2O_7^{2-} \rightarrow Cr_2O_4^{2-}$ (d) $VO^{2+} \rightarrow V_2O_3$

Assam CEE-2021, 2018

Ans. (c) : Following reaction does not involve any electron transfer.

$$\overset{+6}{Cr_2}O_7^{2-} \rightarrow \overset{+6}{Cr_2}O_4^{2-}$$

In this reaction oxidation state of Cr is +6 in reactant and oxidation state of Cr is +6 in product. Hence, the no electron transfer.

145. In which of the following reactions, H_2O_2 acts as a reducing reagent?

(a) $PbO_2(s)+H_2O_2(aq) \rightarrow PbO(s)+H_2O(l)+O_2(g)$
(b) $Na_2SO_3(aq)+H_2O_2(aq) \rightarrow Na_2SO_4(aq)+H_2O(l)$
(c) $2KI(aq)+H_2O_2(aq) \rightarrow 2KOH(aq)+I_2(s)$
(d) $KNO_2(aq)+H_2O_2(aq) \rightarrow KNO_3(aq)+H_2O(l)$

AP EAMCET- 2001, 2000

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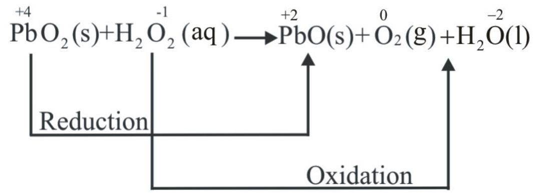
Ans. (a) :



$\overset{+4}{Pb}O_2(s) + H_2\overset{-1}{O_2}(aq) \longrightarrow \overset{+2}{Pb}O(s) + \overset{0}{O_2}(g) + H_2\overset{-2}{O}(l)$

146. Which quantities are conserved in all oxidation-reduction reaction?

(a) Charge only
(b) Mass only
(c) Both charge and mass
(d) Neither charge nor mass

COMEDK-2016
UPTU/UPSEE-2009

Ans. (c) : A redox reaction is a type of chemical reaction in which involves a transfer of electron. In a redox reaction, the mass of reactant particles is conserved. Electron are transferred between atoms, one donates and the other accepts. The charge of atoms depends on this gain or loss of electrons. A gain of electrons reduced the charge of an atom whereas loss of electron increase the charge. Hence, charge and mass conserve in an oxidation reduction reaction.

147. In an oxidation reduction reaction, dichromate ($Cr_2O_7^{2-}$) ion is reduced to Cr^{3+} ion. The equivalent weight of $K_2Cr_2O_7$ in this reaction is

(a) $\frac{\text{molecular weight}}{3}$ (b) $\frac{\text{molecular weight}}{6}$

(c) $\frac{\text{molecular weight}}{1}$ (d) $\frac{\text{molecular weight}}{2}$

UP CPMT-2008
AP-EAMCET (Medical)-2007

Ans.(b): $K_2\overset{+6}{C}r_2O_7 + 4H_2SO_4 \longrightarrow K_2SO_4 + \overset{+3}{Cr_2}(SO_4)_3 + 4H_2O + 3[O]$

Equivalent weight

$$= \frac{\text{Molecular weight}}{\text{Change in O.S. of atom present in one molecule}}$$

$$\therefore \ \text{Equivalent weight} = \frac{\text{Molecular weight}}{2\times3}$$

$$= \frac{\text{Molecular weight}}{6}$$

148. Which of the following is a redox reaction ?

(a) Evaporation of H_2O
(b) Both oxidation and reduction
(c) H_2SO_4 with NaOH
(d) In atmosphere O_3 from O_2 by lightening

AIIMS-2013, NEET-1997

Ans. (b) : A redox reaction can be defined as a chemical reaction in which electrons are transferred between two reactants participating in it.

Redox Reaction = oxidation + reduction

So, redox reaction follows the both oxidation as well as reduction.

149. $KMnO_4$ acts as an oxidising agent in alkaline medium. When alkaline $KMnO_4$ is treated with KI, iodide ion is oxidised to

(a) I_2 (b) IO^-
(c) IO_3^- (d) IO_4^-

Karnataka-CET-2018
Assam CEE-2018

Ans. (c) :

$2KMnO_4 + H_2O + KI \longrightarrow 2MnO_2 + KOH + KIO_3$

$I + 6OH^- \longrightarrow IO_3^- + 3H_2O + 6e^-$

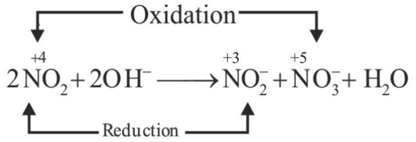
When alkaline $KMnO_4$ is treated with KI, I is oxidized to IO_3^-.

150. Identify disproportionation reaction.

(a) $CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$
(b) $CH_4 + 4Cl_2 \rightarrow CCl_4 + 4HCl$
(c) $2F_2 + 2OH^- \rightarrow 2F^- + OF_2 + H_2O$
(d) $2NO_2 + 2OH^- \rightarrow NO_2^- + NO_3^- + H_2O$

JIPMER-2018
JCECE - 2015

Ans. (d) :



$2\overset{+4}{N}O_2 + 2OH^- \longrightarrow \overset{+3}{N}O_2^- + \overset{+5}{N}O_3^- + H_2O$

Since, in above reaction, the same element, i.e. N is reduced as well as oxidised, so it is a disproportionation reaction.

151. In basic medium, H_2O_2 exhibits which of the following reactions?

A. $Mn^{2+} \rightarrow Mn^{4+}$
B. $I_2 \rightarrow I^-$
C. $PbS \rightarrow PbSO_4$

Choose the most appropriate answer from the options given below.

(a) A and C (b) Only A
(c) Only B (d) A and B

[JEE Main 2021, 18 March Shift-II]

Ans. (d) : In basic medium, oxidising action of H_2O_2

$Mn^{2+} + H_2O_2 \rightarrow Mn^{+4} + 2OH^-$

and $I_2 + H_2O_2 + 2OH^- \rightarrow 2I^- + 2H_2O + O_2$

and In acidic medium oxidising action of H_2O_2

$PbS(s) + 4H_2O_2(aq) \rightarrow PbSO_4(s) + 4H_2O(l)$

152. To oxidize 1 mole sulphite ion in acid medium, tell the required molar amount of $KMnO_4$

(a) 1/5 (b) 2/5
(c) 3/5 (d) 4/5

Tripura JEE-2021

Ans. (b) :

$2MnO_4^- + 5SO_3^{2-} + 6H^+ \rightarrow 2Mn^{2+} + 5SO_4^{2-} + 3H_2O$

Since, 5 moles of sulphite ions react with 2 moles of MnO_4^-.

So, 1 mole of sulphite ions react with 2/5 moles of MnO_4^-.

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153. Observe the following redox reaction:
$NaNO_3 + aZn + bNaOH \rightarrow NH_3 + cNa_2ZnO_2 + H_2O$
Which one will be the correct value of a, b and c among the following?

(a) 2, 4, 2 (b) 3, 8, 3
(c) 1,3,1 (d) 4,7,4

Tripura JEE-2021

Ans. (d) : The redox reaction are given below–
$NaNO_3 + 4Zn + 7NaOH \rightarrow NH_3 + 4Na_2ZnO_2 + H_2O$

154. Given below are two statements.
Statement I : Potassium permanganate on heating at 573 K forms potassium manganate.
Statement II : Both potassium permanganate and potassium manganate are tetrahedral and paramagnetic in nature.
In the light of the above statements, choose the most appropriate answer from the options given below

(a) Statement I is true but statement II is false.
(b) Both statement I and statement II are true.
(c) Statement I is false but statement II is true.
(d) Both statement I and statement II are false.

[JEE Main 2021, 17 March Shift-I]

Ans. (a) : $\underset{\text{Potassium permanganate}}{2K\overset{+7}{Mn}O_4} \xrightarrow{573k} K_2\overset{+6}{M}nO_4 + MnO_2 + O_2$

$KMnO_4$ and K_2MnO_4, both are tetrahedral. In $KMnO_4$ is diamagnetic and K_2MnO_4 is paramagnetic.
So, statement I is true but statement II is false.

155. Which of the following equations depicts the oxidizing nature of H_2O_2 ?

(a) $Cl_2 + H_2O_2 \rightarrow 2HCl + O_2$
(b) $KIO_4 + H_2O_2 \rightarrow KIO_3 + H_2O + O_2$
(c) $2I^- + H_2O_2 + 2H^+ \rightarrow I_2 + 2H_2O$
(d) $I_2 + H_2O_2 + 2OH^- \rightarrow 2I^- + 2H2O + O_2$

JEE Main 25-02-2021, Shift-I

Ans. (c) : (i) $\overset{0}{Cl}_2 + H_2\overset{-1}{O}_2 \rightarrow 2H\overset{-1}{Cl} + \overset{0}{O}_2$

(ii) $K\overset{+7}{I}O_4 + H_2\overset{-1}{O}_2 \rightarrow K\overset{+5}{I}O_3 + H_2\overset{-2}{O} + \overset{0}{O}_2$

Reduction

(iii)

Oxidation

$2I^- + H_2O_2 + 2H^+ \rightarrow \overset{0}{I}_2 + 2H\overset{-2}{O}$

Reduction

O reduces from –1 to –2 so, reduction take place. Hence, it will behave as oxidising agent.

156. Which of the following is not a disproportionation reaction?

(a) $Cl_2(g) + 2OH^-(aq) \rightarrow ClO^-(aq) + Cl^-(aq) + H_2O$
(b) $F_2(g) + 2OH^-(aq) \rightarrow OF_2(g) + 2F^-(aq) + H_2O(l)$
(c) $4ClO_3^-(aq) \rightarrow Cl^-(aq) + 3ClO_4^-(aq)$
(d) $4ClO^-(aq) \rightarrow 2Cl^-(aq) + ClO_3^-(aq)$

TS-EAMCET (Engg.), 06.08.2021

Ans. (b): That reaction in which same substance undergoes oxidation as well as reduction to give two different products called disproportionation reaction.
$2F_2(g) + 2OH^-(aq) \rightarrow OF_2(g) + 2F^-(aq) + H_2O(l)$
So, the above reaction is not disproportionation reaction.

157. Given below are two statements:
Statement I: H_2O_2 can act as both oxidizing and reducing agent in basic medium.
Statement II: In the hydrogen economy, the energy is transmitted in the form of dihydrogen.
In the light of the above statements, choose the correct answer from the options given below:

(a) Both statement I and statement II are true
(b) Both statement I and statement II are false
(c) Statement I is true but statement II is false
(d) Statement I is false but statement II is true

JEE Main 16.03.2021, Shift-I

Ans. (a) : Statement I is correct because H_2O_2 acts as oxidizing and reducing agent in acidic as well as basic medium. Dihydrogen is ecofriendly and releases more energy than petrol. Hydrogen economy refers to the transmission of this energy in the form of dihydrogen. Hence, both statement are true.

158. (A) $HOCl + H_2O_2 \rightarrow H_3O^+ + Cl^- + O_2$
(B) $I_2 + H_2O_2 + 2OH^- \rightarrow 2I^- + 2H_2O + O_2$
Chose the correct option.

(a) H_2O_2 acts as oxidising agent in equations (A) and (B).
(b) H_2O_2 acts as reducing agent in equations (A) and (B).
(c) H_2O_2 acts as oxidizing and reducing agent respectively in equations (A) and (B).
(d) H_2O_2 acts as reducing and oxidising agent respectively in equation (A) and (B).

JEE Main 24.02.2021, Shift-I

Ans. (b) : The given reaction are:
(A) $HOCl + H_2O_2 \longrightarrow H_3O^+ + Cl^- + O_2$
(B) $I_2 + H_2O_2 + 2OH^- \longrightarrow 2I^- + 2H_2O + O_2$
H_2O_2 acts as an oxidising as well as reducing agent in both acidic and alkaline media. In first reaction, HOCl is an acid hence H_2O_2 acts as a reducing agent. The second reaction is take place in basic medium hence the H_2O_2 acts as reducing agent. Hence statement (b) is correct option.

159. Which among the following species doesn't show disproportionation reaction?

(a) ClO^- (b) ClO_2^-
(c) ClO_3^- (d) ClO_4^-

AP EAPCET 20.08.2021 Shift-I

Ans. (d) : A disproportionation reaction is a reaction in which a compound undergoes oxidation as well as reduction ClO_4^- does not show disproportionation reaction.

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160. Which of the following is not a disproportionation reaction?

(a) $P_4 + 5OH^- \longrightarrow H_2PO_2^- + PH_3$

(b) $Cl_2 + OH^- \longrightarrow Cl^- + ClO$

(c) $2H_2O_2 \longrightarrow 2H_2O + O_2$

(d) $PbO_2 + H_2O \longrightarrow PbO + H_2O_2$

BITSAT-2020

Ans. (d) : Disproportionation reaction means both oxidation and reduction.

Option (a), (b) and (c) is the disproportion reaction because oxidation reduction both follow.

and in the reaction-

$PbO_2 + H_2O \rightarrow PbO + H_2O_2$

$$\overset{x+2(-2)=0}{x=4} \xrightarrow[\text{oxidation}]{\text{loss of } e^-} \overset{x+(-2)=0}{x=2}$$

So this is not a Disproportionation reaction.

161. Which oxide among the following cannot act as a reducing agent ?

(a) SO_2 (b) NO_2

(c) CO_2 (d) ClO_2

AP EAMCET (Engg.) 18.9.2020 Shift-I

Ans. (c) : In CO_2, carbon present in the +4 oxidation state which is its maximum oxidation state. So, it cannot act as a reducing agent.

162. Which of the following represents disproportionation of potassium chlorate ?

(a) $2KClO_3 \rightarrow 2KCl + 3O_2$

(b) $3KClO_3 \rightarrow 2KClO_2 + KClO_3$

(c) $4KClO_3 \rightarrow 3KClO_4 + KCl$

(d) None of the above

AP EAMCET (Engg.) 21.09.2020, Shift-I

Ans. (c) : $4K\overset{(+5)}{Cl}O_3 \rightarrow 3K\overset{(-7)}{Cl}O_4 + K\overset{(-1)}{Cl}$

Potassium chlorate disproportionate into potassium perchlorate and potassium chloride at higher temperature. Hence, the correct option is (c).

163. The redox reaction among the following is

(a) reaction of H_2SO_4 with NaOH

(b) reaction of $[Co(H_2O)_6]\,Cl_3$ with $AgNO_3$

(c) combination of dinitrogen with dioxygen at 2000 K

(d) formation of ozone from atmospheric oxygen in the presence of sunlight

[JEE Main 2020, 7 Jan Shift-II]

Ans. (c) : Combination of dinitrogen with dioxygen at 2000 K.

$N_2(g) + O_2(g) \rightarrow 2NO(g)$

Oxidation state of N in $N_2 = 0$

Oxidation state of O in $O_2 = 0$

As in this case, there is addition of oxygen taking place so its oxidation.

So, change in oxidation state of N from 0 to +2 oxidation state and reduction for oxygen from 0 to –2.

164. Which of the following oxides can act both as an oxidising agent as well as reducing agent?

(a) N_2O (b) SO_2

(c) SO_3 (d) P_2O_5

MHT CET-03.05.2019, SHIFT-I

Ans. (b) : In SO_2, the oxidation state of sulphur is–

$x + 2(-2) = 0$

$x = +4$

SO_2 : Sulphur is present in +4 oxidation state so it can act as both oxidizing as well as reducing agent.

165. Consider the change in oxidation state if bromine corresponding to different emf values as shown in the given diagram :

$$BrO_4^- \xrightarrow{1.82V} BrO_3^- \xrightarrow{1.5V} HBrO \xrightarrow{1.595V} Br_2 \xrightarrow{1.0652V} Br^-$$

Then the species undergoing disproportionation is

(a) BrO_3^- (b) BrO_4^-

(c) Br_2 (d) HBrO

NEET-2018

Ans. (d) : HBrO will disproportionation to BrO_3^- and Br_2

$$H\overset{+1}{Br}O \rightarrow \overset{0}{Br_2}, \quad E^o_{HBrO/Br_2} = 1.595V$$

$$H\overset{+1}{Br}O \rightarrow \overset{+5}{Br}O_3^-, \quad E^o_{BrO_3^-/HBrO} = 1.5V$$

$\therefore$ E^o_{cell} for the disproportionation of HBrO.

So, $E^o_{cell} = E^o_{HBrO/Br_2} - E^o_{BrO_3^-/HBrO}$

$= 1.595 - 1.5$

$= 0.095$ V = +ve

The positive value of net cell reaction indicates that the overall cell reaction.

166. How many electrons are involved during the oxidation reaction of $KMnO_4$ in acidic medium?

(a) 1 (b) 3

(c) 5 (d) 4

J & K CET-(2018)

Ans. (c) : Acidic medium the oxidation state of the 'Mn' atom in $KMnO_4$ is +7 in an acidic medium,

$MnO_4^- + 8H^+ + 5e^- \rightarrow Mn^{2+} + 4H_2O$

$MnO_4^- \rightarrow Mn^{2+}$

Change the oxidation state = $7 - 2 = +5$

167. Which of the following is the disproportionation redox reaction?

(a) $2CH_3COOH \xrightarrow{P_2O_5/\Delta}$

(b) $2CH_3CHO \xrightarrow{\text{dil NaOH}}$

(c) $2CH_3COCH_3 \xrightarrow[H_2O]{\text{Mg-Hg}}$

(d) $2HCHO \xrightarrow{50\%\,NaOH(aq)}$

GUJCET-2017

Ans. (d) : $2HCHO \xrightarrow{50\%\,NaOH(aq)} NaCHO_2 + H_2O$ is a disproportionation reaction.

@apna_pdf

168. Which of the following reactions is an example of a redox reaction?

(a) $XeF_4 + O_2F_2 \rightarrow XeF_6 + O_2$

(b) $XeF_2 + PF_5 \rightarrow [XeF]^+ PF_6^-$

(c) $XeF_6 + H_2O \rightarrow XeOF_4 + 2HF$

(d) $XeF_6 + 2H_2O \rightarrow XeO_2F_2 + 4HF$

[JEE Main 2017]

Ans. (a) : The reaction -
$XeF_4 + O_2F_2 \rightarrow XeF_6 + O_2$ is a redox reaction .
Where Xenon (Xe) is oxidized and oxygen (O_2) is reduced. In the above given chemical eq^n.
The oxidation no. of Xe increase from + 4 to +6 and oxidation no. of oxygen decreases from +1 to 0.
So, this is the redox reaction.

169. Which reaction represents the oxidising behaviour of H_2SO_4 ?

(a) $NaCl + H_2SO_4 \rightarrow NaHSO_4 + HCl$

(b) $2NaOH + H_2SO_4 \rightarrow Na_2SO_4 + 2H_2O$

(c) $2HI + H_2SO_4 \rightarrow I_2 + SO_2 + 2H_2O$

(d) $2PCl_5 + H_2SO_4 \rightarrow 2POCl_3 + SO_2Cl_2 + 2HCl$

JCECE - 2016

Ans. (c) : $2HI + H_2SO_4 \rightarrow I_2 + SO_2 + 2H_2O$
In above reaction shows the oxidising behaviour of H_2SO_4. The oxidation no. of iodine increases from –1 (in HI) to 0 in I_2. Thus, iodine is oxidised. Rest of all, there is no change in the oxidation no.

$$H_2\overset{+6}{S}O_4 \rightarrow \overset{+4}{S}O_2$$

Here, oxidation number of 'S' decreases by two, thus this is a reduction reaction and H_2SO_4 behaves as oxidizing agent.

170. Which of the following acts as both reducing and oxidising agents?

(a) H_2SO_4	(b) HNO_3
(c) H_2O_2	(d) $KMnO_4$

BCECE-2016

Ans. (c) : Sulphur, nitrogen and Mn are in their maximum oxidation state. So, can only able to reduce, thus only act as oxidizing agent only.
Here, H_2O_2 will act as both.
(i) In case of oxidizing agent

$$\overset{+1}{H_2}\overset{-1}{O_2} \rightarrow \overset{-2}{O}(H_2O)$$

(ii) In case of reducing agent

$$H_2\overset{-1}{O_2} \rightarrow O_2$$

171. The combustion of methane is written as –

$$CH_4(g) + 2O_2(g) \rightarrow CO_2(g) + 2H_2O(l)$$

The difference between enthalpy charge and energy change is equal to

(a) -2RT	(b) 0
(c) RT	(d) $\frac{RT}{2}$

SCRA-2015

Ans. (a) : Given the combustion of methane is –
$CH_4(g) + 2O_2(g) \rightarrow CO_2(g) + 2H_2O(l)$
Δn_g = No. of moles of product – No. of moles of reactant

$\Delta n_g = (1-3) = -2$

$\therefore$ $\Delta H = \Delta U + \Delta n_g RT$

or $\Delta H - \Delta U = -2RT$

172. Strongest reducing agent among the following is

(I) $Na^+ + e^- \longrightarrow Na(s); E° = -2.71V$

(II) $Al_3 + 3e^- \longrightarrow Al(s); E° = -1.66V$

(iii) $F_{2(g)} + 2e^- \longrightarrow 2F^-; E° == 2.87V$

(iv) $2H_2O + 2e^- \longrightarrow H_2(g) + 2OH^-(aq); E° = -0.83V$

(a) (IV)	(b) (III)
(c) (II)	(d) (I)

COMEDK-2015

Ans. (d) : Lower the E° value (more negative), stronger is the reducing agent.

173. Choose the correct statement applicable for the reaction : $2H_2O + 2F_2 \longrightarrow 4HF + O_2$

(a) Water is oxidized to O_2.

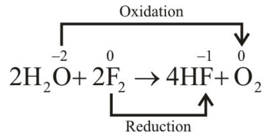
(b) F_2 is oxidized to HF.

(c) Water is reduced to HF.

(d) F_2 acts as reducing agent in the reaction.

COMEDK 2015

Ans. (a) :



$$2H_2\overset{-2}{O} + 2\overset{0}{F_2} \rightarrow 4H\overset{-1}{F} + \overset{0}{O_2}$$

In this reaction water is oxidised to O_2.

174. When $KMnO_4$ acts as an oxidizing agent and ultimately forms MnO_4^{2-} , MnO_2, Mn_2O_3 and Mn^{2+}, then the number of electrons transferred in each case respectively are

(a) 1, 3, 4, 5	(b) 3, 2, 1, 4
(c) 1, 5, 3, 7	(d) 4, 3, 2, 1

JIPMER-2015

Ans. (a) : $KMnO_4 \xrightarrow{+1e^-} MnO_4^{2-}$

$KMnO_4 \xrightarrow{+3e^-} MnO_2$

$KMnO_4 \xrightarrow{+4e^-} Mn_2O_3$

$KMnO_4 \xrightarrow{+5e^-} Mn^{2+}$

So, number of electron transferred is– 1, 3, 4, 5

175. In the redox reaction,

$$MnO^-{}_4 + 8H^+ + 5Br^- \rightarrow Mn^{2+} + 4H_2O + \frac{5}{2}Br_2$$

which one is the reducing agent?

(a) H^+	(b) MnO_4^-
(c) Br^-	(d) Mn^{2+}

AMU-2014

@apna_pdf

Ans. (c) : Given the redox reaction is -

Reduction

$$\overset{+7}{MnO_4^-} + 8H^+ + 5Br^- \rightarrow Mn^{2+} + 4H_2O + \frac{5}{2}\overset{0}{Br_2}$$

Oxidation

So, In this reaction Br^- reduces $KMnO_4^-$ into Mn^{2+} and itself gets oxidised into Br_2. So, it acts as the reducing agent.

176. The compound that can work both as an oxidizing as well as reducing agent is

(a) $KMnO_4$ (b) H_2O_2

(c) $Fe_2(SO_4)_3$ (d) $K_2Cr_2O_7$

UPTU/UPSEE-2014

Ans. (b) : Hydrogen peroxide (H_2O_2) acts as oxidizing as well as reducing agent in both as acidic as well as basic medium. The oxidation state of oxygen in hydrogen peroxide is –1 can be oxidised to O_2 is zero and reduced to H_2O in oxidation of oxygen is –2.

$$H_2\overset{-1}{O_2} \rightarrow H_2\overset{-2}{O} + \overset{0}{O_2}$$

177. The reaction.
$10FeSO_4+2KMnO_4+8H_2SO_4 \rightarrow 2MnSO_4+5Fe_2(SO_4)_3+K_2SO_4+8H_2O$
is an example of reaction of

(a) disproportionation

(b) intermolecular redox

(c) intramolecular redox

(d) None of these

UPTU/UPSEE-2014

Ans. (b) : In intermolecular redox reaction oxidation reduction takes place when molecules of two different substance react each others.

$$10\overset{+2}{Fe}SO_4 + 2K\overset{+7}{Mn}O_4 + 8H_2SO_4 \rightarrow 2\overset{+2}{Mn}SO_4 + 5\overset{+3}{Fe_2}(SO_4)_3 + K_2SO_4 + 8H_2O$$

So, this reaction is intermolecular redox reaction.

178. The correct descending order of oxidizing power of the following is

(a) $Cr_2O_7^{2-} > MnO_4^- > VO_2^+$

(b) $MnO_4^- > Cr_2O_7^{2-} > VO_2^+$

(c) $VO_2^+ > MnO_4^- > Cr_2O_7^{2-}$

(d) $MnO_4^- > VO_2^+ > Cr_2O_7^{2-}$

(e) $Cr_3O_7^{2-} > VO_2^+ > MnO_4^-$

Kerala-CEE-2014

Ans. (b) : The species are given below–

(i) VO_2^+

$x + 2(-2) = +1$
$x - 4 = +1$
$x = +5$

(ii) $Cr_2O_7^{2-}$

$2x + 7(-2) = -2$
$2x - 14 = -2$
$2x = +12$
$x = +6$

(iii) MnO_4^-

$x + 4(-2) = -1$
$x - 8 = -1$
$x = +7$

Hence, the oxidizing power depend upon the stability of reduction. If oxidation no. increases then oxidizing power increases.

So, the order is $MnO_4^- > Cr_2O_7^{2-} > VO_2^+$.

179. The number of electrons that are involved in the reduction of permanganate to manganese (II) salt, manganate and manganese dioxide respectively are

(a) 5, 1, 3 (b) 5, 3, 1

(c) 2, 7, 1 (d) 5, 2, 3

(e) 2, 3, 1

Kerala-CEE-2014

Ans. (a) : The no. of e^- that are involved in the reduction of permanganate ion into manganese (II) salt

$$MnO_4^- \longrightarrow Mn^{2+}$$

$x + (-2) \times 4 = -1$ $x = +2$
$x = +7$

Change in no. of electrons = 7 – 2 = 5

The no. of e^- that are involved in the reduction of permanganate into manganate

$$MnO_4^- \longrightarrow MnO_4^{2-}$$

$x + (-2) \times 4 = -1$ $x + (-2) \times 4 = -2$
$x = 7$ $x = +6$

Change in no. of e^- = 7 – 6 = 1

The no. of e^- that are involved in the reduction of permanganate into manganese dioxide

$$MnO_4^- \longrightarrow \overset{+2}{MnO_2}$$

$x + (-2) \times 4 = -1$ $x + (-2) \times 2 = 0$
$x = +7$ $x = +4$

Change in no. of e^- = 7 – 4 = 3

180. In which of the following reactions H_2O_2 acts as a reducing agent?

A. $H_2O_2 + 2H^+ + 2e^- \rightarrow 2H_2O$

B. $H_2O_2 - 2e^- \rightarrow O_2 + 2H^+$

C. $H_2O_2 + 2e^- \rightarrow 2OH^-$

D. $H_2O_2 + 2OH^- - 2e^- \rightarrow O_2 + 2H_2O$

(a) A, B (b) C, D

(c) A, C (d) B, D

[JEE Main 2014]

Ans. (d) :

(a) $H_2O_2 + 2H^+ + 2e^- \rightarrow 2H_2O$

H_2O_2 loses an O atom and it reduced.

(b) $H_2O_2 + 2e^- \rightarrow O_2 + 2H^+$

mole of H_2O_2 loses $2e^-$ and is oxidized

(c) $H_2O_2 + 2e^- \rightarrow 2(OH^-)$

H_2O_2 gains 2 electrons and is reduced.

(d) $H_2O_2 + 2OH^- + 2e^- \rightarrow O_2 + 2H_2O$

Molecules of H_2O_2 loses hydrogen and is oxidized.

181. On heating, chloric acid decomposes to

(a) $HClO_4$, Cl_2, O_2 and H_2O

(b) $HClO_2$, Cl_2, O_2 and H_2O

(c) $HClO$, Cl_2O and H_2O_2

(d) HCl, HClO, Cl_2O, and H_2O

WB-JEE-2013

@apna_pdf

Ans. (a) : In the heating chloric acid decomposes to

$$3HClO_3 \xrightarrow{\Delta} HClO_4 + Cl_2 + 2O_2 + H_2O$$

182. In the reaction Pb(s) + Cu^{2+}(aq) → Pb^{2+}(aq) + Cu(s) which is reducing agent?

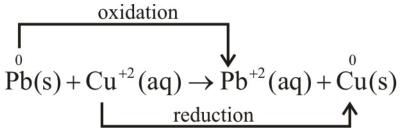
(a) Pb^{2+}(aq) (b) Cu^{2+}(aq)
(c) Pb(s) (d) Cu(s)

MPPET-2013

Ans. (c) : A reducing agent is an element or compound that loses an electron to another substance in a redox reaction. The reducing agent after losing electrons gets oxidised.

Here, Pb ion loses 2 electrons and gets oxidised to Pb^{2+}.

Hence, it is a reducing agent.



$$\overset{0}{Pb}(s) + Cu^{+2}(aq) \rightarrow Pb^{+2}(aq) + \overset{0}{Cu}(s)$$

183. In which of the following reactions, H_2O_2 acts as oxidizing agent?

(a) $Cl_2 + H_2O_2 \rightarrow 2HCl + O_2$
(b) $Ag_2O + H_2O_2 \rightarrow 2Ag + H_2O + O_2$
(c) $2NaOH + H_2O_2 \rightarrow Na_2O_2 + 2H_2O$
(d) $KNO_2 + H_2O_2 \rightarrow KNO_3 + H_2O$

AP EAMCET (Medical) - 2013

Ans. (d) : For the reaction-

$$KNO_2 + H_2O_2 \longrightarrow KNO_3 + H_2O$$

1+x–2(2) = 0 1+x–6 = 0
x = +3 x = +5

The oxidation state of N increases from +3 to +5. Thus, H_2O_2 act as a oxidising agent.

184. Fluorine reacts with $KHSO_4$ to form HF and $\underline{X}$. Which one of the following is $\underline{X}$?

(a) SO_3 (b) K_2SO_4
(c) $K_2S_2O_8$ (d) H_2S

AP EAMCET (Medical) - 2013

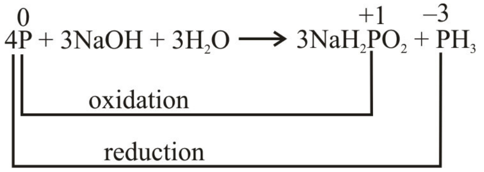
Ans. (c) : Fluorine reacts with potassium hydrogen sulphate to form hydrogen fluorite (HF) and potassium per sulphate. The oxidation state of S in $KHSO_4$ is +6 and $K_2S_2O_8$ is +7 .

185. 4P + 3NaOH + $3H_2O$ → $3NaH_2PO_2$ + PH_3 In the above reaction, find the element undergoing both oxidation and reduction,

(a) Na (b) P
(c) H (d) O

SRMJEEE – 2013

Ans. (b) :



$$\overset{0}{4P} + 3NaOH + 3H_2O \longrightarrow 3NaH_2\overset{+1}{P}O_2 + \overset{-3}{P}H_3$$

Hence, P (Phosphorous) is undergoing both oxidation and reduction in the given reaction.

186. See the following redox reaction

$A^{2+} + 2e^- \rightarrow A; E^0 = +0.34V$

$A^+ + e^- \rightarrow A; E^0 = +0.52V$

Which ion is expected to be stable?

(a) A^{2+}
(b) A^+
(c) Both can form stable complexes
(d) None can from stable complexes

CG PET- 2013

Ans. (a) : For given reaction E^0 is minimum, so ion is expected to be stable and E^0 is maximum so ion is not expected to be stable.

Thus, the equation -

$A^{2+} + 2e^- \rightarrow A, E^0 = +0.34V$

Thus, A^{2+} is stable.

187. What is Z in the following reactions?

$$BCl_3 + H_3 \xrightarrow[450^0C]{Cu-Al} X + HCl, X \xrightarrow{methylation} Z$$

(a) $(CH_3)BH_2$ (b) $(CH_3)_4B_2H_2$
(c) $(CH_3)_3B_2H_3$ (d) $(CH_3)_6B_2$

AP EAMCET (Engg.) - 2012

Ans. (b) : $BCl_3 + 3H_2 \xrightarrow[450°C]{Cu-Al} \underset{\substack{Diborane\\(X)}}{B_2H_6} + 6HCl$

$$\underset{(X)}{B_2H_6} + 4CH_3Cl \xrightarrow{methylation} \underset{(Z)}{(CH_3)_4B_2H_2} + 4HCl$$

In this reaction X is diborane (B_2H_6) and Z is $(CH_3)_4B_2H_2$.

188. The strength of an aqueous solution of I_2 can be determined by titrating the solution with standard solution of:

(a) oxalic acid (b) sodium thiosulphate
(c) sodium hydroxide (d) mohr's salt

(AIIMS-2012)

Ans. (b): The strength of an aqueous solution of I_2 can be determined by titrating the solution with standard solution is Sodium Thiosulphate –

$$I_2 + \underset{\substack{Sodium\\thiosulphate}}{2Na_2S_2O_3} \rightarrow Na_2S_4O_6 + 2NaI$$

189. The reaction, $2H_2O_2 \rightarrow 2H_2O + O_2$; shows that H_2O_2

(a) is decomposed
(b) acts as oxidizing agent
(c) acts as reducing agent
(d) None of the above

UP CPMT-2012

Ans. (a) : H_2O_2 decomposes on standing or heating. It is an example of auto oxidation-reduction.

$$2H_2\overset{-1}{O_2} \rightarrow 2H_2\overset{-2}{O} + \overset{0}{O_2}$$

190. The correct order of increasing oxidizing power in the series is

(a) $VO_2^+ < Cr_2O_7^{2-} < MnO_4^-$
(b) $Cr_2O_7^{2-} < VO_2^+ < MnO_4^-$
(c) $Cr_2O_7^{2-} < MnO_4^- < VO_2^+$
(d) $MnO_4^- < Cr_2O_7^{2-} < VO_2^+$

J & K CET-(2012)

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Ans. (a) : $VO_2^+ < Cr_2O_7^{2-} < MnO_4^-$

This is due to the increasing stability of the lower species to which they are reduced.

$MnO_4^-(Mn^{+7})$ is reduced to (Mn^{2+}) which is having half-filled d^5 stable configuration.

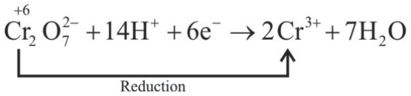
191. Which of the following does not/do not represent the correct equivalent mass of $Cr_2O_7^{2-}$ in the reaction

$Cr_2O_7^{2-} + 14H^+ + 6e^- \to 2Cr^{3+} + 7H_2O$?

(a) The molar mass of dichromate
(b) One third of the molar mass of dichromate
(c) One sixth of the molar mass of dichromate
(d) One half of the molar mass of dichromate

UPTU/UPSEE-2011

Ans. (a,b,d) :



$$\overset{+6}{Cr_2}O_7^{2-} + 14H^+ + 6e^- \to 2Cr^{3+} + 7H_2O$$

Reduction

$$\text{Equivalent weight} = \frac{\text{Molecular mass}}{\text{No.of } e^- \text{ involved}}$$

$$\text{Equivalent weight} = \frac{294.26}{6} = 49\,g/eq.$$

Hence, the option (a), (b) and (d) do not represent correct equivalent mass of $Cr_2O_7^{2-}$ in the reaction.

192. What products are expected from the dispropotionation reaction of hypochlorous acid?

(a) $HClO_3$ and Cl_2O
(b) $HClO_2$ and $HClO_4$
(c) HCl and Cl_2O
(d) HCl and $HClO_3$

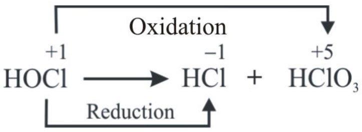
JCECE - 2011

Ans. (d) : In disproportionation reaction, the same element is oxidised as well as reduced.

In HOCl, the oxidation state of Cl is +1.

In $HClO_3$, Cl_2O, $HClO_2$, $HClO_4$ and HCl, the oxidation states of Cl are +5, +1, +3, +7 and –1 respectively.

Thus, the disproportionation products are HCl and $HClO_3$.



193. Consider the following equation, which represents a reaction in the extraction of chromium from its ore

$$2Fe_2O_3.Cr_2O_3 + 4Na_2CO_3 + 3O_2 \longrightarrow 2Fe_2O_3 + 4Na_2CrO_4 + 4CO_2$$

Which one of the following statements about the oxidation states of the substances is correct?

(a) The iron has been reduced from +3 to +2 state.
(b) The chromium has been oxidised from +3 to +6 state.
(c) The carbon has been oxidised from +2 to +4 state.
(d) There is no change in the oxidation state of the substances in the reaction.

VITEEE- 2011

Ans. (b) : The given redox reaction is :

$$2\overset{+3}{Fe_2}O_3\cdot Cr_2O_3 + 4Na_2\overset{+4}{C}O_3 + 4O_2 \to 2\overset{+3}{Fe_2}O_3 + 4Na_2CrO_4 + 4\overset{+4}{C}O_2$$

Hence, the oxidation occurred in chromium from + 3 to +6.

194. In oxidation

1. Hydrogen is displaced from a substance

2. an electropositive element is added to or proportion of electropositive element increases in substance

Select the correct answer using the code given below :

(a) 1 only
(b) 2 only
(c) Both 1 and 2
(d) Neither 1 nor 2

NDA (II)-2011

Ans : (a) In oxidation, hydrogen is displayed from a substance.

• Oxidation is a process where in a synthetic substance changes as a result of the expansion of oxygen in oxidation reaction an element combines with oxygen and removal of hydrogen.

195. When a copper rod is dipped in aqueous silver nitrate solution, the colour of the solution changes to blue. This is because

(a) Cu is more easily reduced than Ag
(b) Ag is more easily reduced than Cu
(c) Nitrate ion acts as an oxidizing agent
(d) Nitrate ion acts as a reducing agent

NDA (II)-2011

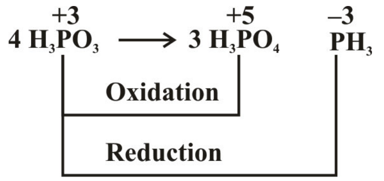
Ans : (a) When a copper rod is dipped in aqueous silver nitrate solution, the colour of the solution changes to blue because copper is more easily reduced than silver.

196. $4H_3PO_3 \to 3H_3PO_4 + PH_3$, in this reaction, phosphorus in H_3PO_3 undergoes

(a) oxidation
(b) reduction
(c) hydrolysis
(d) both (a) and (b).

SRMJEEE – 2011

Ans. (d) :



Therefore, P in H_3PO_3 undergoes both oxidation as well as reduction.

197. A gas X at 1 atm is bubbled through a solution containing a mixture of 1 M Y^- and 1 MZ^- at 25°C . If the reduction potential is Z > Y > X, then

(a) Y will oxidise X and not Z
(b) Y will oxidise Z and not X

@apna_pdf

(c) Y will oxidis both X and Z
(d) Y will reduce both X and Z

BITSAT-2011

Ans. (a) : Given the order of reduction potential $Z > Y > X$

So, higher reduction potential means self reduction of species but oxidised others (oxidising agent).

And lower reduction potential means self oxidation of species but reduce others (reducing agent).

Thus, Y will oxidize X and not Z.

198. Which of the following can be the oxidizing as well as reducing agent?

(a) MnO_4^- (b) CrO_4^-
(c) H_2O_2 (d) $Cr_2O_7^-$

SCRA-2010

Ans. (c) : H_2O_2 can acts oxidizing as well as reducing agent. Oxygen is present in –1 oxidation states. The oxidising activity of hydrogen peroxide results from the presence of extra oxygen atom compared with the structure of water.

199. Oxidation potential of unimoles of calomel is

(a) + 0.25 V (b) 0.00 V
(c) + 0.287 V (d) – 0.28 V

MHT CET-2010

Ans. (d) : The calomel electrode is a saturated calomel electrode (SCE) is a reference electrode based on the reaction between elemental mercury and mercury(I) chloride. The electrode reaction when the electrode acts as cathode is–

$$\frac{1}{2}Hg_2Cl_2 + e^- \rightleftharpoons Hg + Cl^-$$

Hence, the oxidation potential of unimoles of calomel is –0.28V.

200. Which of the following species can function both as oxidizing as well as reducing agent?

(a) Cl^- (b) ClO_4^-
(c) ClO^- (d) MnO_4^-
(e) NO_3^-

Kerala-CEE-2010

Ans. (c) :

Species	O.N
Cl^-	–1
ClO_4^-	+7
ClO^-	+1
MnO_4^-	+7
NO_3^-	+5

In all the given species except ClO^-, the chlorine element have minimum or maximum oxidation state, and they can't for the decrease & increase oxidation state So, In ClO^-, the oxidation state of Cl be a reducing agent.

201. The reduction potential values of X, Y and Z are – 3.05 V, – 0.44 V and 0.83 V respectively. Which of the following order is correct with respect to their reducing property?

(a) $X > Y > Z$ (b) $X > Z > Y$
(c) $Y > Z > X$ (d) $Z > Y > X$

J & K CET-(2010)

Ans. (b) : The reduction potential have more negative value then its shows the stronger reducing nature. The order of reduction potential values with negative sign of given element is-

$$\underset{(-3.05)}{X} > \underset{(-0.83V)}{Z} > \underset{(-0.44v)}{Y}$$

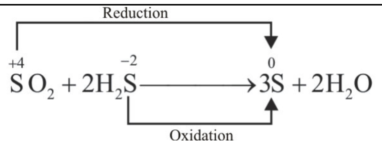
So, the order of reducing property is $X > Z > Y$.

202. In the reaction, $SO_2 + 2H_2S \longrightarrow 3S + 2H_2O$ the substance oxidised is

(a) H_2S (b) SO_2
(c) S (d) H_2O

JCECE - 2010

Ans. (a) :



$$\overset{+4}{S}O_2 + 2H_2\overset{-2}{S} \longrightarrow 3\overset{0}{S} + 2H_2O$$

∴ H_2S is oxidised in this reaction whereas SO_2 get reduced.

203. The reaction that takes place when Cl_2 gas is passed through conc. NaOH solution is

(a) oxidation (b) reduction
(c) displacement (d) disproportionation

WB-JEE-2009

Ans. (d) : $3\overset{0}{Cl_2} + 6NaOH \rightarrow Na\overset{+5}{Cl}O_3 + 5Na\overset{-1}{Cl} + 3H_2O$

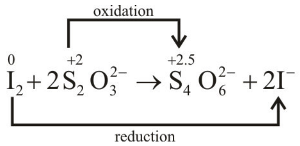
In this reaction chlorine is oxidized to $NaClO_3$ and reduced to NaCl. So this a disproportination in which a substance is simultaneously oxidized and reduced.

204. $I_2 + 2S_2O_3^{2-} \longrightarrow S_4O_6^{2-} + 2I^-$

(a) iodine is reduced, sulphur is reduced
(b) iodine is reduced, sulphur is oxidised
(c) iodine is oxidised, sulphur is reduced
(d) iodine is oxidised, sulphur is oxidised

UP CPMT-2009

Ans. (b):



$$\overset{0}{I_2} + 2\overset{+2}{S_2}O_3^{2-} \rightarrow \overset{+2.5}{S_4}O_6^{2-} + 2I^-$$

The oxidation state of iodine goes 0 to –1. The oxidation state of sulphur goes +2 to 2.5.

Hence, iodine is reduced, sulphur is oxidised.

205. Lead nitrate on heating gives lead oxide, nitrogen dioxide and oxygen. This reaction is known as

(a) Combustion (b) Combination
(c) Displacement (d) Decomposition

MPPET- 2009

Ans. (d) : Decomposition reaction in which compound break down into two or more simpler substances. Lead nitrate on heating decomposes to lead oxide, nitrogen dioxide and oxygen.

$$2Pb(NO_3)_2 \xrightarrow{\Delta} 2PbO + 4NO_2 + O_2$$

@apna_pdf

206. The value of 'n' in the reaction:

$$\mathbf{Cr_2O_7^{2-} + 14H^+ + nFe^{2+} \rightarrow 2Cr^3 + nFe^{3+} + 7H_2O}$$

Will be

(a) 2 (b) 3
(c) 6 (d) 7

MPPET-2008

Ans. (c) :

$Cr_2O_7^{2-} + 14H^+ + 6Fe^{2+} \rightarrow 2Cr^{3+} + 6\ Fe^{3+} + 7H_2O$

Hence, the value of n is +6.

207. Which one of the following reactions occur at the cathode?

(a) $2OH^- \longrightarrow H_2O + 1/2O_2 + 2e^-$
(b) $Ag \longrightarrow Ag^+ + e^-$
(c) $Fe^{2+} \longrightarrow Fe^{3+} + e^-$
(d) $Cu^{2+} + 2e^- \longrightarrow Cu$

AP-EAMCET (Medical), 2008

Ans. (d) :

$$2OH^- \rightarrow H_2O + \frac{1}{2}O_2 + 2e^{\ominus} \quad \text{(oxidation)}$$
$$Ag \rightarrow Ag^+ + e^{\ominus} \quad \text{(oxidation)}$$
$$Fe^{2+} \rightarrow Fe^{3+} + e^{\ominus} \quad \text{(oxidation)}$$
$$Cu^{2+} + 2e^{\ominus} \rightarrow Cu \quad \text{(reduction)}$$

As we know oxidation occurs at the anode whereas reduction occurs at cathode.

208. Which of the following carbonates decomposes readily at low temperatures?

(a) Na_2CO_3 (b) K_2CO_3
(c) Li_2CO_3 (d) Rb_2CO_3

UP CPMT-2008

Ans. (c): On moving in a group from top to bottom electropositive character increases. Hence, the stability of carbocation increase. All the carbonate of the alkali group thermally stable and readily decomposes at low temperature except the lithium.

$$Li_2CO_3 \xrightarrow{\Delta} Li_2O + CO_2$$

209. Which of the following is used as an oxidiser in rocket propellants?

(a) Alcohol (b) Acrylic rubber
(c) Hydrazine (d) Polyurethane
(e) Ammonium perchlorate

Kerala-CEE-2008

Ans. (e) : The propellant is a combination of an oxidiser and a fuel. Among the given only ammonium perchlorate is used as an oxidiser while other are generally used as a fuel in rocket propellant.

210. During a redox titration involving a solution containing Fe^{2+} ions against MnO_4^- in the presence of excess of H+ ions, the number of electrons that get transferred is

(a) 6 (b) 5
(c) 4 (d) 2

J & K CET-(2008)

Ans. (b) : $MnO_4^- + 8H^+ + 5e^- \longrightarrow Mn^{2+} + 4H_2O$

$[Fe^{2+} \longrightarrow Fe^{3+} + e^-]5$

$MnO_4^- + 8H^+ + 5Fe^{2+} \longrightarrow Mn^{2+} + 5Fe^{3+} + 4H_2O$

So, 5 electrons gets transferred.

211. Which of the following is combustion reaction?

(a) $C + O_2 \rightarrow CO_2$
(b) $CH_4 + O_2 \rightarrow CO_2 + H_2O$
(c) $Mg + O_2 \rightarrow MgO$
(d) All of the above

UP CPMT-2007

Ans. (b) : When all substance in a compound combine with oxygen and produces carbon dioxide and water, it is commonly called burning.

During combustion, substances react with oxidising agent such as O_2 and F_2. Not all combustion reaction releases CO_2 and H_2O.

e.g. $Mg + O_2 \rightarrow MgO + heat$

212. One gas bleaches the color of flowers in reduction and another gas by oxidation. The gases respectively are

(a) SO_2 and Cl_2 (b) CO and Cl_2
(c) NH_3 and SO_2 (d) H_2S and Br_2

AP - EAMCET (Medical) - 2007

Ans. (a) : Sulphur dioxide (SO_2) and chlorine gas (Cl_2) are the two gases that bleach the color of flower by oxidation and reduction. Chlorine reacts with water and produces a single oxygen atom also called nascent oxygen. This nascent oxygen when combines with any color make it colorless.

213. A solution of sodium metal in liquid ammonia is a strong reducing agent due to the presence of

(a) sodium atoms (b) sodium hdride
(c) sodium amide (d) solvated electron

CG PET -2007

Ans. (d) : In liquid ammonia, sodium ionizes to give Na^+ ion. The electron is solvated with ammonia.

So this solvated electron gives reducing properties to the solution of sodium in liquid ammonia.

214. In the reaction

$$\mathbf{Cr_2O_7^{2-} + 14H^+ + 6I^- \rightarrow 2Cr^{3+} + 7H_2O + 3I_2}$$

Which element is reduced

(b) I (b) O
(c) H (d) Cr

BITSAT-2006

Ans. (d) : Cr is reduced in this reaction

$$\overset{+6}{Cr_2}O_7^{2-} + 14H^+ + 6I^- \rightarrow 2\overset{+3}{Cr^{+3}} + 3H_2O + 3I_2$$

Reduction

In this reaction $Cr_2O_7^{2-}$ gets reduced to Cr^{3+}→Cr gets reduced and I^- gets oxidized to I_2.

215. Which of the following occurs at anode?

(a) Reduction (b) Oxidation
(c) Both (a) and (b) (d) None of these

CG PET -2006

@apna_pdf

Ans. (b) : Electrochemical cell, in anode oxidation takes place and cathode reduction takes place.
So, anode is oxidation.

216. Which of the following chemical reactions depicts the oxidising behaviour of H_2SO_4?

(a) $2HI + H_2SO_4 \rightarrow I_2 + SO_2 + 2H_2O$
(b) $Ca(OH)_2 + H_2SO_4 \rightarrow CaSO_4 + 2H_2O$
(c) $NaCl + H_2SO_4 \rightarrow NaHSO_4 + HCl$
(d) $2PCl_5 + H_2SO_4 \rightarrow 2POCl_3 + 2HCl + SO_2Cl_2$

[AIEEE 2006]

Ans. (a) : In the reaction,

$$2\underset{+1-1}{HI}+\underset{+1+6-2}{H_2SO_4}\rightarrow \underset{0}{I_2}+\underset{+4}{SO_2}+\underset{+1\ -2}{2H_2O}$$

Ist half reaction–

$$2\underset{-1}{HI}\rightarrow \underset{0}{I_2}$$

In this reaction oxidation number of I increases by one, thus this is an oxidation reaction and HI behaves as a reducing agent.

IInd half reaction–

$$\underset{+6}{H_2SO_4}\rightarrow \underset{+4}{SO_2}$$

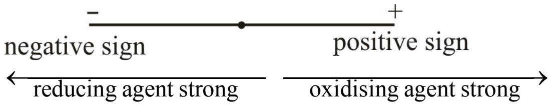
In this reaction oxidation number of S decreases by two, thus this is a reduction reaction and H_2SO_4 behaves as oxidising agent.

217. Given the standard reduction potentials $Zn^{2+}/Zn = -0.74$ V, $Cl_2/Cl^- = 1.36$ V, $H^+/1/2H_2$ = 0V and Fe^{3+}/Fe^{2+} = 0.77 V. The order of increasing strength of reducing agent is:

(a) Cl^-, Zn, H_2, Fe^{2+}
(b) H_2, Zn, Fe^{2+}, Cl^-
(c) Cl^-, Fe^{2+}, Zn, H_2
(d) H_2, Fe^{2+}, Cl^-, Zn
(e) Cl^-, Fe^{2+}, H_2, Zn

Kerala-CEE-2006

Ans. (e) : We know that,



So, given reduction potential in order of increasing strength.

$$\underset{(1.36V)}{Cl^-} < \underset{0.77V}{Fe^{2+}} < \underset{0V}{H_2} < \underset{-0.74V}{Zn}$$

218. Which of the following statements are correct concerning redox properties?

(1) A metal M for which E° for the half reaction $M^{n+} + ne^- = M$, is very negative will be a good reducing agent
(2) The oxidizing power of the halogens decreases from chlorine to iodine
(3) The reducing power of hydrogen halides increases from hydrogen chloride to hydrogen iodide.

(a) 1, 2, and 3
(b) 1 and 2
(c) 1 only
(d) 2 and 3 only
(e) 3 only

Kerala-CEE-2006

Ans. (a) :
(i) High negative value of E° means lower reduction potential which means, the metal M is a good reducing agent.
(ii) Reduction potential of Cl, Br and I are respectively +1.36V, 1.06V and 0.54V show higher oxidizing agent
Cl → Br → I
(iii) Large size of Halogen atom, weaker the bond and easier is the tendency to given hydrogen.

So, stronger is the reducing power. So, Cl < Br < I & reducing power of HCl < HBr < HI

219. The tendency of an electrode to lose electrons is known as

(a) electrode potential
(b) reduction potential
(c) oxidation potential
(d) e.m.f.

J & K CET-(2005)

Ans. (c) : The magnitude of electrode potential of a metal is a measure of its relative tendency to loose or gain electrons.

It is a measure of the relative tendency to undergo oxidation (less of e^-) or deduction (gain of e^-)

$$M \longrightarrow M^{n+} + ne^-$$
(Oxidation potential)

$$M^{n+} + ne^- \longrightarrow M$$
(Reduction potential)

220. In one of the following reactions HNO_3 does not behave as an oxidizing agent. Identify it:

(a) $I_2 + 10HNO_3 \rightarrow 2HIO_3 + 10NO_2 + 4H_2O$
(b) $3Cu + 8HNO_3 \rightarrow 3Cu(NO_3)_2 + 2NO + 4H_2O$
(c) $4Zn + 10HNO_3 \rightarrow 4Zn(NO_3)_2 + NH_4NO_3 + 3H_2O$
(d) $2HNO_3 + P_2O_5 \rightarrow 2HPO_3 + N_2O_5$

JCECE - 2005

Ans. (d) : $2H\overset{+5}{N}O_3+\overset{+5}{P_2}O_5 \longrightarrow 2H\overset{+5}{P}O_3+\overset{+5}{N_2}O_5$

Oxidation no. of phosphorus (P) does not changes and it remains same i.e. (+5).

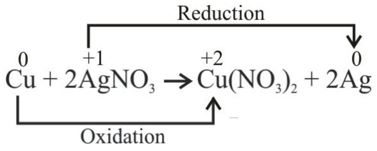
In this reaction, HNO_3 is not behave as oxidizing agent.

221. Which of the following reactions is a redox reaction?

(a) $2AgNO_3 + BaCl_2 \rightarrow 2AgCl + Ba(NO_3)_2$
(b) $BaO_2 + H_2SO_4 \rightarrow BaSO_4 + H_2O_2$
(c) $P_2O_5 + 2H_2O \rightarrow H_4P_2O_7$
(d) $Cu + 2AgNO_3 \rightarrow 2Ag + Cu(NO_3)_2$

CG PET -2005

Ans. (d) :



In the above reaction Cu change in oxidation state 0 to +2 and Ag change in oxidation state +1 to 0.

@apna_pdf

222. For the reaction

$$\mathbf{CrO_4^{-2}(aq.) + 2H^+ \rightarrow Cr_2O_7^{2-}(aq). + H_2O,}$$

Element oxidized is

(a) Oxygen (b) H
(c) Chromium (d) None

BITSAT-2005

Ans. (d) : For the reaction -

$$2CrO_4^{2-} + 2H^+ \rightarrow Cr_2O_7^{-2} + H_2O$$
$$x - 8 = -2 \qquad 2x - 14 = -2$$
$$x = +6 \xrightarrow[\text{oxidation}]{\text{no change}} x = +6$$

223. Among the properties (A) reducing, (B) oxidising and (C) complexing, the set of properties shown by CN⁻ ion towards metal species is

(a) A, B (b) B, C
(c) C, A (d) A, B, C

[AIEEE 2004]

Ans. (c) : CN^- ion acts as ligand and reducing agent. In $K_3[Fe(CN)_6]$ and $K_4[Fe(CN)_6]$, CN^- ion acts as complexing agent.

$$CuI_2 + 5KCN \rightarrow K_3[Cu(CN)_4] + \frac{1}{2}(CN)_2 + 2KCl$$

$$Ni^{+2} + 4CN^- \rightarrow [Ni(CN)_4]^{2-}$$

$\therefore$ CN^- reduce Cu^{2+} to Cu^+

224. Which of the following substances acts as an oxidizing as well as a reducing agent?

(a) Na_2O (b) $SnCl_2$
(c) Na_2O_2 (d) $NaNO_2$

UPTU/UPSEE-2004

Ans. (d) : $NaNO_2$ (sodium nitrite) act both as oxidising as well as reducing agent because nitrogen is in +3 oxidation state.

Oxidising:

$$2Na\overset{+3}{N}O_2 + 2KI + 2H_2SO_4 \rightarrow 2\overset{+2}{N}O + I_2 + Na_2SO_4 + K_2SO_4 + 2H_2O$$

Reducing:

$$H_2O_2 + Na\overset{+3}{N}O_2 \rightarrow Na\overset{+5}{N}O_3 + H_2O$$

225. Of the following reaction, only one is a redox reaction. Identify this reaction.

(a) $Ca(OH)_2 + 2HCl \rightarrow CaCl_2 + 2H_2O$
(b) $2S_2O_7^{2-} + 2H_2O \rightarrow 2SO_4^{2-} + 4H^+$
(c) $BaCl_2 + MgSO_4 \rightarrow BaSO_4 + MgCl_2$
(d) $Cu_2S + 2FeO \rightarrow 2Cu + 2Fe + SO_2$

J & K CET-(2003)

Ans. (d) : In redox reaction oxidation & reduction take place side by side.

$$Cu_2S + 2FeO \longrightarrow 2Cu + 2Fe + SO_2$$

oxidation state of Cu changes from +1 to 0 is reduction
oxidation state of S changes from –2 to +4 is oxidation,

226. In reaction,

$$MnO_4^- + H^+ + C_2O_4^{2-} \longrightarrow Mn^{2+} + H_2O + CO_2$$

What is happening?

(a) Reduction of Mn
(b) Reduction of $C_2O_4^{2-}$
(c) Oxidation of Mn
(d) None of these

JCECE - 2003

Ans. (a) :

$$MnO_4^- + H^+ + C_2O_4^{2-} \longrightarrow Mn^{2+} + H_2O + CO_2$$

Reduction: $MnO_4^- \longrightarrow Mn^{2+}$

Oxidation: $C_2O_4^{2-} \longrightarrow CO_2$

In this reaction, the reduction of MnO_4^- is take place. Hence, the correct option is (a).

227. The oxidation state of halogen atom is '+4' in

(a) Cl_2O_3 (b) ClO_2
(c) Cl_2O_6 (d) I_2O_5

AMU–2003

Ans. (b) : The oxidation of halogen atom in the following reaction–

(a) Cl_2O_3
$2x + 3(-2) = 0$
$2x - 6 = 0$
$x = +3$

(b) ClO_2
$x + 2(-2) = 0$
$x - 4 = 0$
$x = +4$

(c) Cl_2O_6
$2x + 6(-2) = 0$
$2x = 12$
$x = +6$

Therefore, ClO_2 Oxidation no. of + 4.

228. The reaction,

$$\mathbf{Ag^{2+}(aq) + Ag(s) \rightleftharpoons 2Ag^+(aq)}$$

is an example of :

(a) reduction (b) oxidation
(c) comproportionation (d) disproportionation

BCECE-2003

Ans. (c) : A reaction in which an element in a higher oxidation state reacts with the same element in a lower oxidation state to give the element in an intermediate oxidation state.

$$Ag^{2+}(aq) + Ag(s) \rightarrow 2Ag^+(aq)$$

229. Which of the following is a redox reaction?

(a) $NaCl + KNO_3 \rightarrow NaNO_3 + KCl$
(b) $CaC_2O_4 + 2HCl \rightarrow CaCl_2 + H_2C_2O_4$
(c) $Ca(OH)_2 + 2NH_4Cl \rightarrow CaCl_2 + 2NH_3 + 2H_2O$
(d) $2K[Ag(CN)_2] + Zn \rightarrow 2Ag + K_2[Zn(CN)_4]$

[AIEEE 2002]

Ans. (d) : In this reaction oxidation and reaction take place this reaction is know has redox reaction.

Reduction

$$\overset{0}{Zn} + 2K[\overset{+1}{Ag}(CN)_2] \rightarrow 2\overset{0}{Ag} + K_2[\overset{+2}{Zn}(CH)_2]$$

Oxidation

230. Both oxidation and reduction takes place in:

(a) $NaBr + HCl \rightarrow NaCl + HBr$
(b) $HBr + AgNO_3 \rightarrow AgBr + HNO_3$
(c) $H_2 + Br_2 \rightarrow 2HBr$
(d) $CaO + H_2SO_4 \rightarrow CaSO_4 + H_2O$

(AIIMS-2001)

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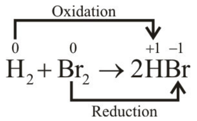
Ans. (c)



$$\overset{0}{H_2} + \overset{0}{Br_2} \rightarrow 2\overset{+1}{H}\overset{-1}{Br}$$

In this reaction both oxidation and reduction take place.

231. In the following chemical reaction:

$$Ag_2O + H_2O + 2e^- \rightarrow 2Ag + 2OH^-$$

(a) hydrogen is reduced
(b) electrons are reduced
(c) water is oxidised
(d) silver is oxidised

(AIIMS-2000)

Ans. (c): $Ag_2O+H_2O + 2e^- \rightarrow 2Ag + 2OH^-$
So, Oxidation state of Ag in Ag_2O is +1 and after the reaction Ag has 0.5 to be 0.
So, Silver is reduced and water is being oxidized because it is accepting oxygen.

232. Which of the following is the strongest oxidizing agent?

(a) F_2 (b) Br_2
(c) Cl_2 (d) O_2

AP EAMCET- 2000

Ans. (a) : Fluorine (F_2) has the strongest oxidizing agent due to highest tendency to form F^- ion. Fluorine is the most electronegative element in the periodic table.

233. Without losing its concentrations $ZnCl_2$ solution cannot be kept in contact with

(a) Pb (b) Al
(c) Au (d) Ag

NEET-1998

Ans. (b) : $ZnCl_2$ solution cannot be kept in contact with Al without losing its concentration because Al is more reactive than Zn due to its highly negative electrode reduction potential. So aluminum displaces zinc from $ZnCl_2$. So, it can't keep in contact with Al.

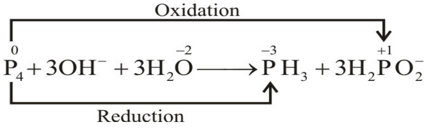
234. When phosphorus is heated with aqueous alkali, the main products are phosphine and a hypophosphite.

P_4 + $3OH$ + $3H_2O \rightarrow PH_3$ + $3H_2PO_2^-$. The reaction is an example of

(a) oxidation (b) reduction
(c) disproportionation reaction (d) hydrolysis

J & K CET-(1998)

Ans. (c) : Given the reaction,



$$\overset{0}{P_4} + 3OH^- + 3H_2\overset{-2}{O} \longrightarrow \overset{-3}{P}H_3 + 3H_2\overset{+1}{P}O_2^-$$

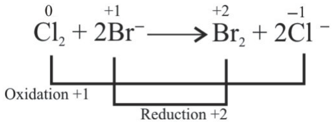
So, this solution is disproportionation reaction.

235. Which of the following reactions is a redox reaction?

(a) $CaCO_3+2HCl \rightarrow CaCl_2+H_2O+CO_2$
(b) $AgNO_3+KI \rightarrow AgI+KNO_3$
(c) $Cl_2+2Br^- \rightarrow Br_2+2Cl^-$
(d) $BaCl_2 + SO_4^{2-} \rightarrow BaSO_4 + 2Cl^-$

J & K CET-(1997)

Ans. (c) : In this reaction, chlorine reduced and bromine is oxidised then this type of reaction is called redox reaction.



$$\overset{0}{Cl_2} + 2\overset{+1}{Br^-} \longrightarrow \overset{+2}{Br_2} + 2\overset{-1}{Cl^-}$$

236. Standard electrode potential data are useful for understanding the suitability of an oxidant in a redox titrations. Some half-cell reactions and their standard potentials are given below:

$$MnO_4^-(aq) + 8H^+(aq) + 5e^- \rightarrow Mn^{2+}(aq) + 4H_2O(l), E^o = 1.51V$$

$$Cr_2O_7^{2-}(aq) + 14H^+(aq) + 6e^- \rightarrow 2Cr^{3+}(aq) + 7H_2O(l), E^o = 1.38V$$

$$Fe^{3+}(aq) + e^- \rightarrow Fe^{2+}(aq), E^o = 0.77\ V$$

$$Cl_2(g) + 2e^- \rightarrow 2Cl^-(aq), E^o = 1.40\ V$$

Identify the only incorrect statement regarding the quantitative estimation of aqueous $Fe(NO_3)_2$.

(a) MnO_4^- can be used in aqueous HCl
(b) $Cr_2O_7^{2-}$ can be used in aqueous HCl
(c) MnO_4^- can be used in aqueous H_2SO_4
(d) $Cr_2O_7^{2-}$ can be used in aqueous H_2SO_4

J & K CET-(1997)

Ans. (a) : MnO_4^- can be used in aqueous HCl. MnO_4^- will oxidize Cl^- into Cl_2. According to the following equation–

$$2MnO_4^- + 16H^+ + 10Cl^- \longrightarrow 2Mn^{2+} + 8H_2O + 5Cl_2$$

The corresponding cell is $PtCl_2$ (1 atm) $|Cl^-|$ MnO_4^-, Mn^{2+}, H^+ (Pt).

$$E^0_{cell} = +1.51 - 1.40 = +0.11V$$

A positive value confirms that the above process is spontaneous. Thus, MnO_4^- will oxidize Cl^- as well as $Fe(NO_3)_2$.

237. Which of the following is reduced by hydrogen peroxide in acid medium?

(a) Potassium permanganate
(b) Potassium iodide
(c) $FeSO_4$
(d) Potassium ferrocyanide

AP – EAMCET - (Medical)-1997

Ans. (a) : Hydrogen peroxide reduced potassium permanganate in acidic medium as:

$$\underset{\substack{\text{Potassium}\\\text{Permanganate}\\\text{ion}}}{2MnO_4^-} + 6H^+ + \underset{\substack{\text{Hydrogen}\\\text{peroxide}}}{5H_2O_2} \longrightarrow 2Mn^{2+} + 8H_2O + 5O_2$$

238. Cu^{2+} salt reacts with potassium iodide to give

(a) Cu_2I_2 (b) Cu_2I_2
(c) CuI (d) $Cu(I_3)_2$

JEE Main, 03.07.2021

Ans. (a) : Cu^{2+} salt reacts with potassium to give Cu_2I_2
For reaction.
$2Cu^{+2} + 4KI \rightarrow Cu_2I_2 + I_2 + 4K^+$

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239. The species given below that does not show disproportionation reaction is

(a) BrO_4^- (b) BrO^-

(c) BrO_2^- (d) BrO_3^-

COMEDK- 2014

Ans. (a) : The species whose oxidation state maximum can't oxidise further.

In BrO_4^-, Br is the highest oxidation state of +7, so it can't oxidise further.

So, it can't show disproportionation reaction.

3. Method for Balancing Redox Reaction

240. Which one of the following reactions indicated the reducing ability of hydrogen peroxide in basic medium?

(a) $HOCl + H_2O_2 \rightarrow H_3O^+ + Cl^- + O_2$

(b) $PbS + 4H_2O_2 \rightarrow PbSO_4 + 4H_2O$

(c) $2MnO_4^- + 3H_2O_2 \rightarrow 2MnO_2 + 3O_2 + 2H_2O + 2OH^-$

(d) $Mn^{2+} + H_2O_2 \rightarrow Mn^{4+} + 2OH^-$

JEE Main-29.06.2022, Shift-I

Ans. (c) : $KMnO_4$ reduced to MnO_2 in the presence of H_2O_2 in basic medium

$\therefore\ 2MnO_4^- + 3H_2O_2 \rightarrow 2MnO_2 + 3O_2 + 2H_2O + 2OH^-$

is correct answer.

241. $aK_2Cr_2O_7 + bKCl + cH_2SO_4 \rightarrow xCrO_2Cl_2 + yKHSO_4 + zH_2O$. The above equation balances when:

(a) a=2, b=4, c=6 and x=2, y=6, z=3

(b) a=4, b=2, c=6 and x=6, y=2, z=3

(c) a=6, b=4, c=2 and x=6, y=3, z=2

(d) a=1, b=4, c=6 and x=2, y=6, z=3

(e) a=1, b=6, c=4 and x=6, y=2, z=3

Kerala-CEE-2004
BITSAT-2019

Ans. (d) : In $K_2Cr_2O_7$ act as a oxidising agent.

So, balanced eq^n is

$K_2Cr_2O_7 + 4KCl + 6H_2SO_4 + 3H_2O$

So, a = 1 , b = 4 , c = 6, x = 2

y = 6 , z = 3

242. In the balanced chemical reaction,

$IO_3^- + aI^- + bH^+ \rightarrow cH_2O + dI_2$

a, b, c and d respectively corresponds to :

(a) 5, 6, 3, 3 (b) 5, 3, 6, 3

(c) 3, 5, 3, 6 (d) 5, 6, 5, 5

Assam CEE-2014
(AIIMS-2005)

Ans. (a): $IO_3^- + aI^- + bH^+ \rightarrow cH_2O + dI_2$

The balanced equation is :

$IO_3^- + 5I^- + 6H^+ \rightarrow 3H_2O + 3I_2$

Hence, a = 5, b = 6, c = 3, d = 3

243. For the redox reaction

$MnO_4^- + C_2O_4^{2-} + H^+ \rightarrow Mn^{2+} + CO_2 + H_2O.$

the correct coefficients of the reactants for the balanced reaction are respectively MnO_4^-, $C_2O_4^{2-}$ and H^+ ___

(a) 2, 5, 16 (b) 16, 3, 12

(c) 15, 16, 12 (d) 2, 16, 5

AP EAPCET 19-08-2021, Shift-II
AIEEE-2013

Ans. (a) : $MnO_4^- + C_2O_4^{2-} + H^+ \rightarrow Mn^{2+} + CO_2 + H_2O$

Now, the chemical reaction atoms other than H and O, coefficient 2 is added in front of CO_2. C is oxidised. It's oxidation number increases from +3 to +4. The net increase in the oxidation no. is +2, Mn is reduced. The oxidation no. decreases from +7 to +2. The net decrease in the oxidation no. is +5. Hence, coefficient of C is multiplied with 5 and the coefficient of Mn is multiplied with 2 balance oxygen atoms, 7 water molecules are added to right. To balance H atoms. 15 protons are added to left. Hence balanced reaction is -

$2MnO_4^- + 5C_2O_4^{2-} + 16H^+ \rightarrow 10CO_2 + 8H_2O + 2Mn^{2+}$

244. Balance the following redox-reaction:

$aI_2 + bNO + 4H_2O = cHNO_3 + dHI$

Hence, find the values of a, b, c and d.

(a) 3,2,2,6 (b) 6,2,3,2

(c) 2,6,3,2 (d) 3,6,2,2

Tripura JEE-2022

Ans. (a) : Balancing the equation of redox reaction–

$3I_2 + 2NO + 4H_2O \rightarrow 2HNO_3 + 6HI$

245. Which of the following equation depicts the oxidising nature of H_2O_2?

(a) $KIO_4 + H_2O_2 \rightarrow KIO_3 + H_2O + O_2$

(b) $I_2 + H_2O_2 + 2OH^- \rightarrow 2I^- + 2H_2O + O_2$

(c) $2I^- + H_2O_2 + 2H^+ \rightarrow I_2 + 2H_2O$

(d) $Cl_2 + H_2O_2 \rightarrow 2HCl + O_2$

[JEE Main 2021, 25 Feb Shift-I]

Ans. (c) : Oxidizing nature of H_2O_2 means it oxidizes other substances and itself gets reduced. In such reactions O_2 is not evolved

In A > reduced
B > reduced
C > Oxidised

I^- gets oxidised to I_2

246. The reaction of sulphur in alkaline medium is given below

$S_8(s) + aOH^-(aq) \rightarrow bS^{2-}(aq) + cS_2O_3^{2-}(aq) + dH_2O(l)$

The value of 'a' is .... (Integer answer)

[JEE Main 2021, 24 Feb Shift-I]

Ans. (12) :

$16e^- + S_8 \rightarrow 8S^{2-}$

$12\ H_2O + S_8 \rightarrow 4S_2O_3^{2-} + 24H^+$

For balancing in basic medium add an equal no of OH^- that of H^+

$2S_8 + 12H_2O + \rightarrow 8s^{2-}O_8^{2-} + 12H_2O$

@apna_pdf

$2S_8 + 24OH^- \rightarrow 8s^- + 4s^-\ 4O_8^{2-} + 12H_2O$

$S_8 + 12OH^- \rightarrow 4s^{2-} + 4s^{2-}2O_8^{2-} + 6H_2O$

So, $a = 12$

247. In the balanced equation of the following reaction, the ratio of a/b is a

$aCaCO_3 + bH_3PO_4 \rightarrow pCa_3(PO_4)_2 + qCO_2 + rH_2O$

(a) 2/3 (b) 3/2

(c) 1/2 (d) 7/5

TS EAMCET 04.08.2021, Shift-I

Ans. (b) : $3CaCO_3+2H_3PO_4\rightarrow1Ca_3(PO_4)_2+3CO_2+3H_2O$

In the balance equation the values are–

$a = 3, b = 2, p = 1, q = 3$ and $r = 3$

Hence, the ratio of a/b is 3/2.

248. The x and y in the following equations, respectively, are

i) $2K_3\left[Fe(CN)_6\right]+2KOH+x\rightarrow2K_4\left[Fe(CN)_6\right]+2H_2O+O_2$

ii) $C_6H_6+H_2O_2\xrightarrow{y}C_6H_5OH+H_2O$

(a) $FeSO_4$, H_2O_2 (b) H_2O_2, $FeSO_4$

(c) H_2O_2, Zn dust (d) H_2O_2, $H^{\oplus}/H_2O$

TS EAMCET 10.08.2021, Shift-II

Ans. (b) :

$$2K_3[\overset{+3}{Fe}(CN)_6]+2KOH+H_2\overset{-1}{O_2}\rightarrow2K_4[\overset{+2}{Fe}(CN)_6]+2H_2O+\overset{0}{O_2}$$

$$C_6H_6+H_2O_2\xrightarrow{FeSO_4}C_6H_5OH+H_2O$$

249. Balance the following equation

$xMnO_4 + yC_2O_4 + zH^+ \rightarrow pMn^{2+} + qCO_2 + rH_2O$

the correct values of x, y and z are

	x	y	z
(a)	5	16	2
(b)	2	5	16
(c)	5	5	16
(d)	2	2	5

TS EAMCET 10.08.2021, Shift-I

Ans. (b) : The balanced chemical equation is

$2MnO_4 + 5C_2O_4^{-2} + 16H^+ \rightarrow 2Mn^{+2} + 10CO_2 + 8H_2O$

Hence, the value of $x = 2$, $y = 5$ and $z = 16$.

250. $2MnO_4^- + bC_2O_4^{2-} + cH^+ \rightarrow xMn^{2+} + yCO_2 + zH_2O$

If the above equation is balanced with integer coefficients, the value of c is ______ (Round off to the Nearest Integer).

JEE Main 16.03.2021, Shift-I

Ans. (16) : The given equation is :

$2MnO_4^- + bC_2O_4^{2-} + cH^+ \rightarrow xMn^{2+} + yCO_2 + zH_2O$

Writing the half reaction—

$MnO_4^- \rightarrow Mn^{2+}$

Balancing oxygen, $MnO_4^- \rightarrow Mn^{2+} + 4H_2O$

Balancing hydrogen, $8H^+ + MnO_4^- \rightarrow Mn^{2+} + 4H_2O$

Balancing charge–

$5e^- + 8H^+ + MnO_4^- \rightarrow Mn^{2+} + 4H_2O$

Reduction half reaction –

$C_2O_4^{2-} \rightarrow CO_2$

Balancing carbon, $C_2O_4^{2-} \rightarrow 2CO_2$

Balancing charge, $C_2O_4^{2-} \rightarrow 2CO_2 + 2e^-$

Net equation–

$16H^+ + 2MnO_4^- + 5C_2O_4^{2-} \rightarrow 10CO_2 + 2Mn^{2+} + 8H_2O$

$\therefore$ The value of c = 16.

251. BrO_3^- changes into Br_2 in an acidic medium of a unbalanced equation. How many electron should be present on the balanced equation?

(a) 10 electron in left (b) 6 electron in left

(c) 3 electron in left (d) 3 electron in right

JIPMER-2019

Ans. (a) : Solution is by balancing

$12H^+ + 10e^- + 2BrO_3^- \rightarrow Br_2 + 6H_2O$

There are $10e^-$ present on balanced the equation.

252. For the redox reaction

$xMnO_4^- + yH_2C_2O_4 + zH^+ \rightarrow mMn^{2+} + nCO_2 + pH_2O$

The values of x, y, m and n are

(a) 10, 2, 5, 2 (b) 2, 5, 2, 10

(c) 6, 4, 2, 5 (d) 3, 5, 2, 10

Karnataka-CET-2018

Ans.(b):

$2MnO_4^- + 5H_2C_2O_4 + 6H^+ \longrightarrow 2Mn^{2+} + 10CO_2 + 8H_2O$

So, the value of x = 2, y = 5, m = 2, n = 10

253. In the redox reaction

The correct coefficients of $C_2O_4^{2-}$ and H^+ ions in the balanced equation are

(a) 5 and 15 (b) 5 and 16

(c) 2 and 16 (d) 2 and 15

BCECE-2017

Ans. (b) : Overall the balance chemical reaction is–

$2MnO_4^- + 5C_2O_4^{2-} + 16H^+ \rightarrow 10CO_2 + 8H_2O + 2Mn^{2+}$

Hence, the overall chemical reaction it is clear that–

$MnO_4^{2-} = 2$, $C_2O_4^{2-} = 5$, $H^+ = 16$

Thus, coefficient of $MnO_4^{-2}, C_2O_4^{-2}$ and H^+ are 2, 5 and 16 respectively.

254. Consider the following reaction occurring in basic medium

$2MnO_4^-(aq) + Br^-(aq) \longrightarrow 2MnO_2(s) + BrO_3^-(aq)$

How the above reaction can be balanced further?

(a) By adding 2 OH^- ions on right side

(b) By adding one H_2O molecule to left side

(c) By adding $2H^+$ ions on right side

(d) Both (a) and (b)

(AIIMS-2017)

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Ans. (d):
$2MnO_4^-(aq) + Br^-(aq) + H_2O \rightarrow 2MnO_2(s) + BrO_3^-(aq) + 2OH^-$
So, adding $2OH^-$ ions on right side and adding one H_2O molecule to left side.
So, both (a) and (b) follow.

255. Pick out the wrong reaction.
(a) $2Na_2CrO_4 + 4H^+ \rightarrow Na_2Cr_2O_7 + 2Na^+ + H_2O$
(b) $4MnO_2 + 4KOH + O_2 \rightarrow 4KMnO_4 + 2H_2O$
(c) $MnO_4^- + 8H^+ + 5Fe^{2+} \rightarrow 5Fe^{3+} + Mn^{2+} + 4H_2O$
(d) $2MnO_4^- + 5C_2O_4^{2-} + 16H^+ \rightarrow 2Mn^{2+} + 10CO_2 + 8H_2O.$

COMEDK 2017

Ans. (b) : Manganese dioxide, potassium hydroxide and oxygen react in the following-
$2MnO_2 + 4KOH + O_2 \rightarrow 2K_2MnO_4 + 2H_2O$
Manganese dioxide is oxidized to potassium manganate and not to potassium permanganate.

256. The value of n in
$MnO_4^- + 8H^+ + ne^- \rightarrow Mn^{2+} + 4H_2O$ is
(a) 5 (b) 4
(c) 2 (d) 3

JIPMER-2016

Ans. (a) : $MnO_4^- + 8H^+ + ne^- \longrightarrow Mn^{2+} + 4H_2O$
$-1 + 8 - n = +2$
$n = +5$

257. Consider the following reaction
$6FeSO_4 + K_2Cr_2O_7 + 7H_2SO_4 \rightarrow$
$3Fe(SO_4) + Cr_2(SO_4)_3 + K_2SO_4 + 7H_2O$
How many electrons are involved in the above redox reaction?
(a) 9 (b) 6
(c) 3 (d) 2

SCRA-2015

Ans. (b): $6FeSO_4 + K_2Cr_2O_7 + 7H_2SO_4 \rightarrow 3Fe_2(SO_4)_3 + Cr_2(SO_4)_3 + K_2SO_4 + 7H_2O$
In the above reaction six electrons are involved in the redox reaction.

258. In neutral or faintly alkaline medium, thiosulphate is quantitatively oxidized by $KMnO_4$ to
(a) SO_3^{2-} (b) SO_4^{2-}
(c) SO_2 (d) SO_5^{2-}
(e) $S_2O_8^{2-}$

Kerala-CEE-2013

Ans. (b) : The reaction between thiosulphate ion and $KMnO_4$ in neutral medium is given as
$8MnO_4^- + 3S_2O_3^{2-} + H_2 \longrightarrow 8MnO_2 + 6SO_4^{2-} + 2OH^-$

259. For the reaction,
$NH_3 + OCl^- \longrightarrow N_2H_4 + Cl^-$
occurring in basic medium, the coefficient of N_2H_4 in the balanced equation will be
(a) 1 (b) 2
(c) 3 (d) 4

JIPMER-2012

Ans. (a) : $NH_3 + OCl^- \rightarrow N_2H_4 + Cl^-$
For ammonia.
$2NH_3 \rightarrow N_2H_4 + 2H^+ + 2e^-$
since, it is in basic media for OCl^-
$OCl^- + 2H^+ + 2e^- \rightarrow Cl^- + H_2O$
adding both eq^n we get,
$2NH_3 + OCl^- \rightarrow N_2H_4 + Cl^- + H_2O$
So, coefficient of N_2H_4 is 1.

260. The reduction potential of three metallic ions X, Y and Z correspondingly are +0.52,-3.03 and -1.18 V. The sequence of reducing capacity of these metals will be
(a) $Y > Z > X$ (b) $X > Y > Z$
(c) $X > Z > Y$ (d) $Z > X > Y$

CG PET -2008

Ans. (a) : The reducing potential in greater then metal is fast reduced
So, reduction potential = (–O.P)
So, $-3.03 > -1.18V > 0.52V$
So, $Y > Z > X$

261. E°= –0.44 V for the reaction,
$Fe^{2+} + 2e^- \rightarrow Fe$ and $E^o = -0.76 V$
for the reaction, $Zn^{2+} + 2e^- \rightarrow Zn$. **Which of the following statement is correct?**
(a) Fe is more electropositive
(b) Zn is more electropositive
(c) Zn is more electronegative
(d) None of the above

CG PET -2008

Ans. (b) : Zn is more electropositive
$Zn^{2+} + 2e^- \rightarrow Zn(s)$
$$E = E^0 - \frac{RT}{nF}\ln Q$$
$$\ln Q = \frac{1}{[Zn^{2+}]}$$
or $$E = E^0 - \frac{RT}{nF}\ln\frac{1}{[Zn^{2+}]}$$

262. For the electrolysis of aqueous $CuSO_4$ solution using inert Pt electrodes, the reaction on anode is
(a) $2SO_4^{-2} \rightarrow S_2O_3^{2-} + 2\frac{1}{2}O_2 + 2e^-$
(b) $Cu^{2+} + 2e^- \rightarrow Cu$
(c) $2H_2O \rightarrow O_2 + 4H^+ + 4e^-$
(d) $2H^+ + 2e^- \rightarrow H_2$

CG PET -2008

@apna_pdf

Ans. (c) : Oxidation is defined as loss of electron. At anode oxidation takes place.

$$2H_2O \rightarrow O_2 + 4H^+ + 4e^-$$

263. For decolourisation of 1 mole of $KMnO_4$, the moles of H_2O_2 required is:

(a) 1/2 (b) 3/2
(c) 5/2 (d) 7/2

(AIIMS-2004)

Ans. (c): $KMnO_4+H_2O+H^+ \rightarrow K^++Mn^{2+}+H_2O+O_2$

Balancing a chemical reaction

$$K\overset{+7}{M}nO_4 + H_2\overset{-1}{O_2} \rightarrow \overset{2+}{M}n^{2+} + \overset{0}{O_2}$$

Reduction = $K\overset{+7}{M}nO_4 \rightarrow \overset{+2}{M}n^{2+}$

Oxidation= $H_2\overset{-1}{O_2} \rightarrow \overset{0}{O_2}$

Show that above oxidation change in reduction gain $5e^-$ 4 oxidation loss $2e^-$ then balance the total charge

Reduction:– $K\overset{+7}{M}nO_4 \rightarrow \overset{+2}{M}n^{2+} \times 2(\text{gain of } 10e^-)$

Oxidation:– $H_2\overset{-1}{O_2} \rightarrow \overset{0}{O_2} \times 5(\text{loss of } 10e^-)$

Balance K, atom zero in reduction by adding H_2O and then balance H by H^+

Reduction:– $2K\overset{+7}{M}nO_4 + 16H^+ \rightarrow 2\overset{+2}{M}n^{+2} + 2K^+ + 8H_2O$

Oxidation:– $5H_2\overset{-1}{O_2} \rightarrow 5\overset{0}{O_2} + 10H^+$

This overall balanced react

$$2K^+ + 8H_2O + 5\overset{0}{O_2} + 10H^+$$

Cancel H^+ from both sides.

$2KMnO_4+6H^+ + 5H_2O_2 \rightarrow 2Mn^{2+}+2K^++8H_2O+5O_2$

So 2 mole of $KMnO_4$ require 5 mol of H_2O_2 for decolourisation. Therefore decolourisation of 1 mole of acidified $KMnO_4$ the moles of H_2O_2 required are 5/2.

264. MnO_4^{2-} (1 mole) in neutral aqueous medium disproportionate of

(a) 2/3 mole of MnO_4^- and 1/3 mole of MnO_2
(b) 1/3 mole of MnO_4^- and 2/3 mole of MnO_2
(c) 1/3 mole of Mn_2O_7 and 1/3 mole of MnO_2
(d) 2/3 mole of Mn_2O_7 and 1/3 mole of MnO_2

(AIIMS-2003)

Ans. (a): MnO_4^- (one mole) in neutral aqueous medium disproportionate to 2/3 mole MnO_4^- and 1/3 mole of MnO_2.

$$3K_2MnO_4+2H_2O \rightarrow 2KMnO_4+MnO_2+4KOH$$

265. MnO_4^- is a good oxidising agent in different medium changing to

$MnO_4^- \rightarrow Mn^{+2} \rightarrow MnO_4^{2-} \rightarrow MnO_2 \rightarrow Mn_2O_3$

Changes is oxidation number respectively, are

(a) 1,3,4,5 (b) 5,4,3,2
(c) 5,1,3,4 (d) 2,6,4,3

[AIEEE 2002]

Ans. (c) : Changes in oxidation no.–

(i) $MnO_4^- \longrightarrow Mn^{2+}$

$x+4\times(-2)=-1 \quad x = 2$
$x = +7$

∵ Change in oxidation no. = (7 – 2) = 5

(ii) $MnO_4^- \longrightarrow MnO_4^{2-}$

$x+4\times(-2)=-1 \quad x+4\times(-2)=-2$
$x = +7 \quad x = +6$

∵ Change in oxidation no. = (7 – 6) = 1

(iii) $MnO_4^- \longrightarrow MnO_2$

$x+4\times(-2)=-1 \quad x+2\times(-2)=0$
$x = +7 \quad x = +4$

∵ Change in oxidation no. = (7 – 4) = 3

(iv) $MnO_4^- \longrightarrow Mn_2O_3$

$x+4\times(-2)=-1 \quad 2x+3\times(-2)=0$
$x = +7 \quad x = +3$

∵ Change in oxidation no. = (7 – 3) = 4

4. Oxidising and Reducing Agent

266. Which compound among the following can act an oxidizing and a reducing agent?

(a) H_2O_2 (b) SO_3
(c) H_2S (d) F_2

AP- EAPCET- 07-09-2021, Shift-I

Ans. (a) : Hydrogen peroxide (H_2O_2) both as oxidizing and reducing agent. H_2O_2 oxygen has -1 oxidation state lies between –2 to +2. Therefore oxygen can be oxidized to O_2 zero oxidation state acting as reducing agent or can be reduced to H_2O or OH^- is –2 oxidation state acting as an oxidizing agent.

267. The compound that cannot act both as oxidising and reducing agent is

(a) H_2SO_3 (b) H_3PO_4
(c) HNO_2 (d) H_2O_2

[JEE Main 2020, 9 Jan Shift-I]

Ans. (b) : The oxidation no. of P in H_3PO_4,

$3 (+1) + x + 4 (-2) = 0$
$3 + x - 8 = 0$
$x = +5$

P has its highest oxidation state +5 means cannot be further released electrons to act as a reducing agent therefore, act as an oxidizing.

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268. Which one of the following statements is NOT correct for the given reaction ?

$Fe(s) + CuSO_4(aq) \rightarrow FeSO_4(aq) + Cu(s)$

(a) Iron is the reducing agent
(b) The solution turns green in colour after the reaction
(c) Copper is a more reactive metal than iron
(d) The reaction is an example of a redox reaction

NDA (I)-2019

Ans : (c) In the given reaction,

$Fe(s)+CuSO_4(aq)\rightarrow FeSO_4(aq)+Cu(s)$

Iron(Fe) displace copper (Cu) from its solution. Therefore, Copper is less reactive than iron.

269. Identify the weakest oxidising agent among the following.

(a) Li^+
(b) Na^+
(c) Cs^{2+}
(d) I_2

MHT CET-2017

Ans. (a) : Li^+ is the weakest oxidizing agent as it has most negative standard reduction potential. Lithium is small in size and high ionization enthalpy. Therefore lithium has a high tendency to lose electron in solution other an alkali metals. Hence, lithium is the weakest oxidizing agent.

270. In the reaction ZnO + C → Zn + CO, 'C' acts as:

(a) an acid
(b) a base
(c) an oxidising agent
(d) a reducing agent

NDA (I)-2015

Ans : (d) : In reaction ZnO + C → Zn + CO, 'C' (1) act as a reducing agent.

271. Which of the following is not a reducing agent?

(a) SO_2
(b) H_2O_2
(c) CO_2
(d) NO_2

JCECE - 2014

Ans. (c) : In CO_2, the oxidation number of C, i.e., +4 is already the maximum and it cannot increase its oxidation number. Hence, does not act as a reducing agent.

272. Which one of the following gases has both oxidizing as well as reducing property?

(a) CO
(b) SO_2
(c) H_2S
(d) PH_3

CG PET- 2011

Ans. (b) : The oxidation no. of sulphur lies from –2 to +6. In SO_2 the oxidation state of sulphur is +4.

Thus oxidation no. may increase or decrease. So it can behave as both oxidising agent as well as reducing agent.

273. Which of the following is reducing agent?

(a) $LiAlH_4$
(b) Zn + HCl
(c) Sn + HCl
(d) All of the above

CG PET -2007

Ans. (d) : A substance which loses electrons to other substance in a redox reaction and gets oxidized to the higher valency state is called reducing agent.

(a) $LiAlH_4$ is reducing agent H^- easily thought.
(b) Zn + HCl is reducing agent reduce HCl.
(c) Sn + HCl is reducing agent reduce HCl.

274. Which of the following is the strongest oxidising agent?

(a) HOCl
(b) $HClO_2$
(c) $HClO_3$
(d) $HClO_4$

J & K CET-(2004)

Ans. (d) : Perchloric acid ($HClO_4$) is the strongest acid among these acidic character of oxoacid increases with increasing the oxidation no. of a particular halogen atom.

$$HO\overset{+1}{Cl} < H\overset{+2}{Cl}O_2 < H\overset{+5}{Cl}O_3 < H\overset{+7}{Cl}O_4$$

275. In organic reactions, sodium in liquid ammonia is used as

(a) Reducing agent
(b) Hydrating agent
(c) Oxidizing agent
(d) Precipitating agent

AP EAMCET- 2001

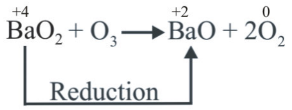
Ans. (a) : In organic reaction sodium in liquid ammonia is used as reducing agent. Sodium is a strong electropositive element.

276. In which of the following reactions ozone acts as a reducing agent?

(a) $BaO_2+O_3 \rightarrow BaO+2O_2$
(b) $2HCl+O_3 \rightarrow Cl_2+H_2O+O_2$
(c) $PbS+4O_3 \rightarrow PbSO_4+4O_2$
(d) $2KI+O_3+H_2O \rightarrow 2KOH+I_2+O_2$

AP EAMCET- 1999

Ans. (a) :



Hence, BaO_2 is reduced into BaO by O_3. O_3 act as reducing agent.

277. In the following two reactions :

(1) $2H_2O_2 \rightarrow 2H_2O+O_2$

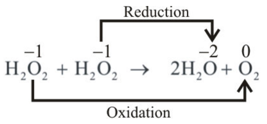
(2) $H_2O_2+2I^-+2H^+ \rightarrow I_2+2H_2O$

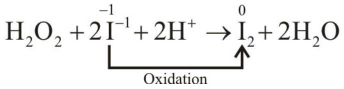
H_2O_2 acts as

(a) An oxidizing agent
(b) A reducing agent
(c) Both oxidizing agent and reducing agent respectively
(d) Both reducing agent and oxidizing agent respectively

AP EAMCET- 1995

Ans. (a) :





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10.

Hydrogen

1. Heavy water

1. **Heavy water is**
   (a) $CaSO_4$
   (b) Water contain $CaSO_4$, $MgSO_4$
   (c) D_2O
   (d) Water contain $CaCO_3$

UPTU/UPSEE-2008, 2006
JIPMER-2008, JCECE – 2007
UPCPMT-2007

Ans. (c) :
- Heavy water is a compound that is made up of oxygen and deuterium, a heavier isotope of hydrogen which is denoted by D.
- Heavy water is also called deuterium oxide and denoted by the chemical formula D_2O.
- "Heavy water" deuterium oxide (D_2O) is sometimes used in nuclear reactors to slow down the speed of neutrons associated with the fission process.

2. **Some statements about heavy water are given below.**
   (i) Heavy water is used as moderator in nuclear reactors
   (ii) Heavy water is more associated than ordinary water
   (iii) Heavy water is more effective solvent than ordinary water
   Which of the above statements are correct?
   (a) (i) and (ii) (b) (i), (ii) and (iii)
   (c) (ii) and (iii) (d) (i) and (iii)

JEE Main-2021, 26 Feb Shift-I
VITEEE- 2012 , NEET-2010

Ans. (a) : In nuclear reactors heavy water is used as a moderator. It has higher boiling point as compared to ordinary water. Thus, it is more associated as compared to ordinary water. The dielectric constant is however higher for H_2O. Thus, H_2O is a more effective solvent as compare to heavy water (D_2O).

3. **Statements about heavy water are given below.**
   A. Heavy water is used in exchange reactions for the study of reaction mechanisms.
   B. Heavy water is prepared by exhaustive electrolysis of water.
   C. Heavy water has higher boiling point than ordinary water.
   D. Viscosity of H_2O is greater than D_2O.
   Choose the most appropriate answer from the options given below:
   (a) A and B only (b) A and C only
   (c) A and D only (d) A, B and C only

JEE Main 26.02.2021, Shift-I
[JEE Main-2021, 26 Aug Shift-II]

Ans. (d) : Heavy water is used in exchange reactions for study of reaction mechanisms.
Heavy water is prepared by exhaustive electrolysis of water.

B.P. of D_2O = 374.4 K
B.P. of H_2O = 373 K
Viscosity of H_2O = 0.89 centipoise
Viscosity of D_2O = 1.107 centipoise

4. **The incorrect statements (s) about heavy water is (are)**
   (a) used as a moderator in nuclear reactor.
   (b) Obtained as a by-product in fertilizer industry.
   (c) Used for the study of reaction mechanism.
   (d) Has a higher dielectric constant than water.
   Choose the correct answer from the options given below:
   (a) (B) only (b) (C) only
   (c) (D) only (d) (C) and (D) only

[JEE Main-2021, 17 March Shift-I]

Ans. (c) Heavy water:-
- Used as a moderator in nuclear reactor.
- Obtained as a by-product in fertilizer industry
- Used for the study of reaction mechanism.

The dielectric constant of H_2O is greater than heavy water
Heavy water is used as a moderater in nuclear reactor and is more associated than ordinary water.

5. **Observe the following statements**
   1. Heavy water is harmful for the growth of animals.
   2. Heavy water reacts with Al_4C_3 and forms deuterated acetylene.
   3. $BaCl_2 . 2D_2O$ is an example of interstitial deuterate.
   The correct statements are
   (a) 1 and 3 (b) 1 and 2
   (c) 1, 2 and 3 (d) 2 and 3

AP-EAMCET (Engg.) 2013

Ans. (a) : Heavy water is injurious to human beings, plants and animals since it slows down the rate of reactions occurring in them. Heavy water reacts with Al_4C_3 and forms deutero methane.

$$Al_4C_3 + 12D_2O \longrightarrow 4Al(OD)_3 + \underset{\text{deuteromethane}}{3CD_4}$$

$BaCl_2 \cdot 2D_2O$ is an example of interstitial deuterate

6. **With hard water, ordinary soap forms curdy precipitate of**
   (a) $(RCOO)_2Ca$ (b) $(RCOO)_2Mg$
   (c) Both (a) and (b) (d) None of these

BCECE-2013

@apna_pdf

Ans. (c) : Hardness in water is due to dissolved sulphate, chlorides and bicarbonates of calcium and magnesium, when such type of water is used for cleaning clothes with soap (i.e, sodium stearate) a curdy precipitate of calcium and magnesium salts are formed.

Therefore, hard water and soap produce a curdy precipitate called soap scum.

7. The reagent commonly used to determine hardness of water titrimetrically is

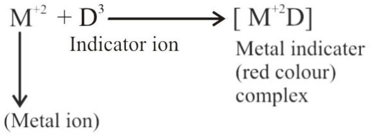
(a) oxalic acid
(b) disodium salt of EDTA
(c) sodium citrate
(d) sodium thiosulphate

JCECE - 2012

Ans. (b) : The hardness of water is estimated by simple titration of Ethylenediamine tetraacetate (EDTA) solution. EDTA forms stable complexes with metal ions present in hard water.

Estimate of disodium salt of EDTA used to Ca^{+2} and mg^{+2}

(i)



$$M^{+2} + D^{3} \longrightarrow [M^{+2}D]$$

(ii) $$[M^{+2}D]^{-1} + EDTA^{-4} \rightleftharpoons [M^{+2}EDTA]^{-2} + D^{-3}$$

Red Blue colour.

8. Heavy water is not used for drinking because

(a) It is costly
(b) Its chemical properties are different from ordinary water
(c) Its physiological action is different from ordinary water
(d) Its physical properties are different

SCRA-2010

Ans. (c) : As molecular mass of heavy water is higher than water so its physiological action is different from ordinary water. So, it can't be used as drinking water.

- Density : 1.11 g cm^3
- Melting point: 3.8 °C
- Boiling point: 101.4 °C
- Molar mass: 20.276 g/m
- D_2O is more toxic to normal animal cells as it starts to gum up all matter of body parts if consumed in a large quantity.

9. Assertion: We feel cold on touching the ice.
Reason: Ice is a solid form of water.

(a) If both Assertion and Reason are correct and the Reason is the correct explanation of Assertion.
(b) If both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.
(c) If Assertion is correct but Reason is incorrect.
(d) If both the Assertion and reason are incorrect.

(AIIMS-2009)

Ans. (b): We feel cold when we touch on object or matter like ice at a lower temperature then our body temperature. This is because the heat from our body being higher in amount moves to the ice through our skin (by thermal conduction) in order to attain thermal equilibrium between the ice and the body.

10. Assertion (A) : NaCl is less soluble in heavy water than in ordinary water.
Reason (R) : Dielectric constant of ordinary water is more than that of heavy water.
The correct answer is

(a) Both (A) and (R) are true and (R) is the correct explanation of (A)
(b) Both (A) and (R) are true and (R) is not the correct explanation of (A)
(c) (A) is true, (R) is not true
(d) (A) is not true, (R) is true

AP EAMCET- 2007

Ans. (a) : Due to the lower dielectric constant of heavy water (D_2O) over ordinary water (H_2O), NaCl is less soluble in D_2O than in ordinary water.

- The solubility of a substance mainly depends on the composition of solute and solvent (including their pH and the presence of dissolved substances) as well as on temperature and pressure.

Hence, both (A) and (R) are true and (R) is the correct explanation of (A).

11. The value of .... is less for D_2O compared to that of H_2O.

(a) Density (g. mL^{-1}) at 20°C
(b) Boiling point
(c) Dielectric constant at 20°C
(d) Latent heat of vaporisation ($J.g^{-1}$)

AP-EAMCET (Engg.)-2005

Ans. (c) : The dielectric constant is less for D_2O than H_2O due to the strong H-bonding in H_2O.

- Value of solubility ability are less for D_2O than H_2O due to strong H-bonding and self ionization power.
- Density of water is roughly 1 gram per milliliter whereas the density of heavy water is 1.107 gmL^{-1}.
- The value of boiling point is more for D_2O (101.4°C) compared to that of H_2O.
- The latent heat of vapourization of water is 2260 kJ/kg & heavy water is 2073.20 kJ/kg.

12. Water gas is essentially a mixture of

(a) $H_2O_{(g)}$ and CO_2 (b) H_2O and CO
(c) H_2 and CO (d) CO and CO_2

AMU 2002

Ans. (c) : Water gas is a mixture of CO and H_2. It is prepared by passing steam over red hot coke.

$$C + H_2O \longrightarrow \underset{\text{(Water gas)}}{CO + H_2}$$

13. The products formed when heavy water is reacted with magnesium nitride, are

(a) NH_3, $Mg(OH)_2$ (b) NH_3, $Mg(OD)_2$
(c) ND_3, $Mg(OH)_2$ (d) ND_3, $Mg(OD)_2$

AP EAMCET- 2002

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Ans. (d) : When heavy water is reacted with magnesium nitride then the following products are formed–

$$\underset{\text{Magnesium nitride}}{Mg_3N_2} + \underset{\text{Heavy water}}{6D_2O} \rightarrow 3Mg(OD)_2 + 2ND_3$$

• The reaction between heavy water and magnesium nitride is a double decomposition reaction in which the anion of one reactant is exchanged with the anion of another reactant, and new products are formed.

14. At what temperature, the density of heavy water will be maximum?

(a) 0 °C (b) 11.6 °C

(c) 4 °C (d) 27 °C

AP EAMCET- 1999

Ans. (b) : The Density of heavy water is maximum at temperature 11.6 °C.

• The formula of heavy water is D_2O.

• Heavy water is about 11% heavier than ordinary water.

• The density of heavy water at 298K is 1.1059 g/mL.

• The density of water (H_2O) is maximum at 4 °C.

15. Which of the following statement concerning heavy water is correct?

(a) It is also known as dry ice.

(b) It is an isotope of water.

(c) It is used as moderator in nuclear reactors.

(d) It occurs in plenty in natural water.

Ans. (c) : Heavy water is used as moderator in nuclear reactors because it slows down neutrons effectively and also has a low probability of absorption of neutrons.

• Heavy water is used as a primary coolant to transport heat generated by the fission reaction to secondary coolant light water.

2. Hydrogen peroxide

16. The correct statements about H_2O_2 are

(A) Used in the treatment of effluents.

(B) Used as both oxidising and reducing agents.

(C) The two hydroxyl groups lie in the same plane.

(D) Miscible with water.

Choose the correct answer from the options given below.

(a) (A), (B), (C) and (D) (b) (A), (B) and (D)

(c) (B), (C) and (D) (d) (A) , (C) and (D)

[JEE Main-2021, 16 March Shift-II]

Ans. (b) : (a) H_2O_2 Used in the treatment of effluents as it is an oxidizing agent.

(b) In H_2O_2 oxidation of oxygen is –1. Therefore, it acts both as O.A. and R.A.

(c) H_2O_2 has an open book structure in which both –OH group are not in the same plane.

(d) H_2O_2 is miscible in water due to intermolecular H-bonding.

17. Given below are two statements: One is labelled as Assertion A and other is labelled as Reason R.

Assertion (A) The dihedral angles in H_2O_2 in gaseous phase is 90.2° and in solid phase is 111.5°.

Reason (R) The change in dihedral angle in solid and gaseous phase is due to the difference in the intermolecular forces.

Choose the most appropriate answer from the options given below for A and R.

(a) A is correct but R is not correct.

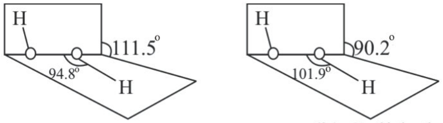
(b) Both A and R are correct but R is not the correct explanation of A.

(c) Both A and R are correct and R is the correct explanation of A.

(d) A is not correct but R is correct.

[JEE Main-2021, 20 July Shift-I]

Ans. (d) :



(a) Gas phase (b) Solid phase

(a) H_2O_2 structure in gas phase, dihedral angle is 111.5°.

(b) H_2O_2 structure in solid phase at 110K dihedral angle is 90.2°.

In H_2O_2 the change in dihedral angle in solid and gaseous phase is due to the difference in the inter molecular forces.

The change in dihedral angle in solid and gaseous phase is due to the difference in the inter molecular forces.

Hence A is not correct but R is correct.

18. When H_2O_2 reacts with chlorine the product obtained is :

(a) O_2 (b) H_2

(c) ClO_2 (d) HOCl

AP EAMCET (Medical) -1998

Ans. (a): When hydrogen peroxide (H_2O_2) reacts with chlorine, (Cl_2) the product obtained is oxygen(O_2).

$$H_2O_2+Cl_2 \rightarrow 2HCl+O_2$$

• In this reaction chlorine is reduced to HCl.

19. The moderator used in nuclear reactor is

(a) TEL (b) D_2O

(c) H_2O_2 (d) R–O–R

UP CPMT-2002

Ans. (b) : TEL[$(C_2H_5)_4$ Pb]- Tetraethyl lead used as antiknocking agent in fuel.

D_2O – It is used as a moderator in nuclear reactor.

H_2O_2- Used an antiseptic for skin to prevent infection in cut, or burns.

Ether(R-O-R)- As a solvent, for fat, oil, waxes and perfumes.

20. Consider the following compounds.

1. **Sulphur dioxide**
2. **Hydrogen peroxide**
3. **Ozone**

Among the compound identify those that can acts as bleaching agent.

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(a) 1 and 3 (b) 2 and 3
(c) 1 and 2 (d) 1, 2 and 3

JCECE - 2005

Ans. (d) : All three compounds act as a bleaching agents. SO_2 through reduction process where as H_2O_2 and O_3 through oxidation process.

$SO_2 + 2H_2O \rightarrow 2H_2SO_4 + 2\,[H]$

Colour matter + [H] → colourless matter

$H_2O_2 \rightarrow H_2O + [O]$

[O] + colourd matter → colourless matter

$O_3 \rightarrow O_2 + [O]$

21. Hydrogen peroxide when added to a solution of potassium permanganate acidified with sulphuric acid:
(a) Forms water only
(b) Acts as an oxidizing agent
(c) Acts as a reducing agent
(d) Reduces sulphuric acid

JCECE - 2005

Ans. (c) :

$$2K\overset{+7}{Mn}O_4 + 3H_2SO_4 + 5H_2O_2 \rightarrow K_2SO_4 + 2\overset{+2}{Mn}SO_4 + 8H_2O + 5O_2$$

∴ H_2O_2 is acting as a reducing agent it reduce $KMnO_4$ to Mn^{+2} ion.

22. Which of the following statements is incorrect?
(a) H_2O_2 has weak acidic property
(b) H_2O_2 has weak basic property
(c) H_2O_2 can act as an oxidising agent
(d) H_2O_2 can act as a reducing agent

AP- EAMCET(Medical) -2010

Ans. (b): Hydrogen peroxide is a very weak acid. So, a 0.1N solution should have a pH of about 6.4. It acts as an oxidising agent in acidic medium and also as a reducing agent in acidic as well as basic medium.

- H_2O_2 is weakly acidic in nature and pure hydrogen peroxide turns blue litmus to red litmus.

($K_a = 1.57 \times 10^{-12}$ at 293K). It ionizes in two steps.

$$H_2O_2 \rightleftharpoons H^+ + HO_2^-$$

$$HO_2^- \rightleftharpoons H^+ + O_2^{2-}$$

23. Find the reaction in which hydrogen peroxide is a reducing agent.
(a) $SO_2 + H_2O_2 \rightarrow H_2SO_4$
(b) $2KI + H_2O_2 \rightarrow 2KOH + I_2$
(c) $PbS + 4H_2O_2 \rightarrow PbSO_4 + 4H_2O$
(d) $Ag_2O + H_2O_2 \rightarrow 2Ag + H_2O + O_2$

SRMJEEE – 2013, BITSAT-2010
AMU – 2009

Ans. (d) : Hydrogen peroxide acts as an oxidising agent as well as reducing agent in both acidic and basic media. Silver oxide reacts with hydrogen peroxide to produce elemental silver and oxygen. In this reaction oxidation state of Ag changes from +1 to 0 and oxidation state of oxygen in H_2O_2 changes from –1 to 0

$H_2O_2 + Ag_2O \longrightarrow 2Ag + H_2O + O_2$

24. (A) $HOCl + H_2O_2 \rightarrow H_3O^+ + Cl^- + O_2$
(B) $I_2 + H_2O_2 + 2OH^- \rightarrow 2I^- + 2H_2O + O_2$
Choose the correct option.
(a) H_2O_2 acts as oxidising agent in equations (A) and (B)
(b) H_2O_2 acts as reducing agent in equations (A) and (B).
(c) H_2O_2 act as oxidising and reducing agent respectively in equations (A) and (B).
(d) H_2O_2 acts as reducing and oxidising agent respectively in equations (A) and (B)

[JEE Main-2021, 24 Feb Shift-I]
BITSAT-2018

Ans. (b) : (A) $HOCl + H_2O_2 \rightarrow H_3O^+ + Cl^- + O_2$
In this reaction, H_2O_2 is reducing chlorine from +1 to –1.
(B) $I_2 + H_2O_2 + 2OH^- \rightarrow 2I^- + 2H_2O + O_2$
In this reaction, H_2O_2 is reducing iodine from 0 to –1.
In (A) reduction of HOCl occurs so it will be an oxidising agent.Hence, H_2O_2 will be a reducing agent.
In (B) reduction of I_2 occurs so it will be an oxidising agent and H_2O_2 will be a reducing agent.

25. Which of the following is not correct regarding the electrolytic preparation of H_2O_2?
(a) Lead is used as cathode
(b) 50% H_2SO_4 is used
(c) Hydrogen is liberated at anode
(d) Sulphuric acid undergoes oxidation

UP CPMT-2008
AP-EAMCET (Engg.)-2005

Ans. (c): H_2O_2 can be prepared by electrolysis of 50% H_2SO_4. In this method, hydrogen is liberated at cathode.

$H_2SO_4 \rightleftharpoons 2H^+ + 2HSO_4^-$

At anode: $2HSO_4^- \rightarrow H_2S_2O_8 + 2e^-$

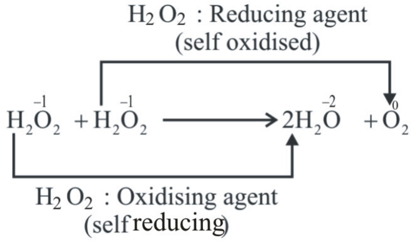
$H_2S_2O_8 + 2H_2O \rightarrow 2H_2SO_4 + H_2O_2$

At cathode: $2H^+ + 2e^- \rightarrow H_2\uparrow$

26. Hydrogen peroxide is ....
(a) an oxidising agent
(b) a reducing agent
(c) both an oxidising and a reducing agent
(d) neither oxidising nor reducing agent

AP EAMCET (Engg.) 17.09.2020, Shift-II
Karnataka CET-2018

Ans. (c) :


H_2O_2 : Reducing agent
(self oxidised)
$\overset{-1}{H_2O_2} + \overset{-1}{H_2O_2} \longrightarrow 2\overset{-2}{H_2O} + \overset{0}{O_2}$
H_2O_2 : Oxidising agent
(self reducing)

So, H_2O_2 (hydrogen peroxide) can act both as oxidising agent and reducing agent.

27. H_2O_2 cannot oxidise
(a) PbS (b) Na_2SO_3
(c) O_3 (d) KI

Karnataka-CET-2015, BCECE-2007

Ans. (c) : H_2O_2 can not oxidise O_3 because O_3(ozone) is a much better oxidizing agent. When H_2O_2 react with O_3, it act as reducing agent.

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28. Which of the following gives hydrogen peroxide on reaction with dilute acids?

(a) PbO_2 (b) MnO_2
(c) TiO_2 (d) Na_2O_2

SRMJEEE – 2013
BCECE-2005

Ans. (d) : When sodiumdioxide is treated with dil-H_2SO_4 then sodium sulphate and hydrogen peroxide are formed during the reaction.

$$\underset{\text{sodiumdioxide}}{Na_2O_2} + \underset{\text{Sulfuric acid}}{\text{dil. }H_2SO_4} \longrightarrow \underset{\text{Sodiumsulfate}}{Na_2SO_4} + \underset{\text{Hydrogenperoxide}}{H_2O_2}$$

29. Hydrogen peroxide reacts with iodine in basic medium to give

(a) IO_4^- (b) IO^-
(c) I^- (d) IO_3^-

[JEE Main-2021, 1 Sep Shift-II]

Ans.(c):$I_{2(s)}+H_2O_{2(aq)}+2OH^-_{(aq)}\to 2I^-_{(aq)}+2H_2O_{(l)}+O_{2(g)}$
Therefore, the product of the reaction of I_2 with H_2O_2 in the basic medium is Iodine (I^-).

30. Which of the following solution produces H_2O_2 on electrolysis?

(a) 0.2N NaOH (b) 50% H_2SO_4
(c) 2% H_2SO_4 (d) 5% NaCl

AP EAPCET 25.08.2021, Shift-II

Ans. (b) : Hydrogen peroxide can be produced by electrolysis of sulphuric acid.

$$2HSO_4^- \to S_2O_8^{2-} + 2H^+ + 2e^-$$

$$S_2O_8^{2-} + 2H_2 \to H_2O_2 + 2HSO_4^-$$

So the option 50% H_2SO_4 is correct.

31. The correct statements about H_2O_2 are:

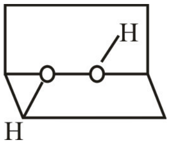
(A) used in the treatment of effluents.
(B) used as both oxidising and reducing agents.
(C) the two hydroxyl groups lie in the same plane.
(D) miscible with water.

Choose the correct answer from the options given below:

(a) (A), (B) and (D) only
(b) (B), (C) and (D) only
(c) (A), (C) and (D) only
(d) (A), (B), (C) and (D)

JEE Main 16.03.2021, Shift-II

Ans. (a) : Hydrogen peroxide used as a treatment of effluents. The structure of H_2O_2 is like as open book i.e. both OH group are in non-planer. H_2O_2 acts as oxidising as well as reducing



Structure of H_2O_2
(open book type) → non-planer

agent in acidic and basic medium. It is miscible in water due to hydrogen bonding.

32. Which metal oxide among the following gives H_2O_2 on treatment with dilute acid?

(a) BaO_2 (b) RbO_2
(c) MnO_2 (d) Al_2O_3

AP EAPCET 19-08-2021 Shift-I

Ans. (a) :
(i) $BaO_2 + H_2SO_4(\text{dil}) \longrightarrow H_2O_2 + BaSO_4$
(ii) RbO_2 + dilute acid $\longrightarrow$ X(Reaction is not take place with RbO_2
(iii) $MnO_2 + 4HCl \longrightarrow MnCl_2 + Cl_2 + 2H_2O$
(iv) $Al_2O_3 + 6HCl \longrightarrow 2AlCl_3 + 3H_2O$

33. A commercial sample of H_2O_2 marked as 100 volume hydrogen peroxide means

(a) 1 mL of H_2O_2 will give 100 mL of O_2 at STP
(b) 1 L of H_2O_2 will give 100 mL of O_2 at STP
(c) 1 L of H_2O_2 will give 22.4 L O_2 at STP
(d) 1 mL of H_2O_2 will give 1 mole of O_2 at STP

AP EAMCET (Engg.) 18.9.2020 Shift-I

Ans. (a) : 100 volume H_2O_2 solution indicates 1 mL of the H_2O_2 solution will give 100 mL of O_2 (g) at STP.

34. Hydrogen peroxide, in the pure state, is

(a) Non-planar and almost colourless
(b) Linear and blue in colour
(c) Linear and almost colourless
(d) Planar and blue in colour

[JEE Main-2020, 5 Sep Shift-II]

Ans. (a) : H_2O_2 has open book structure and it is non-planar and colourless.

35. Among statements (A)-(D), the correct ones are

(A) Decomposition of hydrogen peroxide gives dioxygen.
(B) Like hydrogen peroxide compounds, such as $KClO_3$ $Pb(NO_3)_2$ and $NaNO_3$ when heated liberate dioxygen.
(C) 2-ethylanthraquinone is useful for the industrial preparation of hydrogen peroxide.
(D) Hydrogen peroxide is used for the manufacture of sodium perborate.

(a) (A), (B) and (C) only
(b) (A), (B), (C) and (D)
(c) (A), (C) and (D) only
(d) (A) and (C) only

[JEE Main-2020, 7 Jan Shift-II]

Ans. (b):
(A) Hydrogen peroxide decomposes to give water and oxygen gas.

$$2H_2O_2(l) \longrightarrow 2H_2O(l) + O_2(g) \quad \Delta H = -196\ kJmol^{-1}$$

Hence, statement is true.
(B) When $Pb(NO_3)_2$, $KClO_3$ and $NaNO_3$ are heated then the oxygen gas evolved.

$$2Pb(NO_3)_2 \xrightarrow{\Delta} 2PbO + 4NO_2 + O_2$$

$$2KClO_3 \xrightarrow{\Delta} 2KCl + 3O_2(g)$$

$$2NaNO_3 \xrightarrow[800^\circ C]{\Delta} 2Na_2O + 2N_2 + 5O_2$$

Hence, statement is true.

@apna_pdf

(C) By the auto-oxidation, 2-ethyl anthraquinone is reduced to 2-ethyl enthraquinol and H_2O_2. Thus, statement is true.

(D) Sodium perborate is produced by adding one mole of sodium peroxide to one mol of borax and then add H_2O_2 to complete the oxidation. Hence, statement is true.

36. The chemical nature of hydrogen peroxide is
- (a) Oxidising and reducing agent in both acidic and basic medium
- (b) Oxidising and reducing agent in acidic medium, but not in basic medium
- (c) Reducing agent in basic medium, but not in acidic medium
- (d) Oxidising agent in acidic medium, but not in basic medium

[JEE Main-2019, 10 Jan Shift-I]

Ans. (a) : H_2O_2 act as oxidizing agent and reducing agent in acidic medium as well as basic medium.

H_2O_2 Acts as oxidant:-

$H_2O_2+2H^{\oplus}+2e^{\ominus}\rightarrow 2H_2O$ (In acidic medium)

$H_2O_2+2e^{\ominus}\rightarrow 2OH^{\ominus}$ (In basic medium)

H_2O_2 Acts as reductant:-

$H_2O_2\rightarrow 2H^{\oplus}+O_2+2e^{\ominus}$(In acidic medium)

$H_2O_2+2OH^{\ominus}\rightarrow 2H_2O+O_2+2e^{\ominus}$ (In basic medium)

37. Which reaction shows oxidizing nature of H_2O_2?
- (a) $H_2O_2+2KI\rightarrow 2KOH+I_2$
- (b) $Cl_2+H_2O_2\rightarrow 2HCl+O_2$
- (c) $H_2O_2+Ag_2O\rightarrow 2Ag+H_2O+O_2$
- (d) $NaClO+H_2O_2\rightarrow NaCl+H_2O+O_2$

BITSAT-2019

Ans. (a) : $H_2O_2+KI\rightarrow I_2$

O.S. of I^- (-1) changes to I_2 (zero)

There is increase in oxidation numbers hence oxidation.

38. Assertion: Hydrogen peroxide forms two series of salts called peroxides and hydroperoxides.

Reason: Hydrogen peroxide molecule has two replaceable hydrogen atoms.
- (a) If both Assertion and Reason are correct and Reason is the correct explanation of Assertion.
- (b) If both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.
- (c) If Assertion is correct but Reason is incorrect.
- (d) If both the Assertion and Reason are incorrect.

AIIMS 26 May 2019 (Evening)

Ans. (a): Both Assertion and reason are true. Hydrogen peroxide forms two series of salt called hydroperoxide and peroxides.

39. H_2O_2 is obtained by which of the following?

(a) BaO_2	(b) MnO_2
(c) SeO_2	(d) TeO_2

AIIMS 26 May 2019 (Evening)

Ans. (a): $BaO_2+H_2SO_{4\,(aq)}\longrightarrow BaSO_{4\,(s)}+H_2O_{2\,(aq)}$

$BaO_2\cdot 8H_2O(s)+H_2SO_4(aq)\longrightarrow BaSO_4(s)+H_2O_2(aq)+8H_2O(l)$

40. The label on a bottle of H_2O_2 solution reads as '10 volume'. The concentration of H_2O_2 in percentage by volume is

(a) 4.05%	(b) 3.03%
(c) 6.06%	(d) 2.03%

(AIIMS-26 May, 2018(E))

Ans. (b): $2H_2O_2\rightarrow 2H_2O+O_2$

From equation, it is cleared that 22400 mL O_2 is formed by 68g of H_2O_2 10 mL O_2 is formed by

$$\frac{68}{22400}\times 10=0.0303\,g\,H_2O_2$$

100 mL= 3.03 g i.e. 3.03 %

41. The following reactions show the H_2O_2 behaviour in A and B reactions as

(i) $PbS_{(s)}+4H_2O_{2(aq)}\rightarrow PbSO_{4(s)}+4H_2O_{(l)}$

(ii) $HOCl+H_2O_2\rightarrow H_3O^++Cl^-+O_2$
- (a) oxidising in acidic medium and reducing in basic medium
- (b) reducing in acidic medium and oxidising in basic medium
- (c) oxidising in acidic medium and reducing in acidic medium
- (d) reducing in acidic medium and oxidising in acidic medium.

AMU-2018

Ans. (c) : Hydrogen peroxide, H_2O_2 oxidises lead sulphide, PbS(s) to lead sulphate. $PbSO_4$(s) in acidic medium.

$$\underset{\text{Black}}{PbS(s)}+4H_2O_2(aq)\rightarrow \underset{\text{White}}{PbSO_4(s)}+4H_2O(l)$$

It reacts with hydrochloric acid, HOCl, to produce water, oxygen and hydrochloride acid, showing oxidising action in acidic medium.

$HOCl+H_2O_2\rightarrow H_3O^++Cl^-+O_2$

42. Hydrogen peroxide oxidises $[Fe(CN)_6]^{4-}$ to $[Fe(CN)_6]^{3-}$ in acidic medium but reduces $[Fe(CN)_6]^{3-}$ to $[Fe(CN)_6]^{4-}$ in alkaline medium. The other products formed are, respectively.
- (a) (H_2O+O_2) and H_2O
- (b) (H_2O+O_2) and (H_2O+OH^-)
- (c) H_2O and (H_2O+O_2)
- (d) H_2O and (H_2O+OH^-)

[JEE Main-2018]

Ans. (c) : Oxidising action of H_2O_2 in acidic medium .

$[Fe(CN)_6]^{4-}+H_2O_2+2H^+\rightarrow [Fe(CN)_6]^{3-}+2H_2O$

Reducing action of H_2O_2 in alkaline medium.

$[Fe(CN)_6]^{3-}+2OH^-+H_2O_2\rightarrow [Fe(CN)_6]^{4-}+2H_2O+O_2$

43. Decomposition of hydrogen peroxide can be prevented by adding

(a) NaOH	(b) MnO_2
(c) Urea	(d) Oxalic acid

COMEDK 2015

Ans. (c) : H_2O_2 decomposes slowly on exposure to light.

$2H_2O_{2(l)}\longrightarrow 2H_2O_{(l)}+O_{2(g)}$

Its decomposition can be prevented by adding urea as a stabilizer.

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44. From the following statements regarding H_2O_2, Choose the incorrect statement.
(a) It can act only as an oxidising agent
(b) It decomposed on exposure to light
(c) It has to be stored in plastic or wax lined glass bottles in dark
(d) It has to be kept away from dust

[JEE Main-2015]

Ans. (a) : H_2O_2 acts as an oxidizing as well as a reducing agent.

45. Peroxide ion.........
i. has five completely filled antibonding molecular orbitals
ii. is diamagnetic
iii. has bond order one
iv. is isoelectronic with neon
Which one of these is correct?
(a) ii and iii
(b) i, ii and iv
(c) i, ii and iii
(d) i and iv

BCECE-2014

Ans. (a) : Peroxide ion is O_2^{2-}

$$O_2^{2-}(18) = \sigma 1s^2, \overset{*}{\sigma}1s^2, \sigma 2s^2, \overset{*}{\sigma}2s^2, \sigma 2p_z^2$$

$$\pi 2p_x^2 \approx \pi 2p_y^2,\ \overset{*}{\pi}2p_x^2 \approx \overset{*}{\pi}2p_y^2$$

$$\text{Bond order} = \frac{N_b - N_a}{2} = \frac{10-8}{2} = 1$$

It contains four completely filled antibonding molecular orbitals. Since, all the electrons are paired, O_2^{2-} is diamagnetic. Peroxide ion is isoelectronic with argon, not with neon.

46. Moist hydrogen peroxide can not be dried over conc. H_2SO_4 because
(a) It can catch fire
(b) It is reduced by H_2SO_4
(c) It is oxidized by H_2SO_4
(d) It is decomposed by H_2SO_4

JIPMER-2012

Ans. (d) : Concentrated H_2SO_4 decomposes H_2O_2 and cannot be dried over it.
$H_2O_2+[O]\rightarrow H_2O+O_2$

47. The product (s) formed when H_2O_2 reacts with disodium hydrogen phosphate is
(a) $P_2O_5{\cdot}Na_3PO_4$
(b) $Na_2HPO_4{\cdot}H_2O_2$
(c) $NaH_2PO_4{\cdot}H_2O$
(d) $Na_2HPO_4{\cdot}H_2O$

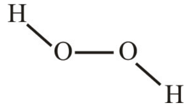
AP EAMCET (Engg.) - 2012

Ans. (b) : $Na_2HPO_4+H_2O_2\rightarrow Na_2HPO_4{\cdot}H_2O_2$ The product formed when H_2O_2 reacts with disodium hydrogen phosphate is $Na_2HPO_4{\cdot}H_2O_2$.

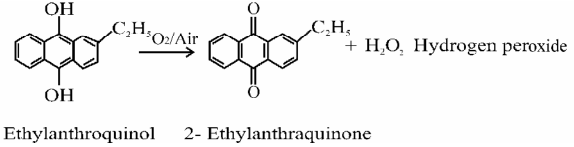
48. Which one of the following is not correct in respect of hydrogen peroxide?
(a) It is industrially produced from 2-ethylanthroquinol.
(b) It has a linear structure.
(c) Hydrogen peroxide acts as a strong oxidizing and reducing agent.
(d) It acts widely used as bleaching agent.

SCRA 2012

Ans. (b) : Hydrogen peroxide having the open book like structure.



(a) The first statement is true. H_2O_2 formed from auto-oxidation of 2-ethyl anthroquinol.

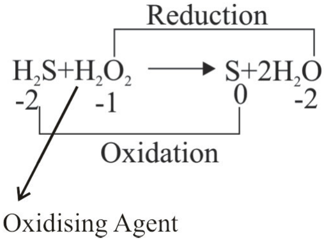


(b) Second statement is false because the H_2O_2 has the open book like structure.
(c) Third statement is true because hydrogen peroxide acts as a strong oxidizing and reducing agent.
(d) Fourth statement is true because hydrogen peroxide acts as bleaching agent due to the release of nascent oxygen.

49. In the reaction $H_2S + H_2O_2 \longrightarrow S + 2H_2O$
(a) H_2S is an acid and H_2O_2 is a base
(b) H_2S is a base and H_2O_2 is an acid
(c) H_2S is an oxidizing agent and H_2O_2 is a reducing agent
(d) H_2S is a reducing agent and H_2O_2 is an oxidizing agent
(e) H_2S is hydrolysed to S

Kerala-CEE-2011

Ans. (d) : The reaction-
$H_2S+H_2O_2\rightarrow S+2H_2O$
manifests oxidising nature of H_2O_2 as it oxidizes S from -2 to 0 oxidation state



Hence, H_2S is oxidised to S.

50. Which of the following undergoes reduction with hydrogen Peroxide in alkaline medium?
(a) Mn^{2+}
(b) HOC
(c) PbS
(d) Fe^{2+}
(e) I_2

Kerala-CEE-2010

Ans.(e):$I_2(S)+H_2O_2(aq)+2OH^-\rightarrow 2I^-(aq)+2H_2O(l)+O_2$
H_2O_2 reduces iodine to iodide solution in an alkaline medium.

51. Which one of the following statements is correct for H_2O_2?
(a) It reduces ferricyanide to ferrocyanide in acid medium.
(b) It oxidises lead monoxide to lead dioxide.

@apna_pdf

(c) It acts as a reducing agent in the decolourisation of acidified $KMnO_4$.

(d) It oxidises hydrides of chlorine and bromine to their diatomic gases.

AP - EAMCET(MEDICAL) - 2009

Ans. (c) : As we know that H_2O_2 reduces acidified $KMnO_4$ into colourless manganous salt and gets oxidised into O_2.

$$\underset{\text{Potassium permanganate}}{2KMnO_4}+\underset{\text{Sulfuric acid}}{3H_2SO_4}+\underset{\text{Hydrogen peroxide}}{5H_2O_2}\rightarrow\underset{\text{Potassium sulfate (colourless)}}{K_2SO_4}+2MnSO_4+8H_2O+SO_2$$

It reduces ferricyanide to ferrocyanide in alkaline medium not in acid medium.

52. 30 volume hydrogen peroxide means:

(a) 30% of H_2O_2 solution

(b) 30 cm^3 of solution contains 1g of H_2O_2

(c) 1cm^3 of solution liberates 30 cm^3 of O_2 at STP

(d) 30 cm^3 of solution contains 1 mole of H_2O_2

BITSAT-2008

Ans. (c) : 30 volume H_2O_2 means one volume of H_2O_2 on decomposition will give 30 volume of oxygen.

53. Which one of the following reactions represents the oxidizing property of H_2O_2?

(a) $2KMnO_4 + 3H_2SO_4 + 5H_2O_2 \rightarrow K_2SO_4 + 2MnSO_4 + 8H_2O + 5O_2$

(b) $2K_3[Fe(CN)_6] + 2KOH + H_2O_2 \rightarrow 2K_4[Fe(CN)_6] + 2H_2O + O_2$

(c) $PbO_2 + H_2O_2 \longrightarrow PbO + H_2O + O_2$

(d) $2KI + H_2SO_4 + H_2O_2 \longrightarrow K_2SO_4 + I_2 + 2H_2O$

AP EAMCET- 2008

Ans. (d) : The reaction in which H_2O_2 is reduced while the other reactant is oxidized represent the oxidizing property of H_2O_2.

54. Match the following

	Set-I		Set-II
(A)	10 vol H_2O_2	1.	perhydrol
(B)	20 vol H_2O_2	2.	5.358 N
(C)	30 vol H_2O_2	3.	1.785 M
(D)	100 vol H_2O_2	4.	3.03%

The correct match is

(a) A–4, B–3, C–2, D–1

(b) A–1, B–2, C–3, D–4

(c) A–1, B–3, C–2, D–4

(d) A–4, B–2, C–3, D–1

AP - EAMCET (Medical) - 2007

Ans. (a) : Set-I		**Set-II**
(A) 10 vol H_2O_2	–	(4) 3.03%
(B) 20 vol H_2O_2	–	(3) 1.785 M
(C) 30 vol H_2O_2	–	(2) 5.358 N
(D) 100 vol H_2O_2	–	(1) Perhydrol

55. In the hydrogen peroxide molecule:

(a) O-H bonds are polar but molecule is non polar

(b) The four atoms are arranged in a non linear and non planar manner

(c) All the four atoms are in same plane

(d) Two hydrogen atoms are connected to one of the oxygen

BITSAT-2005

Ans. (b) : Hydrogen peroxide (H_2O_2) has open book like structure and both-OH bonds are trans to each other thus they cancel each other polarity. So H_2O_2 is non polar.

56. Which one of the following is reduced by hydrogen peroxide in acid medium?

(a) Potassium permanganate

(b) Potassium iodide

(c) $FeSO_4$

(d) Potassium ferrocyanide

AP EAMCET- 1997

Ans. (a) : Potassium permanganate ($KMnO_4$) is Mn^{+7} state gets reduced to Mn^{+2}state by the action of H_2O_2 in acidic medium. Hence, $KMnO_4$ is reduce by H_2O_2.

57. Sodium amalgam is useful as

(a) Oxidising agent (b) Catalyst

(c) Reducing agent (d) Bleaching agent

AP EAMCET- 1996

Ans. (c) : Sodium amalgam Na(Hg) reduces H_2O to H_2. So it is used as a reducing agent. It is safer to handle than sodium itself. It is also used in Emde degradation and also for reduction of aromatic ketones to hydrols.

58. In aqueous solutions, H_2O_2 oxidizes H_2S to

(a) Sulphur (b) Sulphuric acid

(c) Caro's acid (d) Marshall's acid

AP EAMCET- 1994

Ans. (a) : H_2O_2 oxidizes H_2S to sulphur in the presence of aqueous solution. The reaction is given as under–

$$\underset{\text{Hydrogen peroxide}}{H_2O_2}+H_2S\rightarrow 2H_2O+\underset{\text{Sulphur}}{S}$$

59. Hydrogen peroxide molecules are

(a) monoatomic and form X_2^{2-} ions

(b) diatomic and form X^- ions

(c) diatomic and form X_2^- ions

(d) monoatomic and form X^- ions

NEET-1991

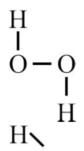
Ans. (a) : Hydrogen peroxide molecules are monoatomic as it contain only one atom. It acts as both reducing and oxidizing agent in both acidic and basic medium. It forms $(OH)_2^{2-}$ ions on breakage.

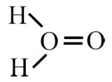
i.e. it forms X_2^{2-} ions.

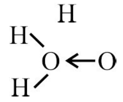
$$OH-OH \rightleftharpoons (OH)_2^{2-}$$

60. Which of the following is the true structure H_2O_2?

(a) $H-O-O-H$

(b) 

(c) 

(d) 

NEET-1989

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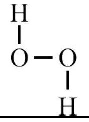
Ans. (b) : The structure of H_2O_2 is non planar but open book structure. The O–O–H bond angle is 101.5^o and O–O single bond distance is $1.48\ \overset{o}{A}$.



61. The reaction of H_2O_2 with H_2S is an example of ...... reaction.

(a) addition (b) oxidation

(c) reduction (d) acidic

NEET-1988

Ans. (b) : When H_2O_2 is reacted with hydrogen sulphide (H_2S) it form S and water. In this reaction H_2S is oxidized to suphur. H_2O_2 act as oxidizing agent.

$H_2O_2 + H_2S \rightarrow S + 2H_2O$

3. Properties of hydrogen

62. Given below are two statements one is labelled as Assertion A and the other is labelled as Reason R:

Assertion A: The amphoteric nature of water is explained by using Lewis acid/base concept

Reason R: Water acts as an acid with NH_3 and as a base with H_2S.

In the light of the above statements choose the correct answer from the options given below:

(a) Both A and R are true and R is the correct explanation of A

(b) Both A and R are true but R is NOT the correct explanation of A

(c) A is true but R is false

(d) A is false but R is true

JEE Main-25.06.2022, Shift-II

Ans. (d) : The amphoteric nature of water is explained by using Bronsted - Lowry acid base concept

$$H_2O + NH_3 \rightleftharpoons OH^- + NH_4^+$$

$$H_2S + H_2O \rightleftharpoons H_3O^+ + HS^-$$

So, A is false but R is true.

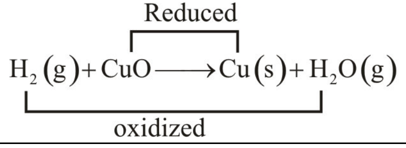
63. Dihydrogen reacts with CuO to give

(a) CuH_2 (b) Cu

(c) Cu_2O (d) $Cu(OH)_2$

JEE Main-28.06.2022, Shift-I

Ans. (b) : Dihydrogen reacts with CuO to give Cu.



$$H_2(g) + CuO \longrightarrow Cu(s) + H_2O(g)$$

64. In the industrial production of which of the following, molecular hydrogen is obtained as a by product?

(a) NaOH (b) NaCl

(c) Na metal (d) Na_2CO_3

JEE Main-24.06.2022, Shift-II

Ans. (a) : Molecular hydrogen is produced as a by product in the industrial production of NaOH by electrolysis of aq NaCl solution.

$$NaCl \longrightarrow Na^+ + Cl^-$$

$$H_2O \rightleftharpoons H^+ + OH^-$$

Cathode : $2H_2O + 2e \longrightarrow H_2 + 2OH^-$

Anode : $2Cl^- \longrightarrow Cl_2 + 2e^-$

NaOH is crystallized from the remaining part of electrolyte.

65. The correct order of increasing intermolecular hydrogen bond strength is

(a) $HCN < H_2O < NH_3$ (b) $HCN < CH_4 < NH_3$

(c) $CH_4 < HCN < NH_3$ (d) $CH_4 < NH_3 < HCN$

JEE Main-27.06.2022, Shift-II

Ans. (c) : Due to high difference in electronegativity of H and N the H-bond strength of NH_3 is highest. It is clear that smaller the size of the atom, greater is the electronegativity and because of that hydrogen holds strong bonding between the molecules.

Methane can not form hydrogen bond because it does not contain an N–H, O–H bond.

Degree of H-bonding is highest in HCN.

The correct order of increasing intermolecular hydrogen bond strength is-

$CH_4 < HCN < NH_3$

66. Hydrogen has three isotopes: protium (^1H), deuterium (^2H or D) and tritium (^3H or T). They have nearly same chemical properties but different physical properties. They differ in

(a) Number of proton

(b) Atomic number

(c) Electronic configuration

(d) Atomic mass

JEE Main-28.06.2022, Shift-II

Ans. (d) : ${}^1_1H, {}^2_1H$ and ${}^3_1H$ have same atomic number but their atomic masses are different.

Isotopes have same atomic number i.e. same number of protons.

67. Given below are two statements: one is labelled as Assertion A and the other is labelled as Reason R.

Assertion A: Polluted water may have a value of BOD of the order of 17 ppm.

Reason R: BOD is a measure of oxygen required to oxidize both the bio-degradable and non- biodegradable organic material in water.

In the light of the above statements, choose the most appropriate answer from the options given below.

(a) Both A and R are correct and R is the correct explanation of A

(b) Both A and R are correct but R is NOT the correct explanation of A

(c) A is correct but R is not correct

(d) A is not correct but R is correct

JEE Main-25.06.2022, Shift-II

@apna_pdf

Ans. (c) : The amount of oxygen required by bacteria to breakdown the organic matter present in a certain volume of a sample of water is called Biochemical Oxygen Demand (BOD).

Clean water could have BOD value of less than 5ppm whereas highly Polluted water could have a BOD value of 17 ppm or more.

68. The measured BOD values for four different water samples (A-D) are as follows:
A = 3 ppm; B = 18 ppm; C = 21 ppm; D = 4 ppm; the water samples which can be called as highly polluted with organic wastes, are

(a) A and B (b) A and D
(c) B and C (d) B and D

JEE Main-26.06.2022, Shift-II

Ans. (c) : Biological Oxygen Demand (BOD) is used as a measure of degree of water pollution.

Clean water $\rightarrow$ B.O.D. < 5ppm

Highly polluted $\rightarrow$ B.O.D. > 17ppm

69. The production of dihydrogen gas via water-gas shift reaction:

$$CO_{(g)} + H_2O_{(g)} \xrightarrow[\text{Catalyst}]{\Delta} CO_{2(g)} + H_{2(g)}$$

The CO_2 gas is removed by scrubbing with solution of

(a) sodium arsenite (b) calcium oxide
(c) sodium phosphite (d) aluminium oxide

AMU-2014

Ans. (a) : The given water gas shift reaction, is used to increase the production of hydrogen gas. Here, the obtained carbon dioxide (CO_2) is removed by scrubbing with a solution of sodium arsenite.

- The water gas shift reaction is an important and commonly employed reaction in the industry. In the water gas shift reaction, hydrogen is produced from water or steam while carbon monoxide is converted into carbon dioxide.

$$CO_{(g)} + H_2O_{(g)} \xrightarrow[\text{Catalyst}]{\Delta} CO_{2(g)} + H_{2(g)}$$

70. Radioactive isotope of hydrogen is

(a) uranium (b) deuterium
(c) tritium (d) None of these

CG PET-2006
UP CPMT-2005

Ans. (c) : (i) Tritium $\left({}_1^3H\right)$ is the most stable radioactive isotope of hydrogen. Half life of hydrogen is 12.32 years. It has n/p ratio = 2.0. So, it is unstable.

(ii) Deuterium $\left({}_1^2H\right)$ is heavy hydrogen, another isotope of hydrogen.

71. When same amount of zinc is treated separately with excess of sulphuric acid and excess of sodium hydroxide solution, the ratio of volumes of hydrogen evolved is:

(a) 1 : 1 (b) 1 : 2
(c) 2 : 1 (d) 9 : 4

JEE Main-09.01.2020, Shift-II
BITSAT-2013

Ans. (a) : The balance chemical reaction of zinc with sulphuric acid and NaOH are -

$Zn+H_2SO_4 \rightarrow ZnSO_4+H_2(g)$

$Zn+2NaOH \rightarrow Na_2ZnO_2 + H_2\uparrow$

Since, one mole of H_2(g) is produced per mole of zinc with both sulphuric acid and NaOH respectively, hydrogen gas is produced in the molar ratio 1:1 in the above reaction.

72. The shortest wavelength in hydrogen spectrum is approximately______

(a) 121 nm (b) 91.2 nm
(c) 91.5 nm (d) 912 nm

AP-EAMCET 25-08-2021 Shift - I

Ans. (b) : According to Rydberg's formula –

$$\frac{1}{\lambda} = R_H Z^2 \left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right)$$

Where R = Rydbergs constant [$\because$ $R_H = 109678\ cm^{-1}$]

From line spectrum of hydrogen

Fro lyman series, $n_1 = 1$

For shortes wavelength of lyman series, the energy difference in two levels showing transition should be maximum ($n_2 = \infty$)

$$\frac{1}{\lambda} = R_H \left(\frac{1}{1^2} - \frac{1}{\infty}\right) \Rightarrow \frac{1}{\lambda} = 109678$$

$$\lambda = 911.7 \times 10^{-8}\ cm = 91.17 nm \quad [\because 1cm = 10^7\ nm]$$

73. Which of the following forms of hydrogen emits low energy β^- particles?

(a) Proton H^+ (b) Protium ${}_1^1H$
(c) Deuterium ${}_1^2H$ (d) Tritium ${}_1^3H$

JEE Main 26.02.2021,Shift-II

Ans. (d) : Tritium $\left({}_1^3H\right)$ isotope of hydrogen is radioactive and emits low energy β^- particle. It has one proton and two neutrons in the nucleus. Thus n/p ratio of tritium which makes nucleus unstable. The concentration of tritium is very low.

For tritium ${}_1H^3$

No. of neutron (n) = 2

No. of proton (p) = 1

$$\frac{n}{p} = 2$$

$\therefore$ $\frac{n}{p}$ is high, tritium will emit β particle.

74. Which one of the following methods in most suitable for preparing de-ionised water?

(a) Synthetic resin method (b) Clark's method
(c) Calgon's method (d) Permutit method

[JEE Main-2021, 26 Aug Shift-I]

Ans. (a) : Pure demineralised (de-ionised) water free from all soluble mineral salts is obtained by passing water successively through a cation exchange (in the H^+ form) and an anion exchange (in the OH^+ forms) resins.

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75. The functional groups that are responsible for the ion-exchange property of cation and anion exchange resins, respectively, are

(a) —SO_3H and —NH_2
(b) — SO_3H and —COOH
(c) —NH_2 and —COOH
(d) —NH_2 and —SO_3H

[JEE Main-2021, 17 March Shift-II]

Ans. (a) : The functional groups that are responsible for the ion-exchange property of cation and anion exchange resins, respectively, are –SO_3H and – COOH are cation exchange resin and –NH_2 is anion exchange resin.

76. Calgon is used for water treatment. Which of the following statements is not true about Calgon?

(a) Calgon contains the 2nd most abundant element by weight in the Earth's crust.
(b) It is polymeric compound and is water soluble.
(c) It is also known as Graham's salt,
(d) It does not remove Ca^{2+} ion by precipitation.

[JEE Main-2021, 26 Feb Shift-II]

Ans. (a) : Calgon contains the 2nd most abundant element by weight in the earth's crust.

• 2nd most abundant element is Si and it is not present is calgon $Na_6P_6O_{18}$ (Graham's salt or hexametaphosphate).

• It exist in polymeric form as $(NaPO_3)_6$ and water soluble compound.

• It removes Ca^{2+} in soluble ion but not by precipitation.

77. The single largest industrial application of dihydrogen is

(a) Manufacture of metal hydrides
(b) Rocket fuel in space research
(c) In the synthesis of ammonia
(d) In the synthesis of nitric acid

[JEE Main-2021, 20 July Shift-II]

Ans. (c) : The single largest industrial application of dihydrogen is in the synthesis of ammonia. Which is mainly used in the manufacture of fertilizer.

78. Match the following and identify the correct option.

(A) $CO_{(g)} + H_{2(g)}$	**(i)$Mg(HCO_3) + Ca(HCO_3)_2$**
(B) Temporary hardness of water	**(ii) An electron deficient hydride**
(C) B_2H_6	**(iii) Synthesis gas**
(D) H_2O_2	**(iv) Non-planar structure**

	A	B	C	D
(a)	(iii)	(i)	(ii)	(iv)
(b)	(iii)	(ii)	(i)	(iv)
(c)	(iii)	(iv)	(ii)	(i)
(d)	(i)	(iii)	(ii)	(iv)

NEET-2020

Ans. (a) : • Synthesis gas is a fuel gas mixture consisting primarily of hydrogen carbon monoxide.

• Temporary hardness is a type of water hardness caused by the presence of dissolved bicarbonate minerals (calcium bicarbonate and magnesium bicarbonate)

• B_2H_6 an electron deficient hydride

• H_2O_2 Hydrogen peroxide is a non-planar molecule with (twisted) symmetry. It is non-linear, non-planar molecule with a open book structure.

79. Dihydrogen of high purity (>99.95%) is obtained through

(a) The reaction of Zn with dilute HCl
(b) The electrolysis of acidified water using Pt electrodes
(c) The electrolysis of brine solution
(d) The electrolysis of warm $Ba(OH)_2$ solution using Ni electrodes.

[JEE Main-2020, 6 Sep. Shift-II]

Ans. (d) : High purity (>99.95%) dihydrogen is obtained by electrolysis of warm aqueous barium hydroxide solution between nickel electrodes.

As water does not conduct electricity very well it is usual to electrolyse aqueous solution of Barium hydroxide.

80. The equation that represents the water-gas shift reaction is

(a) $C(s)+H_2O(g)\xrightarrow{1270K}CO(g)+H_2(g)$
(b) $2C(s)+O_2(g)+4N_2(g)\xrightarrow{1273K}2CO(g)+4N_2(g)$
(c) $CO(g)+H_2O(g)\xrightarrow[\text{Catalyst}]{673K}CO_2+H_2(g)$
(d) $CH_4(g)+H_2O(g)\xrightarrow[\text{Ni}]{1270K}CO(g)+3H_2(g)$

[JEE Main-2020, 5 Sep. Shift-I]

Ans. (c)

(c)Water gas shift reaction.

The reaction of carbon monoxide and water vapor to form carbon dioxide and hydrogen.

$$CO_{(g)}+H_2O_{(g)}\xrightarrow[\text{Catalyst}]{673K}CO_{2(g)}+H_{2(g)}$$

(a) Water gas is produced by this reaction.

$$C_{(s)}+H_2O_{(g)}\xrightarrow{1270K}CO_{(g)}+H_{2(g)}$$

(b) Producer gas is produced by this reaction

$$2C_{(s)}+O_{2(g)}+4N_{2(g)}\xrightarrow{1273K}2CO_{(g)}+4N_{2(g)}$$

(d) Water gas is produced by this reaction.

$$CH_{4(g)}+H_2O_{(g)}\xrightarrow[\text{Ni}]{1273K}CO_{(g)}+3H_{2(g)}$$

81. Water gas is a mixture of

(a) CO and N_2
(b) CO and H_2
(c) CO, H_2 and N_2
(d) CO_2 and H_2 O

COMEDK 2020

Ans. (b) : $C_{(s)}+H_2O_{(g)}\to CO_{(g)}+H_{2(g)}$. Thus,when the steam ($H_2O$) is passed over red-hot coke (C), then mixture of carbon monoxide (CO) and hydrogen (H_2) is formed. It is known as water gas.

82. The amount of H_2O_2 present in 1 litre of 1.5 NH_2O_2 solution is:

(a) 25.5 g
(b) 3.0 g
(c) 8.0 g
(d) 2.5 g

BITSAT-2020

Ans. (a) : Normality = Molarity × n*f*

Molecular mass of H_2O_2 = 34

Normality = 1.5

For $H_2\overset{-1}{O_2}\to H_2\overset{-2}{O}$

@apna_pdf

Nf = 2×1=2

N = M×2

$$1.5 = \frac{\text{No. of moles}}{\text{Volume}} \times 2$$

$$1.5 = \frac{\text{mass}}{\text{molar mass of } H_2O_2} \times \frac{1}{\text{Volume}} \times 2$$

$$1.5 = \frac{\text{mass}}{34} \times \frac{1}{1L} \times 2$$

mass of H_2O_2 =25.5g.

83. The correct statements among (I) to (IV) regarding H_2 as a fuel are :

I. It produces less pollutants than petrol.

II. A cylinder of compressed dihydrogen weights~30 times more than a petrol tank producing the same amount of energy.

III. Dihydrogen is stored in tanks of metal alloys like $NaNi_5$.

IV. On combustion, values of energy released per gram of liquid dihydrogen and LPG are 50 and 142 kJ, respectively.

(a) I, II and III only (b) II, III and IV only

(c) II and IV only (d) I and III only

[JEE Main-2019, 11 Jan Shift-I]

Ans. (a)

- H_2 is a 100% pollution free fuel.
- Molecular weight of

H_2 (2u) = $\frac{1}{29}$ × molecular weight of butane C_4H_{10} (LPG) (58u)

So, compressed H_2 weighs ~ 30 times more than a petrol tank.

- $NaNi_5$, Ti-TiH_2 etc. are used for storage of H_2 in small quantities.
- On combustion, values of energy released per gram of liquid dihydrogen (H_2): 50 kJ g^{-1}, and for LPG : 142 kJ g^{-1} is incorrect statement because LPG produces less energy than dihydrogen for per gm.
- The hydrogen fuel is a zero-emission fuel that is when it burned in presence of oxygen it produces fewer pollutants in the atmosphere. Hydrogen is made by using fossil fuels by steam reforming process.

84. The correct statements among (a) to (d) are:

(1) Saline hydrides produce H_2 gas when reacted with H_2O.

(2) Reaction of $LiAlH_4$ with BF_3 leads to B_2H_6.

(3) PH_3 and CH_4 are electron rich and electron precise hydrides, respectively.

(4) HF and CH_4 are called as molecular hydrides.

(a) (1), (2), (3) and (4) (b) (1), (2) and (3) only

(c) (3) and (4) only (d) (1), (3) and (4) only

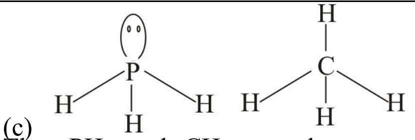
[JEE Main-2019, 10 April Shift-II]

Ans. (a)

(a) $\underset{\text{saline hydride}}{MH} + HOH \rightarrow MOH + H_2$

(b) $4\,BF_3 + 3LiAl\,H_4 \rightarrow 2B_2H_6 + 3LiF + 3AlF_3$

(c)



Thu, PH_3 and CH_4 are electron- rich and electron precise hydrides respectively.

(d) HF and CH_4 are molecular hydride because they are covalent molecules.

85. The metal that gives hydrogen gas upon treatment with both acid as well as base is

(a) Magnesium (b) Mercury

(c) Zinc (d) Iron

[JEE Main-2019, 12 April Shift-I]

Ans. (c) : $Zn + 2HCl \rightarrow ZnCl_2 + H_2$

$Zn + NaOH \rightarrow Na_2ZnO_2 + H_2$

Here Zinc (Zn) is amphoteric metal, that is why it reacts with both acid and base.

86. The isotopes of hydrogen are

(a) Deuterium and tritium only

(b) Protium and deuterium only

(c) Protium, deuterium and tritium

(d) Tritium and protium only

[JEE Main-2019, 9 Jan Shift-I]

Ans. (c) : Isotopes of hydrogen

(1) Protium ($1H^1$)

(2) Deuterium ($1H^2$)

(3) Tritium ($1H^3$)

87. Which one of the following substances is NOT a mixture ?

(a) Ice (b) Ice-cream

(c) Air (d) Honey

NDA (I)-2019

Ans : (a) Among the given option, ice is not a mixture. Ice is pure substance as it is simply frozen water. Ice is the solid state of water and since water is a compound of hydrogen and oxygen.

88. Which one of the following statements about water is not true?

(a) Hydrogen bonds are present in liquid water.

(b) Water has a high boiling point.

(c) Water has a high heat of fusion.

(d) Water is a non-polar molecule.

NDA (II)-2019

Ans : (d) : Water molecule is a polar molecule with opposite ends of the molecule with opposite charges.

In a water molecule, two hydrogen atoms form single polar covalent bonds with an oxygen atom.

89. Match the following items in Column I with the corresponding items in column II.

Column I	**Column II**
(i) $Na_2CO_3.\,10H_2O$	A. Portland cement ingredient
(ii) $Mg(HCO_3)_2$	B. Castner-kellner process
(iii) NaOH	C. Solvay process
(iv) $Ca_3Al_2O_6$	D. Temporary hardness

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(a) (i)-(D);(ii)-(A);(iii)-(B);(iv)-(C)
(b) (i)-(B);(ii)-(C);(iii)-(A);(iv)-(D)
(c) (i)-(C);(ii)-(B);(iii)-(D);(iv)-(A)
(d) (i)-(C);(ii)-(D);(iii)-(B);(iv)-(A)

[JEE Main-2019, 11 Jan Shift-II]

Ans. (d) : Na2CO$_3$.10H2O→ Solvay process
Mg $(HCO_3)_2$ →Temporary hardness
NaOH→Castner kellner cell
$Ca_3Al_2O_6$→ Portland cement ingredient.

90. The recommended concentration of fluoride ion in drinking water is up to 1 ppm as fluoride ion required to make teeth enamel harder by converting $[3Ca_3(PO_4)_2.Ca(OH)_2]$ to:

(a) $[CaF_2]$
(b) $[3(CaF_2).Ca(OH)_2]$
(c) $[3Ca_3(PO_4)_2.CaF_2]$
(d) $[3\{Ca_3\ (PO_4)_2\}.\ CaF_2]$

[JEE Main-2018]

Ans. (c) : The fluoride ion converts
$[3Ca_3(PO_4)_2Ca(OH)_2]$ to $[3Ca_3(PO_4)_{2.}CaF_2]$
hydroxyapatite Fluorapatite
The reaction can be given as follows:-

$$\underset{\text{Drinking water upto 1 ppm}}{[3Ca_3(PO_4)_2.Ca(OH)_2]+2F^-} \longrightarrow \underset{\text{Harder teeth enamel}}{3[Ca_3(PO_4)_2CaF_2]+2OH^-}$$

91. Water softening by Clark's process uses

(a) Calcium bicarbonate (b) Sodium bicarbonate
(c) Potash alum (d) Calcium hydroxide

COMEDK 2018

Ans. (d) : In Clark's process, calculated amount of quick lime is added to hard water to convert bicarbonates to carbonates.

92. The dielectric constant of H_2O is 80. The electrostatic force of attraction between Na^+ and Cl^- will be

(a) reduced to 1/40 in water than in air.
(b) reduced to 1/80 in water than in air.
(c) will be increased to 80 in water than in air.
(d) will remain unchanged.

(AIIMS-27 May, 2018(E))

Ans. (b): Water is a polar solvent and have dielectric constant 80. As NaCl is a polar compound forces of attraction between Na^+ and Cl^- ion will reduce to $\frac{1}{80}$ in water.

93. Which of the following properties of interstitial hydrides is correct?

(a) They generally form non-stoichiometric species.
(b) The hydrogen dissolved in titanium improves its mechanical properties.
(c) They can be used as hydrogenation catalysts.
(d) All of these.

COMEDK 2017

Ans. (a) : (a) These interstitial hydrides are often form non-stoichiometric species because in these hydrides law of constant composition does not hold good.
(b) Titanium hydride releases hydrogen which serves to remove carbon, oxygen and producing a strong alloy due to this hydrogen dissolves in titanium improves its mechanical properties.
(c) Due to interstitial hydride formation, metal absorb large volume of hydrogen on their surface. So, it is used as hydrogenation catalyst.
Here, all options are correct.

94. In which of the following reactions, hydrogen is liberated?

(i) $Al(s) + HCl(aq) \longrightarrow$
(ii) $Al(s) + NaOH(aq) \longrightarrow$
(iii) $NaBH_4 + I_2 \longrightarrow$

(d) i, ii (b) ii, iii
(c) i, iii (d) i, ii, iii

AP EAMCET-2017

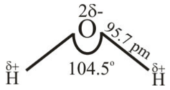
Ans. (d):
(i) $2Al(s) + 6HCl(aq) \longrightarrow 2AlCl_3\ (aq) + 3H_2$
(ii) $2Al(s) + 2NaOH(aq) \longrightarrow 2Na[Al(OH)_4] + 3H_2$
(iii) $NaBH_4 + I_2 \longrightarrow BH_3 + NaI + HI$
$\quad \xrightarrow{NaBH_4} 2BH_3 + 2NaI + H_2$

So the option (d) is correct. Hydrogen is liberated in all there reactions.

95. Identify the structure of water in the gaseous phase.

(a) $H-\ddot{O}-H$

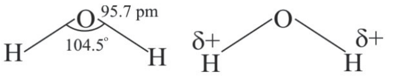
(b) $H-\overset{+}{\underset{|}{O}}-H$
$\quad\quad H$

(c) 

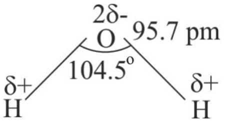
(d) None of these

BITSAT-2017

Ans. (c) :



So,



96. There are two statements, one labeled as Assertion (A) and the other as Reason (R). Examine both the statements carefully and mark the correct choice.

(A) Hydrogen has one electron in its orbit but it produces several spectral lines.
(R) There are many excited energy levels available.

(a) Both (A) and (R) are correct and (R) is the correct explanation of (A).
(b) Both (A) and (R) are correct but (R) is not the correct explanation of (A).
(c) (A) is correct and (R) is wrong.
(d) (A) is wrong and (R) is correct.

J & K CET-(2017)

@apna_pdf

Ans. (a) : Hydrogen has one electron in its orbit but it produces several spectra line. Different lines correspond to different transitions.

- Different transitions are due to different excited states available.

Hence, option (a) is correct.

97. Which one of the following statements about water is false?

(a) Water can act both as an acid and as a base
(b) There is extensive intramolecular hydrogen bonding in the condensed phase
(c) Ice formed by heavy water sinks in normal water
(d) Water is oxidised to oxygen during photosynthesis

[JEE Main-2016]

Ans. (b) : Water possesses intermolecular hydrogen bonding in the condensed phase rather than intramolecular hydrogen bonding.

98. Which of the following option best describes the 'hydrogen economy?'

(a) Using dihydrogen in an efficient manner
(b) Dihydrogen is carried and stored in the form of liquid or gas
(c) Addition of dihydrogen to the reactant
(d) Both (a) and (b)

Manipal-2016

Ans. (d) : The term "hydrogen economy" refers to the vision of using hydrogen as a low-carbon energy source- replacing for example, gasoline as a transport fuel or natural gas as heating fuel.

99. Moist hydrogen cannot be dried over (conc.) H_2SO_4 because

(a) It catches fire
(b) It is reduced by H_2SO_4
(c) It is oxidised by H_2SO_4
(d) It decomposes H_2SO_4

JCECE - 2016

Ans. (c) : Moist hydrogen cannot be dried over conc. H_2SO_4 because it is oxidised by H_2SO_4.

$$H_2SO_{4(Conc.)} + H_2 \longrightarrow 2H_2O + SO_{2(g)}$$

100. Which of the following statements is incorrect?

(a) Ionic hydrides are stoichiometric compounds of dihydrogen formed with most of s-block elements.
(b) Ionic hydrides are crystalline, non-volatile and non-conducting in solid state.
(c) Melts of ionic hydrides conduct electricity and liberate dihydrogen gas at cathode.
(d) Both (a) and (c)

(AIIMS-2016)

Ans. (c): Ionic hydrides have high melting and boiling points and conduct electricity in fused states, liberating dihydrogen at the anode.

- The ionic hydrides are stoichiometric compounds of dihydrogen formed with most of the s-block elements which are highly electropositive in character. Hence, the statement is true.
- The ionic hydrides are crystalline and non-volatile and non-conducting in solid state. Thus, statement is true.

101. Consider the following statement in respect of reactivity of hydrogen

(1) Hydrogen is not reactive under ambient conditions
(2) Hydrogen reacts with fluorine violently
(3) Hydrogen and chlorine reaction is catalyzed by daylight
(4) Hydrogen and nitrogen can react directly in presence of visible light

Which of the above statement are correct?

(a) 1, 2, 3 and 4
(b) 1, 2, and 3 only
(c) 2 and 3 only
(d) 1 and 4 only

SCRA-2015

Ans. (b): Hydrogen is not reactive under ambient conditions and hydrogen reacts with fluorine violently. Hydrogen and chlorine reaction is catalyzed by daylight.

$$H_2(g) + Cl_2(g) \xrightarrow{hv} 2HCl(g)$$

Hence, statement is true.

- Hydrogen and nitrogen can't react directly in presence of visible light. Hence, statement is false.

102. H^+ ion always gets associated with other atoms or molecules due to

(a) its positive charge
(b) absence of any electron in its orbitals
(c) its resemblance with alkali metal cations
(d) small size so that it cannot exist free

SCRA-2015

Ans. (d): H^+ ion always get associated with other atoms or molecules due to small size so that it can't exist as free.

103. Assertion: Hydrogen combines with other elements by losing, gaining or sharing of electrons.

Reason: Hydrogen forms electrovalent and covalent bonds with other elements.

(a) If both Assertion and Reason are correct and the Reason is the correct explanation of Assertion.
(b) If both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.
(c) If Assertion is correct but Reason is incorrect.
(d) If both the Assertion and reason are incorrect.

(AIIMS-2015)

Ans. (a): Hydrogen to attain stable configuration, combines with other elements by sharing of electrons which is called covalent bond and either by loosing or gaining electrons which is called electrovalent bond. Here, reason is the correct explanation of assertion.

104. 500 mL of a sample of water required 19.6 mg of $K_2Cr_2O_7$ for the oxidation of dissolved organic matter in it in the presence of H_2SO_4. The COD of water sample is

(a) 3.2 ppm
(b) 7.2 ppm
(c) 6.4 ppm
(d) 4.6 ppm

JIPMER-2015

@apna_pdf

Ans. (c) : The molecular weight of $K_2Cr_2O_7$ is 294 g/mol

$K_2Cr_2O_7 + 4H_2SO_4 \rightarrow K_2SO_4 + Cr_2(SO_4)_3 + 4H_2O + 3[O]$

$\because$ 294 g $K_2Cr_2O_7$ correspond to $3\times16 = 48$ g [O]

$\therefore$ 19.6 mg $K_2Cr_2O_7$ corresponds to $19.6\times\frac{48}{294}$

$= 3.2$ mg [O]

This is for 500 mL of sample.

for 1000 mL of sample, COD $= 3.2\times\frac{1000}{500}$

$= 6.4$ ppm.

105. Consider the following trends in properties of hydrogen halides :

1. Acidic Strength : HF < HCl < HBr < HI
2. Thermal stability : HF > HCl > HBr > HI
3. Dipole moment : HF < HCl < HBr < HI
4. Reducing power : HF > HCl > HBr > HI

The number of correct trends is :

(a) One (b) Two
(c) Three (d) Four

S. C. R. A - 2014

Ans. (b) : The trend of acidic strength down the group in 17 group is increases due to the increase the size down the group. Hence, the trend of acidic strength is correct.

Thermal stability of hydrogen halides decreases down the group 17 because the size of anions is increases. Thus, the trend of thermal stability is correct.

- Dipole moment of hydrogen halides decreases from HF to HI because the electronegativity difference decreases down the group. Hence, the correct order of dipole moment is HI < HBr < HCl < HI.

106. The radioactivity is highest for which one of the following?

(a) ortho hydrogen (b) Tritium
(c) Protium (d) Deuterium

S. C. R. A - 2014

Ans. (b) : Hydrogen have three isotope namely protium, deuterium and tritium. Tritium has two neutrons, where regular hydrogen does not have any neutron which makes tritium unstable and therefore radioactive.

107. In which one of the following properties of hydrogen, its resemblance with halogens is seen?

1. It forms oxides
2. It forms a diatomic molecule
3. Its ionization enthalpy is quite high
4. It forms numerous covalent compounds

Select the correct answer using the code given below :

(a) 2, 3 and 4 only (b) 1, 2 and 3 only
(c) 1 and 4 only (d) 1, 2, 3 and 4

S. C. R. A - 2014
(AIIMS-2000)

Ans. (a) : (i) All the halogens does not form an oxide due to high electronegativity and small size.

(ii) All the halogens are forming the diatomic molecule. So the statement is true.

(iii) As we know that in the periodic table, the halogens group shown the higher ionization energy. Hence, the statement is true.

(iv) The 17-group elements forms many number of covalent compounds.

108. Consider the following statements :

1. Atomic hydrogen is obtained by passing hydrogen through an electric arc.
2. Hydrogen gas will not reduce heated aluminium oxide.
3. Finely divided palladium absorbs large volume of hydrogen gas.
4. Pure nascent hydrogen is best obtained by reacting Na with C_2H_5OH.

Which of the above statements is/are correct?

(a) Only 1 (b) Only 2
(c) 1, 2 and 3 (d) 2, 3 and 4

(AIIMS-2012)

Ans. (c): By passing hydrogen through an electric arc, atomic hydrogen is obtained. Hydrogen gas will not reduce heated Al_2O_3 due to low reactivity of H_2 than Al, hence cannot displace Al in the reaction. Pd being neutral metal provider large volume of H_2 to be absorbed.

- Pure nascent hydrogen is best obtained by reaction with Na and C_2H_5OH.

$$C_2H_5OH + Na \longrightarrow C_2H_5ONa + \underset{\text{Nascent hydrogen}}{[H]}$$

Hence, statement is true.

109. The boiling point of water is exceptionally high because

(a) There is a covalent bond between H and O
(b) Water molecule is linear
(c) Water molecules associate due to hydrogen bonding
(d) Water molecule is not linear.

BITSAT-2012

Ans. (c) : Boiling point of water is exceptionally high because water molecules associate due to hydrogen bonding. Hydrogen bonding increases the melting point of water also.

110. Very pure hydrogen (99.9%) can be made by which of the following processes?

(a) Reaction of methane with steam
(b) Mixing natural hydrocarbons of high molecular weight
(c) Electrolysis of water
(d) Reaction of salts like hydrides with water

[AIEEE-2012]

Ans. (c) : Hydrogen of high purity is usually prepared by the electrolysis of water using platinum electrodes in presence of small amount of acid or alkali.

$$2H_2O(l) \xrightarrow{\text{electrolysis}} 2H_2(g) + O_2(g)$$

Hydrogen is collected at cathode

111. Which property among the following is same for both hydrogen and deuterium molecules?

(a) Bond energy (b) Melting point
(c) Boiling point (d) Bond length

AP-EAMCET- (Engg.)-2011

@apna_pdf

Ans. (d) : Hydrogen (H_2) and deuterium (D_2) both molecules have same bond length. The two isotopes have same atomic number therefore inter nuclear distance is same. But it has different bond energy, melting point and boiling point.

Property	**Hydrogen(H_2) 74pm**	**Deuterium 74pm**
Bond energy	436 kJ mol^{-1}	443.3 kJ mol^{-1}
Melting point	0°C	3.81°C
Boiling point	100°C	101.42°C

112. The temperature of maximum density of H_2O and D_2O respectively are

(a) 0ºC and 11.6ºC (b) 4ºC and 0ºC
(c) 4ºC and 11.6ºC (d) 4ºC and 12.5ºC

CG PET- 2011

Ans. (c) : The temperature of maximum density H_2O and D_2O are 4 °C and 11.6 °C respectively.

113. Hydrogen can have oxidation number/s of

(a) –1 only (b) +1 only
(c) 0 only (d) –1, 0, +1

JCECE - 2011

Ans. (d) : Hydrogen can have –1, 0 and +1 oxidation states.

(–1 in H^-, 0 in H atom or H_2 gas and +1 in H^+)

114. Hydrogen is prepared on large scale for an industrial use

(a) by $Zn + H_2SO_4$ (b) by $Al + NaOH$
(c) by $Na + C_2H_5OH$ (d) from water gas

CG PET -2009

Ans. (d) : Water gas is the mixture of CO and H_2 gas. To increase the production of hydrogen from water gas, CO is oxidized to CO_2 by mixing it with steam and mixture is passed over and hot $FeCrO_4$ catalyst at 673 K.

$$\underbrace{H_2 + CO}_{\text{Water gas}} + H_2O \xrightarrow[FeCrO_4]{673K} CO_2 + 2H_2$$

115. Which one of the following pairs of substances will not produce hydrogen when reacted together?

(a) Copper and conc. nitric acid
(b) Ethanol and metallic sodium
(c) Magnesium and steam
(d) Phenol and metallic sodium
(e) Sodium hydride and water

Kerala-CEE-2009

Ans. (a) : $\underset{\text{Conc.}}{Cu + 4HNO_3} \rightarrow Cu(NO_3)_2 + 2H_2O + 2NO_2\uparrow$

Copper and conc. nitric acid pairs of substances will not produce hydrogen when reacted together.

$2C_2H_5OH(l) + 2Na(s) \rightarrow 2C_2H_5ONa(l) + H_2(g)$
$Mg(s) + H_2O(g) \rightarrow MgO(s) + H_2(g)$
$C_6H_6OH + Na \rightarrow C_6H_6O^-Na^+ + H_2$
$NaH + H_2O \rightarrow NaOH + H_2$

116. The most abundant element in the universe is thought to be

(a) carbon (b) oxygen
(c) hydrogen (d) nitrogen

UPTU/UPSEE-2009

Ans. (c) : Hydrogen is the most abundant element in the universe followed by Helium.

117. In context with the industrial preparation of hydrogen from water gas ($CO+H_2$), which of the following is the correct statement?

(a) CO and H_2 are fractionally separated using differences in their densities
(b) CO is removed by absorption in aqueous Cu_2Cl_2 solution
(c) H_2 is removed through occlusion with Pd
(d) CO is oxidised to CO_2 with steam in the presence of a catalyst followed by absorption of CO_2 in alkali.

[AIEEE-2008]

Ans. (d) : On the industrial scale hydrogen is prepared from water gas according to following reaction sequence:-

$$\underbrace{CO + H_2}_{\text{water gas}} + \underbrace{H_2O}_{\text{steam}} \xrightarrow{\text{Catalyst}} CO_2 + 2H_2$$

$$\xrightarrow[\text{(alkali)}]{2NaOH} \times Na_2CO_3 + H_2O$$

From the above reaction it is clear that CO is first oxidized to CO_2 which is then absorbed in NaOH.

118. Electronic configuration of hydride ion is

(a) $1s^0$ (b) $1s^1$
(c) $1s^2$ (d) $1s^1\ 2s^1$

UP CPMT-2005

Ans. (c) : The hydride ion is H^- and its electronic configuration is $1s^2$.

119. Which of the following could act as a propellant for rockets?

(a) Liquid hydrogen + liquid nitrogen
(b) Liquid oxygen + liquid argon
(c) Liquid hydrogen + liquid oxygen
(d) Liquid nitrogen + liquid oxygen

[AIEEE-2003]

Ans. (c) : The propellant is the mixture burned to produce thrust in rockets and consists of a fuel and an oxidizer.

Liquefied gases are cryogenic propellant in which liquid hydrogen act as the fuel and liquid oxygen act as the oxidizer.

120. Which of the following reaction produces hydrogen?

(a) $Mg + H_2O$ (b) $H_2S_2O_8 + H_2O$
(c) $BaO_2 + HCl$ (d) $Na_2O_2 + 2HCl$

(AIIMS-2002)

Ans. (a): Mg reacts with hot water to produce H_2 because it is more electropositive than hydrogen.

$Mg+H_2O \rightarrow MgO+H_2$

All other reactions are used to manufacture of H_2O_2

$H_2S_2O_8+2H_2O \rightarrow 2H_2SO_4+H_2O_2$
$BaO_2+2HCl \rightarrow BaCl_2+H_2O_2$
$Na_2O_2+2HCl \rightarrow 2NaCl+H_2O_2$

121. Bond dissociation energies of HF, HCl, HBr follow the order

(a) HCl > HBr > HF (b) HF > HBr > HCl
(c) HF > HCl > HBr (d) HBr > HCl > HF

AP EAMCET- 2001

@apna_pdf

Ans. (c) : Bond dissociation energy increase when bond length is decrease.
∴ Correct order of bond dissociation energy is –
HF > HCl > HBr

122. Hydrogen has high ionisation energy than alkali metals because it has :
(a) ionic bond (b) covalent bond
(c) large size (d) small size
(AIIMS-1999)

Ans. (d): Hydrogen has only one orbital which is strongly attracted by the nucleus. Thus it has very small size than the alkali metal and hence has high ionization enthalpy.

123. Hydrogen is not more reactive at ordinary temperature, because at ordinary temperature it is in its:
(a) gaseous state (b) liquid state
(c) molecular state (d) atomic state
(AIIMS-1997)

Ans. (c): Hydrogen is not reactive at ordinary temperature because it is in molecular state. i.e. as H_2 with its completes duplet which makes it stable and lesser reactive. At very high temperature, hydrogen exists in atomic form having one electron i.e, in complete duplet which makes it less stable and highly reactive.

124. Hydrogen gas may be readily prepared in the laboratory by reacting water with
(a) Silver (b) Copper
(c) Sodium (d) Barium peroxide
AP EAMCET- 1993

Ans. (c) : $2Na+2H_2O \rightarrow 2NaOH + H_2$
Hydrogen gas readily prepared in the laboratory by reacting water with sodium.

125. At its melting point, ice is lighter than water because
(a) H_2O molecules are more closely packed in solid state
(b) ice crystals have hollow hexagonal arrangement of H_2O molecules
(c) on melting of ice the H_2O molecules shrinks in size
(d) ice forms mostly heavy water on first melting.
NEET-1992

Ans. (b) : When ice melts, its molecules move into the holes or open spaces and comes closer to each other then they were in solid state. Thus, ice has lower density than water and there is contraction in volume.
Hence, ice crystals have hollow hexagonal arrangement of H_2O molecules.

126. The ionization of hydrogen atom would give rise to
(a) hydride ion (b) hydronium ion
(c) proton (d) hydroxyl ion
NEET-1990

Ans. (c) : The ionization energy of hydrogen is less due to low ionization energy. Hydrogen readily losses is one electron to produce H^+ ion. This H+ ion is commonly known as proton as it contains only one proton and no neutron.

127. Consider the water gas equilibrium reaction,
$$C(s)+H_2O(g) \rightleftharpoons CO(g)+H_2(g)$$
Which of the following statements is true at equilibrium?
(a) If the amount of C(s) is increased, less water would be formed
(b) If the pressure of C(s) is increased, more CO and H_2 would be formed
(c) If the pressure on the system is increased by halving the volume, more water would be formed
(d) If the pressure on the system is increased by halving the volume, more CO and H_2 would be formed

Ans. (c) : Given the water gas equilibrium reaction
$$C(s)+H_2O(g) \rightleftharpoons CO(g)+H_2(g)$$
$$K=\frac{[CO(g)][H_2(g)]}{[H_2O(g)]}$$
Concentration will increase, on halving the volume. There are two terms in numerator. So to keep K constant more water would be formed.

4. Hardness of Water

128. Boiling of hard water is helpful in removing the temporary hardness by converting calcium hydrogen carbonate and magnesium hydrogen carbonate to
(a) $CaCO_3$ and $Mg(OH)_2$
(b) $CaCO_3$ and $MgCO_3$
(c) $Ca(OH)_2$ and $MgCO_3$
(d) $Ca(OH)_2$ and $Mg(OH)_2$
JEE Main-26.06.2022, Shift-II

Ans. (a) : Boiling of hard water is helpful in removing the temporary hardness.
$$Mg(HCO_3) \xrightarrow{\text{Boiling}} Mg(OH)_2 + 2CO_2\uparrow$$
$$Ca(HCO_3) \xrightarrow{\text{Boiling}} CaCO_3\downarrow + H_2O + CO_2\uparrow$$

129. The temporary hardness of a water sample is due to compound X. Boiling this sample converts X to compound Y. X and Y, respectively, are
(a) $Mg(HCO_3)_2$ and Mg $(OH)_2$
(b) $Ca(HCO_3)_2$ and $Ca(OH)_2$
(c) $Mg(HCO_3)_2$ and $MgCO_3$
(d) $Ca(HCO_3)_2$ and CaO
[JEE Main-2019, 12 April Shift-II]
[JEE Main-2019, 9 Jan Shift-II]

Ans. (a) : Temporary hardness of water is due to soluble Mg $(HCO_3)_2$ and $Ca(HCO_3)_2$
$$Mg(HCO_3)_2 \xrightarrow{\text{Boil}} Mg(OH)_2\downarrow + 2CO_2\uparrow.$$
$$Ca(HCO_3)_2 \xrightarrow{\text{Boil}} CaCO_3\downarrow + H_2O + CO_2\uparrow$$

@apna_pdf

130. Permanent hardness cannot be removed by

(a) Using washing soda
(b) Calgon's method
(c) Clark's method
(d) Ion exchange method

Kerala-CEE-29.08.2021
JEE Main-2020, 5 Sep Shift-II

Ans. (c) : The hardness of water is due to the presence of soluble bicarbonates, chlorides and sulphates of calcium and magnesium. The permanent hardness of the water can be removed by Gan's Permutit method, the Ion exchange resin method, and the washing soda method. The uses of Clark's method is that to remove the temporary hardness in the water. So, this method can not remove permanent hardness.

131. Which compound among the following is used to remove the hardness of water?

(a) $Ca_3(PO_4)_2$ (b) Na_3PO_4
(c) $Na_6P_6O_{18}$ (d) Na_2HPO_4

AP EAPCET-6 Sep. 2021, Shift-II

Ans. (c) : Sodium-hexa-meta-phosphate ($Na_6P_6O_{18}$), commercially called 'calgon' is used for water softening.

- The hardness of water is due to the presence of soluble bicarbonates, chlorides and sulfates of calcium and magnesium.
- The hardness of water is removed by the adsorption of Ca^{++} and Mg^{++} ions.
- Hard water does not give lather with soap.
- The addition of calgon to hard water causes the calcium and magnesium ions of hard water to replace sodium ion from the anion of calgon this result in the removal of calcium and magnesium ions from hard water in the form of a complex with calgon.

132. In comparison to the zeolite process for the removal of permanent hardness, the synthetic resins method is

(a) More efficient as it can exchange only cations
(b) Less efficient as it exchanges only anions
(c) Less efficient as the resins cannot be regenerated
(d) More efficient as it can exchange both cations as well as anions

[JEE Main-2020, 7 Jan Shift-I]

Ans. (d) : The difference between the zeolite and ion exchange process is that the zeolite process uses the mineral zeolite as the exchanging resin for cations in the hard water whereas the ion exchange process include several different resins for the ion exchange.

∴ Synthetic resins method is more efficient as it can exchange both cations as well as anions.

133. The method used to remove temporary hardness of water is

(a) Synthetic resins method
(b) Calgon's method
(c) Clark's method
(d) Ion-exchange method

NEET-2019

Ans. (c) : Clark's method is used to remove the temporary hardness of water in which bicarbonates of calcium and magnesium are reacted with slaked lime $Ca(OH)_2$.

$Ca(HCO_3)_2 + Ca(OH)_2 \rightarrow 2CaCO_3\downarrow + 2H_2O$

134.Permanent hardness of water cannot be removed by which one of the following methods?

(a) Treatment with washing soda
(b) Calgon's method
(c) Boiling
(d) Ion exchange method

NDA (II)-2018

Ans. (c) : The permanent hardness of water can be removed by following methods–

(i) On treatment with washing soda
(ii) By calgon's method
(iii) By Ion exchange method.
Boiling does not remove permanent hardness of water.

135. Which of the following ions will cause hardness in water?

(a) Ca^{2+} (b) Na^+
(c) Cl^- (d) K^+

Karnataka-CET-2018

Ans. (a) : Presence of calcium and magnesium salts in the form of hydrogen carbonate chloride and sulphate in water makes water 'hard'.

136. Temporary hardness in water is due to which one of the following of Calcium and Magnesium?

(a) Hydrogencarbonates (b) Carbonates
(c) Chlorides (d) Sulphates

NDA (I)-2017

Ans : (a) Temporary hardness is due to the presence of magnesium and calcium hydrogencarbonates.

It can easily removed by heating.

$$Ca(HCO_3)_2 \xrightarrow{\text{Heat}} CaCO_3\downarrow + H_2O + CO_2\uparrow$$

$$Mg(HCO_3)_2 \xrightarrow{\text{Heat}} Mg(OH)_2\downarrow + CO_2\uparrow$$

137. When zeolite (hydrated sodium aluminium silicate) is treated with hard water the sodium ions are exchanged with

(a) H^+ ions (b) Ca^{2+}ions
(c) SO_4^{2-} ions (d) OH^- ions

(AIIMS-2017)

Ans. (b): When zeolite (hydrated sodium aluminium silicate) is treated with hard water, the sodium ions are exchanged with Ca^{2+} and Mg^{2+} ions hence making water soft. The reaction occurs as

$Na_2Al_2Si_2O_8.xH_2O + Ca^{2+} \rightarrow CaAl_2Si_2O_8.xH_2O$

Hard water contains dissolved salts of chlorides, sulphates and bicarbonates of calcium and magnesium.

138. Permanent hardness of water is due to the presence of:

(a) sulphates of sodium and potassium
(b) sulphates of magnesium and calcium
(c) carbonates of sodium and magnesium
(d) bicarbonates of magnesium and calcium

NDA (I)-2015

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Ans : (b) It is due to the presence of chloride and sulphate of calcium and magnesium. These salts do not decompose on boiling. So, permanent hardness can't be removed easily. It can be removed by Soda(Na_2CO_3), surfactant (Na_3PO_4) or lime ($Ca(OH)_2$) when $MgSO_4$ is responsible for hardness.

139. Which one the following remove temporary hardness of water?

(a) Slaked lime (b) Plaster of pairs
(c) Epsom (d) Hydrolith

BITSAT-2015

Ans. (a) : This method is know as Clark's process. In this method temporary hardness is removed by adding lime water or milk of lime.

$Ca(OH)_2 + Ca(HCO_3)_2 \rightarrow 2CaCO_3\downarrow + 2H_2O$.

140. On which of the following principles hydrogen bomb is based?

(a) Nuclear fission
(b) Nuclear fusion
(c) Artificial radioactivity
(d) Natural radioactivity

CG PET -2004

Ans. (b) : A hydrogen bomb is based on the principle of uncontrollable nuclear fusion. Nuclear fusion is the process where the nuclei of two light atoms combine to form a new nucleus.

- No combustion occurs in nuclear power (fission or fusion), so there is no air pollution.
- Less nuclear waste - The fusion reactors will not produce high level nuclear wastes like their fission counterparts so that disposal will be less of a problem.

141. The hardness of water is estimated by :

(a) conductivity method (b) titrimetric method
(c) EDTA method (d) distillation method

BCECE-2003

Ans. (c) : Ethylene diamine tetra acetic acid (EDTA) when treated with water, forms stable complex with the metal ions present in the hard water. Since stability constants of calcium and magnesium complexes of EDTA are different even the selective estimation of these ions is possible.

142. Which one of the following processes will produce hard water?

(a) Saturation of water with $CaCO_3$
(b) Saturation of water with $MgCO_3$
(c) Saturation of water with $CaSO_4$
(d) Addition of Na_2SO_4 to water

[AIEEE-2003]

Ans. (c) : Permanent hardness of water is due to chlorides and sulphates of calcium and magnesium i.e $CaCl_2$, $CaSO_4$, $MgCl_2$ and Mg SO_4.

143. Which process is used for the removal of hardness of water?

(a) Calgon (b) Baeyer
(c) Serpeck (d) Hoope

AP EAMCET- 2001

Ans. (a) Calgon process is used for the removal of hardness of water**.**

- The Baeyer's process is used for leaching of Aluminium metal.
- Serpeck process is used for purification of bauxite ore containing silica (SiO_2) as the main impurity.
- The Hoope process is a metallurgical process, used to obtain the aluminium metal of very high purity.

144. Permanent hardness of water is due to

(a) The chlorides of Ca and Mg
(b) The sulphates of Ca and Mg
(c) Both chlorides and sulphates of Ca and Mg
(d) The bicarbonates of Ca and Mg

AP EAMCET- 1994

Ans. (c) : Permanent hardness of water is due to both chlorides and sulphates of Ca and Mg. We can remove this hardness by treating the water with washing soda (Na_2CO_3).

145. Temporary hardness of water is due to the presence of .... of calcium and magnesium in water.

(a) Chlorides (b) Sulphates
(c) Bicarbonates (d) Phosphates

AP EAMCET- 1993

Ans. (c) : Calcium and magnesium bicarbonates cause temporary hardness while chlorides and sulphates of calcium and magnesium are caused by permanent hardness of water.

146. The hardness of water samle containing 0.002 mol of magnesium sulphate dissolved in a litre of water is expressed as

(a) 20 ppm (b) 200 ppm
(c) 2000 ppm (d) 120 ppm
(e) 240 ppm

Kerala-CEE-2007

Ans. (b) : The hardness of water sample containing 0.002 mole of

$MgSO_4$ dissolved in 1 L of water.

$$\text{Number of moles } = \frac{\text{mass}}{\text{molecular mass}}$$

$$0.002 = \frac{\text{mass}}{120}$$

mass = 240×10^{-3} ie,

240×10^{-3} g mass of $MgSO_4$ in 1 L of water.

$\therefore$ 10^3g of H_2O contains = 0.240 g of $MgSO_4$

$\because$ 10^6 g of H_2O contains = $\frac{0.240\times10^6}{10^3}$ g of $MgSO_4$ =

0.240×10^3 g of $MgSO_4$

$\because$ 10^6 g of water contains = 240g of $MgSO_4$ 120g $MgSO_4 \equiv$ 100g fo $CaCO_3$ 240g of $MgSO_4$

$$= \frac{100\times240}{120} = 200\text{g of } CaCO_3$$

Hence, hardnes of H_2O = 200 ppm.

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11.

The Main Group Elements

1. Alkali Metals

1. s-block element which cannot be qualitatively confirmed by the flame test is

(a) Li (b) Na

(c) Rb (d) Be

JEE Main-26.06.2022, Shift-II

Ans. (d) :

Li	Crimson Red
Na	Yellow
Rb	Red violet
Be	No color

Beryllium does not give flame test because of its small size and high ionization energy the energy of flame is not sufficient to provoke the elements to higher energy level.

2. Match List-I with List-II

List-I		List-II	
(Metal)		[Emitted light wavelength(nm)]	
a.	Li	I.	670.8
b.	Na	II.	589.2
c.	Rb	III.	780.0
d.	Cs	IV.	455.5

Choose the most appropriated answer from the options given below:

(a) (a)-(I), (b)-(II), (c)-(III), (d)-(IV)

(b) (a)-(III), (b)-(II), (c)-(I), (d)-(IV)

(c) (a)-(III), (b)-(I), (c)-(II), (d)-(IV)

(d) (a)-(IV), (b)-(II), (c)-(I), (d)-(III)

JEE Main-29.06.2022, Shift-I

Ans. (a)

Metal	Li	Na	K	Rb	Cs
Wavelength (λ) in nm.	670.8	589.2	766.5	780.0	455.5
Colour	Crimson-red	yellow	violet	Red Violet	Blue

3. Which of the following statements are correct?

(A) Both LiCl and $MgCl_2$ are soluble in ethanol.

(B) The oxides Li_2O and MgO combine with excess of oxygen to give superoxide.

(C) LiF is less soluble in water than other alkali metal fluorides.

(D) Li_2O is more soluble in water than other alkali metal oxides.

Choose the most appropriate answer from the options given below:

(a) (A) and (C) only

(b) (A), (C) and (D) only

(c) (B) and (C) only

(d) (A) and (D) only

JEE Main-24.06.2022, Shift-I

Ans. (a) : (a) Both LiCl and $MgCl_2$ are covalent in nature due to high polarizing power of Li^+ and Mg^{+2} ions so, they are soluble in ethanol.

(b) Lithium and magnesium ion is small in size it cannot stabilize larger peroxide. So, oxide of Li_2O and MgO do not form superoxide.

(c) LiF is comparatively less soluble among all other alkali metal fluoride due to high lattice energy of LiF.

(d) Li_2O have high lattice enthalpy than hydration enthalpy hence, it is less soluble among all other alkali metal oxide.

4. Which of the following is added to commercial salt to control hypothyroidism?

(a) Magnesium iodide (b) Potassium iodide

(c) Sodium iodide (d) Calcium iodide

(e) Lithium iodide

Kerala CEE -03.07.2022

Ans. (c) : Sodium iodide is added to commercial salt as sodium iodide is used to treat hypothyroidism (an overactive thyroid) and certain kind of thyroid cancer.

5. The correct order of hydration enthalpies of alkali is

(a) $Li^+ > Na^+ > K^+ > Rb^+$ (b) $Rb^+ > K^+ > Na^+ > Rb^+$

(c) $Na^+ > K^+ > Li^+ > Rb^+$ (d) $K^+ > Rb^+ > Na^+ > Li^+$

AIIMS-2000

Ans. (a): Hydration enthalpies– Energy released for the formation of new bonds between ions and water molecules is called hydration enthalpy. Hydration enthalpies of alkaline earth metal ions decreases top to bottom with the increasing ionic size.

The ionic size of the atom loses or gains electrons to become negatively charged or positively charged ions. When atoms lose or gain electrons, the size of the ion is not same as the parent atom. Thus, the correct order of hydration enthalpies are–

$Li^+ > Na^+ > K^+ > Rb^+$

6. Which property of hydrogen points its more resemblance with halogen family members as compared to alkali metals?

(a) Affinity for non-metals

(b) Ionization potential

(c) Electronic configuration

(d) Reducing nature

SCRA-2012

Ans. (d) The following properties of hydrogen points its more resemblance with halogen family members as compared to alkali metals are-

(i) It shows +1 oxidation state like alkali metal.

(ii) It is a strong reducing agent like other alkali metals.

(iii) It is librated at the cathode during electrolysis of compounds

@apna_pdf

7. **Consider the following statements:**
Statement- I Cesium is useful as electrodes in photoelectric cells
Statement-II Light energy absorbed by cesium is sufficient to make an atom of cesium lose an electron.
Which one of the following is correct in respect of the above statements?
(a) Both the statements are true and statement II is the correct explanation of statement-I
(b) Both the statements are true but statement I is true, but statement II is not the correct explanation of statement II is false
(c) Statement I is true but statement II is false
(d) Statement I is false but statement II is true

SCRA-2015

Ans. (a): Cesium is useful as electrodes in photoelectric cell because it can easily convert sunlight into electricity because it has low work function. Light energy absorbed by cesium is sufficient to make an atom lose their a valence electron.

8. **The alum used for purifying water is**
(a) Ammonium alum (b) Chrome alum
(c) Ferric alum (d) Potash alum

Ans. (d) : Alum helps in purifying water by potash alum which helps to coagulate the mud particles because of the high charge on the aluminium (Al^{3+}) ion.

9. **Which of the following sets of raw materials is used in the manufacture of Na_2CO_3 by Solvay process?**
(a) $Ca(OH)_2$, NH_3, CO_2 (b) $CaCl_2$, NH_3, CO_2
(c) $NaOH$, NH_3, CO_2 (d) $NaCl$, NH_3, CO_2

AP EAMCET- 1999

Ans. (d) : Solvay process is a manufacturing process of Na_2CO_3 in which soda from common salt by passing carbon dioxide into ammonical brine resulting in precipitation of sodium bicarbonate which is then calcined to carbonate.

$$NH_3 + H_2O + CO_2 \rightarrow NH_4HCO_3$$

$$NH_4HCO_3 + NaCl \rightarrow NaHCO_3 + NH_4Cl$$

$$2NaHCO_3 \xrightarrow{\text{roasting}} Na_2CO_3 + H_2O + CO_2$$

So, the raw material used is $NaCl$, NH_3, CO_2.

10. **In the Castner's process of extraction of sodium cathode is**
(a) Iron rod (b) Nickel rod
(c) Copper rod (d) Graphite rod

AP EAMCET- 2000

Ans. (a) : The Castner's process is a process for manufacturing of sodium metal by electrolysis of molten sodium hydroxide at 330°C.

In Castner's process, cathode is made by iron rod and anode is made by graphite rod.

11. **An element forms a solid oxide which when is dissolved in water to forms an acidic solution. The elements is**
(a) Neon (b) Sodium
(c) Phosphorus (d) Sulphur

MPPET- 2009

Ans. (c) : Phosphorus is forms solid oxide which dissolved in water to forms an acidic solution.

$P_4 + 5O_2 \rightarrow 2P_2O_5$

$P_2O_5 + 3H_2O \rightarrow 2H_3PO_4$

12. **Liquefaction of helium gives two phases called helium-I and helium-II. Consider the following statements :**
1. Helium-I is formed at 4.2 K.
2. Helium-II is formed at 4.2 K.
3. Helium-II is a superconductor.
4. Viscosity of Helium-II is nearly zero.

Which of the above statements are correct?
(a) 1 and 2 only (b) 1, 3 and 4 only
(c) 2, 3 and 4 only (d) 1, 2, 3 and 4

S. C. R. A - 2014

Ans. (b) : The correct statement of liquefaction of helium are–
- Helium-I is formed at 4.2 K
- Helium-II is a superconductor
- Viscosity of Helium-II is nearly zero

13. **Alkali metals are powerful reducing agents because_____**
(a) They are metals
(b) They are monovalent
(c) Their ionic radii are large
(d) Their ionization energies are low

AP EAPCET 23-08-2021 Shift-I

Ans. (d) : Alkali metals are powerful reducing agent because alkali metals have one valence electron which they lose to attain stability. Alkali metals have low ionization energies and easily lose an electron and therefore act as reducing agent.

14. **Orange red coloured monoxide**
(a) K_2O (b) Na_2O
(c) Cs_2O (d) Li_2O

AP EAMCET (Medical) - 2013

Ans. (c) : Cs_2O is orange red coloured.
Li_2O and N_2O are white solids as expected but surprisingly K_2O is pale yellow, Rb_2O is bright yellow. This is due to the gradually increasing ionic character from Li_2O to Cs_2O.

15. **Which factor makes Li the strongest reducing agent in aqueous solution?**
(a) Sublimation enthalpy
(b) Ionisation enthalpy
(c) Hydration enthalpy
(d) Electron gain enthalpy

AP EAMCET (Engg.) 21.09.2020, Shift-I

Ans. (c) : Lithium has highest hydration enthalpy, which accounts for its high negative E° value and its high reducing power. Hence, the correct option is (c).

16. **Assertion (A): Na^+ and Mg^{2+} ions are isoelectronic but the ionic radius of Na^+ is greater than that of Mg^{2+}**
Reason (R): The effective nuclear charge of Na^+ ion is less than that of Mg^{2+} ion
(a) Both (A) and (R) are correct but (R) is not the correct explanation of (A).
(b) Both (A) and (R) are correct and (R) is correct explanation of (A).

@apna_pdf

(c) (A) is not correct but (R) is correct
(d) (A) is correct but (R) is not correct

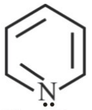
AP EAMCET-2017

Ans. (b) : The effective nuclear charge of Na^+ ion is less that of Mg^+ ion and Na^+ and Mg^{2+} ions are isoelectronic but the ionic radius of Na^+ is greater than that of Mg^{2+}.

17. Statement I : Sodium hydride can be used as an oxidising agent.
Statement II : The lone pair of electrons on nitrogen in pyridine makes it basic.
Choose the CORRECT answer from the options given below:
(a) Both statement I and statement II are true
(b) Both statement I and statement II are false
(c) Statement I is true but statement II is false
(d) Statement I is false but statement II is true

JEE Main 16.03.2021, Shift-II

Ans. (d) : The statement I is false because sodium hydride (NaOH) is the strong hydride donor (H^-) due to which they can not be used as oxidising agent. In pyridine, the lone pair of 'N' is localised makes it basic.



Pyridine

18. Which of the following pair has bleaching property
(a) O_3 and NO_2 (b) O_3 and H_2S
(c) SO_2 and Cl_2 (d) Cl_2 and NO_2

MPPET-2008

Ans. (c) : SO_2 and Cl_2. Bleaching action of Chlorine is the result of its oxidation and is permanent while bleaching action of sulphurdioxide is due to reduction and it is temporary.

19. The most electro + ve element in alkali metals is
(a) Na (b) K
(c) Rb (d) Cs

MPPET-2008

Ans. (d) : On moving from top to button in a group to alkali metals, electropositive character is increases.
Hence, Cs is most electropositive element.

20. Choose the alkali metal with highest reactivity among the following
(a) Cs (b) Li
(c) Na (d) Rb

AP EAMCET (Engg.) 18.9.2020 Shift-I

Ans. (a) : Among the alkali metals (group-1), Cs is most reactive because of its lowest ionization energy.
Reactivity order is Li < Na < K < Rb < Cs

21. Identify the products formed when chlorine reacts with cold and dilute sodium hydroxide solution.
(a) NaCl, $NaClO_3$, H_2O (b) NaCl, $NaClO_4$, H_2O
(c) NaCl, NaOCl, H_2O (d) NaCl, HCl, H_2O

AP EAMCET (Engg.) 18.9.2020 Shift-I

Ans. (c) :

$$Cl_2 + \underset{\substack{\text{Cold \& dilute}\\\text{sodium hydroxide}}}{2NaOH} \rightarrow \underset{\substack{\text{Sodium}\\\text{chloride}}}{NaCl} + \underset{\substack{\text{Sodium}\\\text{hydrochloride}}}{NaOCl} + H_2O$$

22. Assertion (A) : Helium and Beryllium have similar have similar outer electronic configuration ns^2
Reason (R) : Both are chemically inert
(a) Both (A) and (R) are correct and (R) is the correct explanation of (A)
(b) Both (A) and (R) correct but (R) is not the correct explanation of (A)
(c) (A) is correct but (R) is incorrect
(d) Both (A) and (R) are incorrect

AP EAPCET 24.08.2021 Shift-II

Ans. (c) : Helium is a inert element due to presence of $1s^2$ electronic configuration while Beryllium belongs from s-block element having $2s^2$ electronic configuration and it is chemically reactive.

23. Match the following species with the correct number of electrons present in them:

Species		Number of Electrons	
(i)	Be^{2+}	(a)	0
(ii)	H^+	(b)	10
(iii)	Na^+	(c)	2
(iv)	Mg^+	(d)	11
		(e)	4

(a) (i – d), (ii – c), (iii – b), (iv – a)
(b) (i – a), (ii – b), (iii – c), (iv – d)
(c) (i – e), (ii – d), (iii – a), (iv – c)
(d) (i – c), (ii – a), (iii – b), (iv – d)

AP EAPCET 20.08.2021 Shift-I

Ans. (d) : $_4Be : 1s^2\,2s^2$.
$Be^{2+} : 1s^2$
So, the no. of electron = 2
$_1H = 1s^1$
For, $H^+ : 1s^0$
So, the no. of electron = 0
For, $_{11}Na : 1s^2\,2s^2\,2p^6\,3s^1$
$Na^+ : 1s^2\,2s^2\,2p^6\,3s^0$
So, the no. of electron = 10
For $_{12}Mg : 1s^2\,2s^2\,2p^6\,3s^2$
$Mg^+ : 1s^2\,2s^2\,2p^6\,3s^1$
So, the no. of electron = 11

24. When borax is dissolved in water. It gives an alkaline solution. The alkaline solution consists the following products.
(a) NaOH & BH_3 (b) NaOH & H_3BO_3
(c) $NaHCO_3$ & H_3BO_3 (d) Na_2CO_3 & H_3BO_3

AP EAPCET 19-08-2021 Shift-I

Ans. (b) : Chemical Formula of borax is $Na_2\,B_4\,O_7\,10\,H_2O$.

$$Na_2B_4O_7 + 7H_2O \longrightarrow \underset{\substack{\text{Sodium hydroxide}\\\text{(Strong base)}}}{2NaOH} + \underset{\substack{\text{Boric acid}\\\text{(Weak acid)}}}{4H_3BO_3}$$

Alkaline Solution

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25. Assertion (A) K, Rb and Cs form superoxides
Reason (R) The stability of superoxides increases from K to Cs due to decrease in lattice energy.

(a) Both A and R are true and R is a correct explanation for A
(b) Both A and R are true but R is not a correct explanation for A
(c) A is true, R is false
(d) A is false. R is true

AP EAPCET 19-08-2021 Shift-I
BITSAT-2009

Ans. (a) : K, Rb, Cs form superoxides when they are burned in the air. As we move down the group, the size of an atom from K to Cs increases so, lattice energy decreases and hence the stability of superoxide also increases.

26. Which one of the following elements forms highest number of compounds ?

(a) Oxygen (b) Hydrogen
(c) Chlorine (d) Carbon

NDA (I)-2017

Ans : (b) Hydrogen forms highest number of compounds because hydrogen can form bonds with all metals, metalloids, and non-metals except group 18.

27. In organic reactions, sodium in liquid ammonia is used as

(a) Reducing agent (b) Hydrating agent
(c) Oxidizing agent (d) Precipitating agent

AP EAMCET (Engg.) 2001

Ans. (a) : Na is a metal and the property of metal is to loose their valence electron, the substance which loose the electron is known as oxidation.
The substance which is oxidize act as reducing agent.

28. In photoelectric effect, if the energy required to overcome the attractive forces on the electron (work functions) of Li, Na and Rb are 2.41 eV, 2.30 eV and 2.09 eV respectively, the work function of 'K' could approximately be in eV

(a) 2.52 (b) 2.20
(c) 2.35 (d) 2.01

AP EAMCET (Engg.) 2012

Ans. (b) : As the size of atom increases energy required to overcome the attractive force on outermost electron decreases. Increasing the size of group-I

$\mathrm{Li < Na < K < Rb}$

Thus, the energy in case of K is intermediate of Rb, and Na i.e.

$2.30 < \mathrm{K} < 2.09$

$\therefore$ The energy of K is 2.20 eV.

29. Sodium dissolves in liquid NH_3 to give a deep blue solution. This is due to

(a) Ammoniated Na^+
(b) Ammoniated Na^-
(c) Formation of Na+/Na– pair
(d) Ammoniated electrons.

COMEDK-2014

Ans. (d) :

$$\mathrm{M + (a+b)NH_3 \rightarrow [M(NH_3)_x]^+ + [e(NH_3)_y]^-}$$

The deep blue colour of the solution is due to the ammoniated electron which absorbs energy in the visible region of light and thus imparts blue colour to the solution.

30. In Castner-Kellner cell for production of sodium hydroxide

(a) brine is electrolyzed using graphite electrodes
(b) molten sodium chloride is electrolyzed
(c) sodium amalgam is formed at mercury cathode
(d) brine is electrolyzed with Pt electrodes.

Karnataka NEET-2013

Ans. (c) : Sodium amalgam is formed at mercury cathode for the production of sodium hydroxide in Castner-Kellner cell.

31. The correct order of stability for the following superoxides is.

(a) $KO_2 > RbO_2 > CsO_2$
(b) $RbO_2 > CsO_2 > KO_2$
(c) $CsO_2 > RbO_2 > KO_2$
(d) $KO_2 > CsO_2 > RbO_2$

AP-EAMCET (Medical), 2008

Ans. (c) : As the size of alkali metal ions increases, the stability of superoxides increases. If the size of superoxides ion is large then large cation can be stabilised more by large anion. Hence, the order of stability of superoxides of alkali metal is:

$CsO_2 > RbO_2 > KO_2$.

32. Sodium metal reacts with Al_2O_3 at high temperature to give a sodium compound X. X reacts with carbon dioxide in water to form Y. Y is

(a) Na_2O_2 (b) Na_2O
(c) Na_2CO_3 (d) $NaAlO_2$

AP-EAMCET (Medical), 2002

Ans. (c) : Following reaction occur during the process –

$$\underset{\text{Sodium}}{\mathrm{Na}} + \underset{\text{Aluminium oxide}}{\mathrm{Al_2O_3}} \xrightarrow{\text{high temp.}} \underset{\text{'X'}}{\mathrm{Na_2O}} + \mathrm{Al} \xrightarrow[\text{water}]{\mathrm{CO_2}\text{ in}} \underset{\text{sodium carbonate 'Y'}}{\mathrm{Na_2CO_3}}$$

33. What are the products formed when Li_2CO_3 undergoes decomposition?

(a) $Li_23_2 + CO$ (b) $Li_2O + CO$
(c) $Li_2O + CO_2$ (d) $LiO_2 + CO$

AP-EAMCET (Medical), 2002

Ans. (c) : The thermal decomposition of lithium carbonate gives lithium oxide and carbon dioxide.

$$\underset{\text{Lithium carbonate}}{\mathrm{Li_2CO_3}} \xrightarrow{\Delta} \underset{\text{Lithium oxide}}{\mathrm{Li_2O}} + \underset{\text{Carbondioxide}}{\mathrm{CO_2}}$$

34. The correct order of electrical conductivity of alkali metals ions in their aqueous solution for Cs^+, K^+, Na^+ and Li^+ is

(a) $Cs^+ > K^+ > Na^+ > Li^+$
(b) $K^+ > Cs^+ > Li^+ > Na^+$
(c) $Cs^+ > K^+ > Li^+ > Na^+$
(d) $Li^+ > Na^+ > K^+ > Cs^+$

TS EAMCET 04.08.2021, Shift-I

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Ans. (a) : Smaller the ion, greater is the degree of hydration and hence lesser is the ionic mobility. Since, Li^+ ion has the maximum degree of hydration, so it has lowest ionic mobility. Since, the degree of hydration decrease from Li^+ to Cs^+. Therefore, ionic conductance increases from Li^+ to Cs^+.

35. One of the by-products formed during the recovery of NH_3 from Solvay process is:

(a) NH_4Cl (b) $Ca(OH)_2$
(c) $CaCl_2$ (d) $NaHCO_3$

JEE Main 17.03.2021, Shift-II

Ans. (c) : By Solvay process, we can make the Na_2CO_3. The recovery of ammonia from Solvay process is given as-

$$\underset{\text{Calcium hydroxide}}{Ca(OH)_2(s)} + \underset{\text{Ammonium Chloride}}{2NH_4Cl(aq)} \longrightarrow \underset{\text{Ammonia}}{2NH_3(g)} + \underset{\text{Calcium Chloride}}{CaCl_2(aq)} + \underset{\text{Water}}{2H_2O}$$

36. Assertion: The alkali metal dissolves in liquid NH_3 giving deep blue solution.

Reason: Blue color of the solution is due to the ammoniated electron which absorbs energy in visible region of light.

(a) If both Assertion and Reason are correct and Reason is the correct explanation of Assertion.
(b) If both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.
(c) If Assertion is correct but Reason is incorrect.
(d) If both the Assertion and Reason are incorrect.

AIIMS 25 May 2019 (Morning)

Ans. (a): The alkali metals dissolve in liquid NH_3 giving deep blue solution. This blue colour of the solution is due to the ammoniated electron which absorbs energy in the visible region of light.

37. Which of the following is a strong reducing agent?

(a) Cr (b) Cl
(c) Na (d) Ca

AIIMS-1994

Ans. (c) : Sodium (Na) element is a good reducing agent because it belongs to I-group and have only one valence electron which is easy to loose and attain noble gas electronic configuration.

38. Which of the following metal reacts with water?

(a) copper (b) nickel
(c) sodium (d) silver

AIIMS-1994

Ans. (c): Sodium

Sodium will react with water yielding NaOH and H_2 gas.

$$2H_2O + 2Na \longrightarrow 2NaOH + H_2$$

39. Assertion: NaCl (aq) electrolysis produces Na metal.

Reason: Na^+ is obtained at cathode.

(a) If both Assertion and Reason are correct and the Reason is the correct explanation of Assertion.
(b) If both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.
(c) If Assertion is correct but Reason is incorrect.
(d) If both the Assertion and Reason are incorrect.

(AIIMS-27 May, 2018-Evening)

Ans. (a): On electrolysis of NaCl (aq), Na^+ is obtained at cathode because we know that cathode is –ve charge and Na^+ is +ve charge.

Therefore, they attract each other due to presence of opposite charge.

So, both (A) and (R) are correct and (R) is the correct explanation of (A).

40. Assertion: K, Rb and Cs (all belonging to group 1) can also form superoxides.

Reason: The ionic radii of K, Rb and Cs show the following trend $Cs^+ < Rb^+ < K^+$.

(a) If both Assertion and Reason are correct and the Reason is the correct explanation of Assertion.
(b) If both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.
(c) If Assertion is correct but Reason is incorrect.
(d) If both the Assertion and Reason are incorrect.

(AIIMS-2014)

Ans. (c): K, Rb and Cs belongs to I-group of s-block element and also forms superoxide.

The correct order of the ionic radii of K, Rb and Cs is -

$Cs^+ > Rb^+ > K^+$

So, (A) is correct but (R) is not correct.

41. Assertion: Lithium carbonate is not so stable to heat.

Reason: Lithium being very small in size polarizes large CO_3^{2-} ion leading to the formation of more stable Li_2O and CO_2.

(a) If both Assertion and Reason are correct and the Reason is the correct explanation of Assertion.
(b) If both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.
(c) If Assertion is correct but Reason is incorrect.
(d) If both the Assertion and Reason are incorrect.

(AIIMS-2017)

Ans. (a): Lithium carbonate (Li_2CO_3) is not thermally stable because the size of Li is very small due to which polarises large CO_3^{--} ion leading to the formation of more stable Li_2O and CO_2.

So, both (A) and (R) are correct and the (R) is the correct explanation of (A).

42. The decarboxylating agent is

(a) sodamide (b) sodium peroxide
(c) sodalime (d) sodium hydride.

COMEDK-2011

@apna_pdf

Ans. (c) : Sodalime is a mixture of sodium hydroxide and CaO. It is called decarboxylating agent (NaOH+CaO).

43. On heating sodium metal in dry ammonia, the compound formed is

(a) sodium hydride
(b) sodium azide
(c) sodium nitride
(d) sodium amide.

COMEDK-2019

Ans. (d) : $2Na + 2NH_3 \xrightarrow{300°C} 2NaNH_2 + H_2$

In this reaction, sodium amide is formed.

44. Sodium is not ordinarily observed in the +2 oxidation state because of its

(a) High first ionization potential
(b) High second ionization potential
(c) High ionic radius
(d) High electronegativity.

COMEDK-2017

Ans. (b) : High second ionisation potential

$$Na_{11} = 1s^2, 2s^2, 2p^6, 3s^1$$

$$\overset{+}{Na} = 1s^2, 2s^2, 2p^6$$

After removal of one valence electron of Na it is converted into p^6 electronic configuration, which have completely filled p-orbital, which would required very high energy to form $\overset{2+}{Na}$.

45. Which one of the following is used for reviving the exhausted 'permutit'?

(a) HCl solution
(b) 10% $CaCl_2$ solution
(c) 10% $MgCl_2$ solution
(d) 10% NaCl solution

AP-EAMCET (Medical), 2003

Ans. (d) : As we used the permutit to remove the hardness of water, by using it over time to time, it gets exhausted because whole of the sodium zeolite or sodium permutit gets converted into Ca or Mg permutit. Thus, if we want to revive the exhausted permutit, we need to treat with 10% NaCl solution.

$$CaZ + 2NaCl \rightarrow Na_2Z + CaCl_2$$

46. The alkali metals have relatively low melting point. Which one of the following alkali metals is expected to have highest melting point?

(a) Li
(b) Na
(c) K
(d) Rb

NDA (II)-2015

Ans : (a) Lithium is a following alkali metal is excepted to have highest melting point.

- Atomic number of Lithium is 3.
- It have low density as well as viscosity but vigrously react with water.

47. The chemical name of baking soda is

(a) Na_2CO_3
(b) $NaHCO_3$
(c) $CaCO_3$
(d) NaOH

NDA (I)-2017

Ans : (b) The chemical name of baking soda is sodium hydrogen carbonate ($NaHCO_3$). It is sometimes added for faster cooking. It is also an ingredient in antacids. Being alkaline, it neutralizes excess acid in the stomach and provides relief.

48. Which one of the following elements is least reactive with water?

(a) Lithium
(b) Sodium
(c) Potassium
(d) Cesium

NDA (I)-2017

Ans : (a) All of the alkali metals react with water to form hydrogen and hydroxide ion, Li, Na, K, Rb and Cs react in order of reactivity. Lithium is least reactive with water.

49. Which one of the following alkali metals has lowest melting point?

(a) Sodium
(b) Potassium
(c) Rubidium
(d) Caesium

NDA (I)-2018

Ans. (d) : Caesium has the lowest melting point in alkali metals. As going downward to the group, the atomic size increase, this means the atomic size of caesium is highest due to its highest size its melting point is lowest in alkali metals.

50. Which one of the following metals is alloyed with sodium to transfer heat in a nuclear reactor?

(a) Potassium
(b) Calcium
(c) Magnesium
(d) Strontium

NDA (I)-2018

Ans. (a) : Sodium-Potassium (NaK) is the alloyed used to transfer heat in a nuclear reactor.

51. Which one of the following is the chemical formula of Washing Soda?

(a) $NaHCO_3$
(b) $Na_2CO_3 . 10H_2O$
(c) $Na_2CO_3 . 5H_2O$
(d) NaOH

NDA (I)-2018

Ans. (b) : The chemical formula of washing soda is $Na_2CO_3.10H_2O$ and the common name is washing soda. The recrystallization of sodium carbonate from water produces washing soda.

52. Assertion: LiCl is predominantly a covalent compound.

Reason: Electronegativity difference between Li and Cl is too small.

(a) If both Assertion and Reason are correct and the Reason is the correct explanation of Assertion.
(b) If both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.
(c) If Assertion is correct but Reason is incorrect.
(d) If both the Assertion and Reason are incorrect.

(AIIMS-2012)

Ans. (c): LiCl is predominantly a covalent compound due to the bonding between electropositive and electronegative element while the electronegativity difference between Li and Cl is quite large.

So, (A) is correct but (R) is not correct.

@apna_pdf

53. Assertion: Potassium and cesium are used in photoelectric cells.

Reason: Potassium and cesium emit electrons on exposure to light.

(a) If both Assertion and Reason are correct and the Reason is a correct explanation of the Assertion.
(b) If both Assertion and Reason are correct but Reason is not a correct explanation of the Assertion.
(c) If the Assertion is correct but incorrect.
(d) If both the Assertion and Reason are incorrect.
(e) If the Assertion is incorrect but the Reason is correct.

(AIIMS-2002)

Ans. (a): Potassium and Cesium are used in photoelectric cells because Potassium and Cesium lose their valence electron in the presence of light which carry the electric current. K and Cs are operated in photoelectric cells which are careful to blue light.

So, (A) and (R) are correct and (R) is the correct explanation of (A).

54. In the following sequence of reaction, identify the compounds (A), (B) (C) and (D) :

$$\underset{\text{Solution}}{Na_2CO_3} \xrightarrow{SO_2} (A) \xrightarrow{Na_2CO_3}$$

$$(B) \xrightarrow[\text{Heat}]{S} (C) \xrightarrow{AgNO_3} (D)$$

(a) Na_2SO_3, $NaHSO_3$, Na_2S, Ag_2S
(b) $NaHSO_3$, Na_2SO_3, $Na_2S_2O_3$, Ag_2S
(c) $NaHSO_3$, Na_2SO_4, Na_2S, Ag_2O
(d) Na_2SO_3, Na_2SO_4, $Na_2S_2O_3$, Ag

(AIIMS-27 May, 2018-Evening)

Ans. (b) : The complete reaction is as follows-

$$Na_2CO_3 \xrightarrow{SO_2} \underset{\substack{\text{Sodium hydrogen}\\ \text{(A) Sulphide}}}{NaHSO_3} \xrightarrow{Na_2CO_3} \underset{\substack{\text{Sodium}\\ \text{Sulphide}\\ \text{(B)}}}{Na_2So_3} \xrightarrow[\text{heat}]{S} \underset{\substack{\text{Sodium}\\ \text{Thio-Sulphide}\\ \text{(C)}}}{Na_2S_2O_3}$$

$$\text{(C)} \xrightarrow{AgNO_3} \underset{\substack{\text{(D) Silver}\\ \text{Sulphide}}}{Ag_2S}$$

Hence, $NaHSO_3$, Na_2SO_3, $Na_2S_2O_3$, Ag_2S are A, B, C, D respectively.

55. Which of the following is commercially known as oxone?

(a) Na_2O_2+HCl
(b) Na_2O + HCl
(c) Na_2O_2 + Na_2
(d) None of these

(AIIMS-2014)

Ans. (a): Sodium peroxide (Na_2O_2) and hydrochloride acid (HCl) is commercially known as oxone. Na_2O_2 is act as oxidizing agent while HCl is act as reducing agent.

Hence, Na_2O_2 + HCl is correct.

56. Which of the following is not correct?

(a) $2Li_2O \xrightarrow[673K]{heat} Li_2O_2 + 2Li$
(b) $2K_2O \xrightarrow[673K]{heat} K_2O_2 + 2K$
(c) $2Na_2O \xrightarrow[673K]{heat} Na_2O_2 + 2Na$
(d) $2Rb_2O \xrightarrow[673K]{heat} Rb_2O_2 + 2Rb$

(AIIMS-2016)

Ans. (a): $2Li_2O \xrightarrow[673k]{heat} Li_2O_2 + 2Li$ (Reaction not possible)

Since, lithium does not forms peroxide. So, option (a) is not correct.

57. Brine is an aqueous solution of

(a) NaCl
(b) NaOH
(c) $NaHCO_3$
(d) Na_2CO_3

NDA (I)-2018

Ans. (a) : Brine is an aqueous solutions of Sodium Chloride (NaCl). Brine naturally occurs on the Earth's surface (salt lakes), crust and within brine pools on the ocean bottom.

58. Which of the following statement is wrong for Solvay process?

(a) NH_3 is regenerated.
(b) $CaCl_2$ is one of the by product.
(c) $CaCO_3$ is used completely in reaction.
(d) Na_2CO_3 is partially converted into bi-carbonate.

(AIIMS-27 May, 2018-Morning)

Ans. (d): Solvay process is the industrial process for the production of sodium carbonate.

$$NaCl + NH_3 + CO_2 + H_2O \longrightarrow NaHCO_3(s) + NH_4Cl$$

$$NaHCO_3 + heat \longrightarrow \underset{\substack{\text{Sodium}\\ \text{Carbonate}}}{Na_2CO_3} + H_2O + CO_2$$

So, Na_2CO_3 is partially converted into bicarbonate.

Hence, option (d) is correct.

59. The order of solubility of lithium halides in non polar solvents follows the order:

(a) LiI > LiBr > LiCl > LiF
(b) LiF > LiI > LiBr > LiCl
(c) LiCl > LiF > LiI < LiBr
(d) LiBr > LiCl > LiF > LiI

(AIIMS-2012)

Ans. (a): A covalent compound is more soluble is non polar solvents.

As the size of the anion increases from F^- to I^- the covalent character increases and hence the solubility of lithium halides in non polar solvent is

: LiI > LiBr > LiCl > LiF

So, option (a) is correct.

60. Which property of sodium is being used in street lights?

(a) It shows photoelectric effect.
(b) It has low melting point.
(c) Sodium atom emits photons in the yellow region of visible spectrum, due to electrically stimulated transitions.
(d) Sodium vapours show golden colour.

(AIIMS-2011)

@apna_pdf

Ans. (c): Sodium is belongs from the I-group, s-block elements it emits photons in the yellow region of visible spectrum due to electricity stimulated transition is operated in street lights. So, option (c) is correct.

61. The commercial salt is purified by passing
(a) H_2S gas through an alkaline solution of salt.
(b) HCl gas through a saturated solution of salt.
(c) H_2 gas through a saturated of salt.
(d) Cl_2 gas through a saturated of salt.

(AIIMS-2009)

Ans. (b): The common table salt is prepared by passing HCl gas through a saturated solution of salt. The precipitation is due to common ion effect. The salt of Ca and Mg remains in the solution due to their higher solubility.

$$NaCl + H^+Cl^- \longrightarrow \underset{ppt}{NaCl}$$

So, option (b) is correct.

62. Na_2CO_3 reacts with SO_2 in alkaline medium to from:
(a) Na_2SO_3
(b) $NaHSO_3$
(c) Na_2SO_4
(d) $NaHSO_4$

(AIIMS-2010)

Ans. (d): Sodium carbonate reacts with SO_2 in alkaline medium to form sodium bisulphate ($NaHSO_4$).

$$Na_2CO_3 + 2H_2O \longrightarrow 2NaOH + H_2CO_3$$

$$2NaOH + 2SO_2 \longrightarrow 2NaHSO_4 + H_2O$$

63. Largest difference in radii is found in case of the pair
(a) Li, Na
(b) Na, K
(c) K, Rb
(d) Rb,Cs

(AIIMS-2007)

Ans. (b): Radii of atoms increase as we go down the group due to the addition of extra energy shell.

The nuclear charge also increases on moving down the group but the influence of addition of energy shell predominates.

Element →	Li	Na	K	Rb	Cs
Metallic Radius/pm	152	186	227	248	265

From above data it is clear that largest difference in radii is found in Na & K.

64. On dissolving moderate amount of sodium metal in liquid NH_3 at low temperature, which one of the following does not occur?
(a) Blue colored solution is obtained.
(b) Na^+ ions are formed in the solution.
(c) Liquid NH_3 become good conductor of electricity.
(d) Liquid ammonia remains diamagnetic.

(AIIMS-2003)

Ans. (d) : The alkali metals dissolve in liquid ammonia without evolution of hydrogen the colour of the liquid solution is blue and is paramagnetic in nature.

$$2M + NH_3 \longrightarrow 2MNH_2 + H_2$$

Similarly sodium also possesses the same properties when dissolved in liquid ammonia.

$$2Na + 2NH_3 \longrightarrow 2NaNH_2 + H_2$$

So, Liquid ammonia remains diamagnetic.

65. Sodium carbonate is soluble in water because of
(a) High lattice energy
(b) Low lattice energy
(c) Low molecular weight
(d) High molecular weight

(AIIMS-1997)

Ans. (b): Na_2CO_3 is soluble in water because low lattice enthalpy

Lattice enthalpy < Hydration → soluble

Sodium carbonate ionizes in aqueous solution. It is soluble in water because of low lattice energy. Low lattice energy helps in solubility.

$$\text{Solubility} \propto \frac{1}{\text{molar mass}}$$

66. Assertion (A) : K. Rb and Cs form superoxides.
Reason (R) : The stability of the superoxides increases from 'K' to 'Cs' due to decrease in lattice energy.
The correct answer is
(a) Both (A) and (R) are true and (R) is the correct explanation of (A)
(b) Both (A) and (R) are true and (R) is not the correct explanation explanation of (A)
(c) (A) is true but (R) is not true
(d) (A) is true but (R) is true

VITEEE- 2009, BITSET-2009

Ans. (a) : K, Rb, Cs from superoxide when they are burned in the air as we more down the group the size of an atom from K to Cs increases. So lattice energy decrease and hence, the stability of superoxide also decreases.

The species having an O–O bond and O in an oxidation state of $-\frac{1}{2}$ are super oxides and is represented as O_2^-.

Usually these are formed by active metals such as KO_2, RbO_2 and CsO_2. For the salts of larger anions (like O_2^-), lattice energy increases in a group. Since, lattice energy is the driving force for the formation of an ionic compound and its stability, the stability of the superoxides from 'K' to 'Cs' also decreases.

67. Excess of NaOH reacts with Zn to form
(a) ZnH_2
(b) Na_2ZnO_2
(c) ZnO
(d) $Zn(OH)_2$

VITEEE- 2006

Ans. (b) : When NaOH reacts with Zn metal it forms $Zn(OH)_2$ and it can be shown by the following reaction–

$$Zn(s) + 2NaOH(aq) \longrightarrow Zn(OH)(s)$$

$$Zn(OH)_2(s) + 2NaOH \longrightarrow Na_2ZnO_2 + 2H_2O$$

68. Consider the following statements.
I. Cs^+ ion is more highly hydrated than other alkali metal ions.
II. Among the alkali metals, only lithium forms a stable nitride by direct combination with nitrogen.
III. Among the alkali metals Li, Na, K, Rb, the metal, Rb has the highest melting point.

@apna_pdf

IV. Among the alkali metals Li, Na, K, Rb, only Li forms peroxide when heated with oxygen.
Select the correct statement is
(a) I (b) II
(c) III (d) IV

AP-EAMCET – 2016

Ans. (b) : $N_2 + 6Li \rightarrow 2\ Li_3N$ (Nitride)
Lithium (Li) is the only alkali metal which reacts directly with N_2 to give nitride (Li_3N) which is more stable.

- Li^+ ion is more highly hydrated than other alkali metal ions due high polarising power of Li^+.
- Li has the higher melting point among the alkali metals because on going from top to bottom melting point decreases due to increase in the size of monovalent cations.
- Lithium can not form peroxide because there is located over a small size of lithium which will attracted negative ions. So, strongly it does not permit the oxide ion to combine with other oxide ion.

69. Assertion (A) : Alkali metals are soft and have low melting and boiling points.
Reason (R) : This is because inter atomic bonds are weak.
(a) Both (A) and (R) are not true
(b) (A) is true, but (R) is not the correct explanation of (A)
(c) (A) is true, but (R) is false.
(d) Both (A) and (R) are true and (R) is the correct explanation of (A).

AP-EAMCET (Engg.) 2015

Ans. (d) : Alkali metals are soft and have low melting and boiling point because of inter atomic bonds are weak.

70. Which of the following is not correct ?
(a) In Nelson method of NaOH preparation, Cl_2 is liberated at anode
(b) With hot and concentrated NaOH, Cl_2 gas gives NaOCl
(c) NaOH reacts with white phosphorus giving phosphine
(d) NaOH is used in rayon industry

AP - EAMCET (Medical) - 2007

Ans. (b) : • In Nelson method of NaOH preparation, Cl_2 is produced at the anode. Hydrogen and sodium hydroxide both are produced at the cathode. Hence, statement (a) is true.

• With hot and concentrated NaOH, chlorine gives the sodiumchlorate.

$$6NaOH + 3Cl_3 \rightarrow 5NaCl + \underset{\text{Sodium chlorate}}{NaClO_3} + 3H_2O$$

So, statement (b) is not true.

• NaOH reacts with white phosphorus giving phosphine.

$$\underset{\substack{\text{White}\\\text{phosphrous}}}{P_4} + 3NaOH + 3H_2O \rightarrow PH_3 + \underset{\text{Sodium hypophosphite}}{3NaH_2PO_2}$$

So, Statement (c) is true.

• NaOH is used in rayon industry. Hence, this statement is true.

71. Which of the following carbonates decomposes readily at low temperatures ?
(a) Na_2CO_3 (b) K_2CO_3
(c) Li_2CO_3 (d) Rb_2CO_3

AP - EAMCET (Medical) - 2007

Ans. (c) : The stability of alkali carbonate increases down the group due to increases of electropositive character. All carbonates of the alkali group are thermally stable with an exception of lithium and readily decomposes at low temperature.

72. Sodium reacts with water to give H_2 gas and the solution contains substance 'A'. Zinc metal reacts with solutions of 'A' to give the same H_2 gas. Compound 'A' is
(a) Na_2O (b) NaOH
(c) Na_2CO_3 (d) $NaHCO_3$

SRMJEEE – 2013,2012

Ans. (b) : Sodium reacts with H_2O to give NaOH and H_2 gas. This is an exothermic reaction and high amount of heat generated. After that NaOH reacts with zinc metal to form the Na_2ZnO_2 and H_2 gas librated.

$$2Na + 2H_2O \longrightarrow \underset{\text{A}}{2NaOH} + H_2\uparrow$$

$$2NaOH + Zn \longrightarrow Na_2ZnO_2 + H_2\uparrow$$

73. Which of the following statements is false for alkali metals?
(a) Lithium is the strongest reducing agent.
(b) Na is amphoteric in nature.
(c) Li^+ is exceptionally small.
(d) All alkali metals give blue solution in liq. ammonia.

AMU-2016

Ans. (b) : Sodium is not amphoteric in nature. It is basic in nature. It forms strong bond like sodium hydroxide (NaOH).
So, Na is amphoteric in nature is wrong statement.

74. Which of the following metals is most reactive towards water?
(a) Na (b) K
(c) Rb (d) Cs

AMU-2005

Ans. (d) : The reactivity of alkali metals towards water increases from Li to Cs. Hence the order of reactivity of alkali metals towards water is Li < Na < K < Rb < Cs
Hence, option (d) is correct.

75. In Castner-Kellner cell for the manufacture of sodium hydroxide, the anode is made up of
(a) iron (b) copper
(c) graphite (d) aluminium

AMU–2003

Ans. (c) : In Castner–Kellner cell, the anode is made up of graphite.

76. Which of the alkali metals is smallest in size?
(a) Rb (b) K
(c) Na (d) Li

AMU–2003

Ans. (d) : The atomic radius increase on moving from top to the bottom in a group while going from top to bottom in a group due to increase in the number of shell. Hence Li is the smallest alkali metal.

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77. The standerd reduction potential of Li^+/Li, Ba^{2+}/Ba, Na^+/Na and Mg^{2+}/Mg are –3.05, –2.73, –2.71 and –2.37 volt respectively. Which one of the following is strongest oxidizing agent?

(a) Ba^{2+} (b) Mg^{2+}
(c) Na^+ (d) Li^+

AMU 2002

Ans. (b) : Mg^{2+}/Mg has highest reduction potential so it is strongest oxidizing agent.

78. Which of the following does not react with AgCl?

(a) Na_2CO_3 (b) $Na_2S_2O_2$
(c) NH_4OH (d) $NaNO_3$

AMU 2002

Ans. (d) :

$4AgCl + 2Na_2CO_3 \rightarrow 4Ag + 4NaCl + 2CO_2 + O_2$

$AgCl + 2Na_2S_2O_3 \rightarrow NaCl + Na_3[Ag(S_2O_3)_2]$

$AgCl + 2NH_4OH \rightarrow [Ag(NH_3)_2]\,Cl + 2H_2O$

$NaNO_3$ does not react with Agcl.

79. Which is the strongest reducing agent?

(a) Mg (b) Rb
(c) Na (d) K

AMU 2002

Ans. (b) : Alkali metals act as strong reducing agents. On going from top to bottom in a group, reducing power increases. Hence, Rb is present at the bottom of IA group. Hence, Rb is strongest reducing agent.

80. The alkali metal which acts as a nutrient for plants is

(a) Rb (b) Li
(c) K (d) Na

AMU–2001

Ans. (c) : Potassium (K) is an essential nutrient for plant growth.

KNO_3, KCl, K_2SO_4 are used as fertilizers as source of potassium. Potassium is needed by plants for early root formation, ripening of seed and formation of chlorophyll.

81. Which is the lightest gas?

(a) Helium (b) Oxygen
(c) Hydrogen (d) Nitrogen

AMU–2001

Ans. (c) : Hydrogen is lightest gas because its atomic number and atomic mass is one. It has only one electron and one proton and there is no neutron.

82. Which alkali metal forms metal nitride by reacting with nitrogen of air?

(a) Li (b) Na
(c) K (d) Cs

Assam CEE-2020
CG PET-2005

Ans. (a) : Alkali metal that react with nitrogen directly to form nitride is Li. This anomalous behaviour is due to its small size and high polarizing power.

$$6Li + N_2\,(g) \rightarrow 2\,Li_3N$$

Hence, option (a) is correct.

83. Alkali metal hydrides follow the thermal stability order

(a) LiH < NaH < KH < CsH
(b) RbH < KH < NaH < LiH
(c) NaH < LiH < KH < RbH
(d) RbH < KH < LiH < NaH

Assam CEE-2018

Ans. (b) : The thermal stability of hydrides decreases from LiH to CsH in the order of LiH > NaH > KH > RbH > CsH.

The hydride ion is small size lithium ion.The stability decreases as the size of the cation decreases.

So, option (b) is correct.

84. A white substance having alkaline nature in solution is :

(a) $NaNO_3$ (b) NH_4Cl
(c) Na_2CO_3 (d) Fe_2O_3

BCECE-2006

Ans. (c) : $\underset{\substack{\text{Sodium}\\\text{carbonate}}}{Na_2CO_3} + 2H_2O \longrightarrow \underset{\substack{\text{Sodium}\\\text{hydrooxide}\\\text{(Strong base)}}}{2NaOH} + \underset{\substack{\text{Hydrogen}\\\text{carbonate}\\\text{(Weak acid)}}}{H_2CO_3}$

85. Most powerful reducing agent is :

(a) Li (b) Na
(c) Ca (d) Mg

BCECE-2005

Ans. (a) : Due to smallest reduction potential lithium is strongest reducing agent.

Since, $Li \rightarrow Li^+ + e^-$

So, option (a) is correct.

86. Which of the following is not soluble in NaOH?

(a) $Fe(OH)_3$ (b) $Zn(OH)_2$
(c) $Al(OH)_3$ (d) $Sn(OH)_2$

BCECE-2004

Ans. (a) : $Fe(OH)_3$ does not dissolve in NaOH. All other hydroxide are amphoteric in nature and dissolve in NaOH.

$Al(OH)_3 + NaOH \rightarrow NaAlO_2 + 2H_2O$
(soluble)

$Zn(OH)_2 + 2NaOH \rightarrow Na_2ZnO_2 + 2H_2O$
(soluble)

$Sn(OH)_2 + 2NaOH \rightarrow Na_2SnO_2 + 2H_2O$
(soluble)

87. Glauber's salt is :

(a) $Na_2CO_3.10H_2O$ (b) $Na_2SO_4.10H_2O$
(c) $MgSO_4.7H_2O$ (d) $CaSO_4.5H_2O$

BCECE-2009, 2003

Ans. (b) : Glauber's salt is the decahydrate form of sodium sulphate. It is also known as mirabilite. The chemical formula of Glauber's salt can be written as $Na_2SO_4.10H_2O$.

88. A solution of Na in liquid NH_3 is

(a) green (b) blue
(c) pink (d) yellow

BCECE-2009

Ans. (b) : When sodium is added to liquid ammonia, sodium amide compound is obtained and the blue colour formed is associated with the ammoniated electrons also known as solvated electrons.

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89. **The oxide which gives H_2O_2 on treatment with dilute acid is–**

(a) PbO_2 (b) TiO_2
(c) MnO_2 (d) Na_2O_2

BCECE-2009

Ans. (d) : The oxide that gives H_2O_2 on treatment with a dilute acid is Na_2O_2. Only true peroxides which have O – O bond give hydrogen peroxide with dilute acid

$$Na_2O_2 + H_2SO_4 \longrightarrow Na_2SO_4 + H_2O_2$$

90. **Which of the following pairs of atomic numbers represents s-block elements?**

(a) 7, 15 (b) 6, 12
(c) 9, 17 (d) 3, 12

BCECE-2009

Ans. (d) : Atomic number 3 is Lithium which belongs to I-A group of s-block elements and atomic number 11 is Sodium which is also belongs to I-A group of s-block elements.

91. **Which one of the following alkali metals gives hydrated salts?**

(a) Li (b) Na
(c) K (d) Cs

BCECE-2012

Ans. (a) : Among alkali metal ions, Li^+ is the smallest. Hence, Li^+ has the maximum degree of hydration than any other alkali metal cation.

92. **Which of the following ions show maximum hydration in water ?**

(a) Li^+ (b) Na^+
(c) K^+ (d) Cs^+

BCECE-2017

Ans. (a) : As small size of ions has high hydration energy. Therefore, Li^+ ion has the maximum charge density due to its small ionic size among the given ions.

93. **In the reaction, $M + O_2 \rightarrow MO_2$ (superoxide) the metal M is**

(a) Lithium (b) Sodium
(c) Potassium (d) Barium

BCECE-2018

Ans. (c) : Formation of oxides, peroxides and superoxide depend on the size of alkali metal. An atom with larger size produces super oxide. Thus, Lithium (Li) forms oxide, sodium (Na) forms peroxide whereas K, Rb and Cs forms superoxide.

94. **$LiAlH_4$ is used as:**

(a) An oxidizing agent (b) A reducing agent
(c) A mordant (d) A water softener

BITSAT-2005

Ans. (b) : Lithium aluminium hydride ($LiAlH_4$) is used as reducing agent in organic synthesis due to presence of weak bonding in Al-H bond which can easily provide hydrogen.

95. **Sodium peroxide in contact with moist air turns white due to formation of:**

(a) Na_2CO_3 (b) Na_2O
(c) NaOH (d) $NaHCO_3$

BITSAT-2010

Ans. (c) : Sodium on reaction with air first forms sodium peroxide as;

$$2Na + O_2 \longrightarrow Na_2O_2$$

On further exposure to air, it reacts with water following the equation :

$$Na_2O_2 + 2H_2O \longrightarrow 2NaOH + H_2O_2$$

96. **Which of the following among alkali metal is most reactive?**

(a) Na (b) K
(c) Rb (d) Cs

BITSAT-2014

Ans. (d) : On moving from top to bottom in alkali metal group, reactivity of alkali metals increases due to their larger size and low ionization enthalpy. Since, Cs is present at the bottom of 1-A group (alkali metal group), therefore, its reactivity is higher among the given alkali metals.

97. **The alkali metals form salt-like hydrides by the direct synthesis at elevated temperature. The thermal stability of these hydrides decreases in which of the following orders?**

(a) CsH > RbH > KH > NaH > LiH
(b) KH > NaH > LiH > CsH > RbH
(c) NaH > LiH > KH > RbH > CsH
(d) LiH > NaH > KH > RbH > CsH

BITSAT-2013
NEET-2008

Ans. (d) : The thermal stability of hydrides of alkali metals decreases down the group as the size of the alkali metals increases, they can be decomposed easily. Smaller is the size of the cation and larger is the size of the anion, stronger is the covalent bond (Fajan's rule). So, the correct order of thermal stability of hydrides of alkali metals is

LiH > NaH > KH > RbH > CsH

98. **Two elements A and B have similar chemical properties. They don't form solid hydrogencarbonates, but react with nitrogen to form nitrides. A and B, respectively, are :**

(a) Na and Rb (b) Na and Ca
(c) Cs and Ba (d) Li and Mg

BITSAT-2021

Ans. (d) : Lithium (Li) and magnesium (Mg) shows several similar properties due to the diagonal relationships. Both, Li and Mg when combine directly with N_2 gives nitrides like Li_3N_2 and Mg_3N_2.

All alkali metals forms solid hydrogen carbonates except Li due to its exceptionally smaller size and high polarizing power. Since, Li and Mg have diagonal relationship, therefore both Li and Mg does not form solid hydrogen.

99. **Which one of the following elements belongs to s- block?**

(a) Aluminium (b) Chromium
(c) Carbon (d) Potassium

CG PET -2008, 2005

Ans. (d) : Potassium has atomic number 19. It is belongs to 1-A group of s-block elements.

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100. The colour of the flame of sodium is

(a) deep red (b) blue
(c) green (d) golden yellow

CG PET- 2012

Ans. (d) : The colour of the flame of sodium is golden yellow.

101. Pure nitrogen gas is obtained from

(a) NH_3+NaNO_2 (b) $NH_4Cl+NaNO_2$
(c) N_2O+Cu (d) $(NH_4)_2Cr_2O_7$

CG PET- 2012

Ans. (b) : In case of NH_4Cl and $NaNO_2$ both are in the aqueous phase and form a crystalline solid. NH_4NO_2 which on further heating gives N_2 gas and water in liquid form, hence we get the purest form of nitrogen gas because it is not dissolved in H_2O.

$$NH_4Cl\,(aq.) + NaNO_2\,(aq.) \rightarrow NH_4NO_2\,(s) + NaCl\,(aq.)$$

$$NH_4NO_2\,(s) \xrightarrow{heat} N_2\,(g) + H_2O\,(l)$$

102. The reactivity of the alkali metal sodium with water, is made use of

(a) in drying of alcohols
(b) in drying of benzene
(c) in drying of organic amines
(d) as a general drying agent

CG PET -2004

Ans. (d) : The reactivity of the alkali metal sodium with water, is made use of in drying of alcohols in drying of benzene in drying of ammonia solution.
Hence, it act as general drying agent.

103. Alkali metals in each period have

(a) smallest size
(b) lowest ionisation potential
(c) highest ionisation potential
(d) highest electronegativity

CG PET -2004

Ans. (b) : Alkali metals possesses one valence electron in their outermost shell. If they were to lose this electron, they can attain noble gas configuration.
Hence, the ionization energy is the lowest.

104. With the increase in atomic weights, melting points of the alkali metals

(a) increase
(b) decrease
(c) remain constant
(d) do not show definite trend

CG PET -2004

Ans. (b) : On moving from top to bottom in a group, atomic weight and atomic size increases and melting point of alkali metals decreases due to increase in kernel size and decrease in strength of metallic bond.

105. Which of the following represents the electronic configuration of the most electropositive element?

(a) $[He]2s^1$ (b) $[He]2s^2$
(c) $[Xe]6s^1$ (d) $[Xe]2s^2$

CG PET -2005

Ans. (c) : Elements having lower value of ionization potential are called electropositive elements. Ionization potential of element increases from left to right is a period and decreases from top to bottom in group.
So, element belonging to higher period of group I- A group most electropositive.
$[X_e]$ $6s^1$ represent the electronic configuration of the most electropositive element such as cesium.

106. Which one of the following is an s-block element?

(a) Aluminum (b) Chromium
(c) Niobium (d) Potassium

CG PET -2005

Ans. (d) : The atomic number of potassium is 19 and its electronic configuration is.
$1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 4s^1$. As the last electron is going in the S – orbital, hence K is belongs to s-block element.

107. Neon atom requires energy to remove one electron from its outermost orbit, so also to add one electron into the outermost orbit. Which of the following is correct about fluorine?

I. Fluorine releases energy when an electron is removed.

II. Fluorine requires energy to add one electron.

(a) (I) and (II) are correct
(b) (I) is correct, (II) is false
(c) (I) is false, (II) is correct
(d) (I) and (II) are false

CG PET- 2015

Ans. (d) : If we want to add any electron in the valence shell of any atom, then some energy is released and this energy is known as electron gain enthalpy. Whereas, energy required to remove one electron from the valence shell of an atom is known as ionization energy.

108. The alkali metals are low melting. Which of the following alkali metals is expected to melt if the room temperature rises to $30^\circ C$?

(a) Na (b) K
(c) Rb (d) Cs

HP CET-2018

Ans. (d) : On going from top to bottom of alkali metals group, atomic size of metals increases that causes lower strength of metallic bonding which further leads to decrease in melting point. Since, Cs is present at the bottom of the group therefore, it can easily melt at temperature of $30^\circ C$.

109. A metal on combustion in excess air forms X. X upon hydrolysis with water yields H_2O_2 and O_2 along with another product. The metal is

(a) Li (b) Mg
(c) Rb (d) Na

[JEE Main-2019, 12 Jan Shift-I]

Ans. (c) : In excess of air, the reaction involved are as follows;
$Rb + O_2$ (excess) $\rightarrow$ Rb O_2 (x) (Superoxide)
$2\ RbO_2 + 2H_2O \rightarrow 2RbOH + H_2O_2 + O_2$.
Thus, the metal (x) is rubidium (Rb).

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110. A hydrated solid X on heating initially gives a monohydrated compound Y. Y upon heating above 373 K leads to an anhydrous white powder Z. X and Z, respectively, are

(a) baking soda and soda ash
(b) washing soda and soda ash
(c) baking soda and dead burnt plaster
(d) washing soda and dead burnt plaster

[JEE Main-2019, 10 April Shift-II]

Ans. (b) : The reaction involved is as follows;

$$Na_2CO_3.10H_2O(s) \xrightarrow{\Delta} Na_2CO_3.\ H_2O \xrightarrow[T>373K]{\Delta} Na_2CO_3$$

Washing Soda (Y) Soda ash
(X) (Z)

Thus, the compounds X and Z are washing soda and soda ash respectively.

111. The metal mainly used in devising photoelectric cells is

(a) Na (b) Li
(c) Cs (d) Rb

[JEE Main-2020, 2 Sep Shift-I]

Ans. (c) : Cs is used in the photoelectric cell because the ionization energy of Cs is lowest among alkali metals.

112. On combustion of Li, Na and K in excess of air, the major oxides formed, respectively, are

(a) Li_2O, Na_2O and K_2O_2
(b) Li_2O, Na_2O_2 and K_2O
(c) Li_2O, Na_2O_2 and KO_2
(d) Li_2O_2, Na_2O_2 and K_2O_2

[JEE Main-2020, 4 Sep Shift-I]

Ans. (c) : Due to small size, Li forms oxide, sodium form peroxide and potassium and all alkali metals form superoxide.

113. Reaction of an inorganic sulphite X with dilute H_2SO_4 generates compound Y. Reaction of Y with NaOH gives X. Further , the reaction of X with Y and water affords compound Z. Y and Z respectively, are

(a) SO_2 and Na_2SO_3 (b) SO_3 and $NaHSO_3$
(c) SO_2 and $NaHSO_3$ (d) S and Na_2SO_3

[JEE Main-2020, 6 Sep Shift-II]

Ans. (c) :

$$-Na_2SO_3 \xrightarrow{dil.H_2SO_4} SO_2 \xrightarrow{NaOH} Na_2SO_3 \xrightarrow{SO_2+H_2O} NaHSO_3$$

Sodium sulphite Sulphur Sodium Sodium
(X) dioxide Sulphite sulphite
(Y) (X) (Z)

Hence, the compounds Y and Z are SO_2 and $NaHSO_3$ respectively.

114. Among the statements (A)-(D), the correct ones are

(A) Lithium has the highest hydration enthalpy among alkali metals.
(B) Lithium chloride is insoluble in pyridine.
(C) Lithium cannot form ethynide upon its reaction with ethyne.
(D) Both lithium and magnesium react slowly with H_2O.

(a) (A) and (D) only
(b) (B) and (C) only
(c) (A), (C) and (D) only
(d) (A), (B) and (D) only

[JEE Main-2020, 9 Jan Shift-II]

Ans. (c) : Among the above statements only B statement is not true because of small size of Li. The salvation energy of Li is greater than the other salts of the same group.

115. The correct order of hydration enthalpies of alkali metal ions is

(a) $Li^+ > Na^+ > K^+ > Cs^+ > Rb^+$
(b) $Na^+ > Li^+ > K^+ > Rb^+ > Cs^+$
(c) $Na^+ > Li^+ > K^+ > Cs^+ > Rb^+$
(d) $Li^+ > Na^+ > K^+ > Rb^+ > Cs^+$

[JEE Main-2019, 8 April Shift-I]
AIIMS 25 May 2019 (Morning)

Ans. (d) : The hydration enthalpy of alkali metals decreases from top to bottom in 1-A group. Hence hydration enthalpy decreases from Li^+ to Cs^+ due to increase in atomic size.

116. The incorrect statement is

(a) Lithium is the strongest reducing agent among the alkali metals.
(b) Lithium is least reactive with water among the alkali metals.
(c) $LiNO_3$ decomposes on heating to give $LiNO_2$ and O_2.
(d) LiCl crystallise from aqueous solution as $LiCl\text{-}2H_2O$.

[JEE Main-2019, 12 April Shift-II]

Ans. (c) : The statement (c) is not correct because, on heating of $LiNO_3$ it decomposes into Li_2O, NO_2 and O_2 respectively.

$$4LiNO_3 \xrightarrow{\Delta} 2Li_2O + 4NO_2 + O_2.$$

117. Sodium metal on dissolution in liquid ammonia gives a deep blue solution due to the formation of

(a) Sodium ammonia complex
(b) Sodium ion-ammonia complex
(c) Sodamide
(d) Ammoniated electrons

[JEE Main-2019, 10 Jan Shift-II]

Ans. (d) : Alkali metals dissolve in liquid ammonia giving deep blue solution which are conducting in nature. The blue colour of the solution is due to ammoniated electrons which absorb energy in the visible region of light.

118. NaH is an example of

(a) Metallic hydride
(b) Electron-rich hydride
(c) Saline hydride
(d) Molecular hydride

[JEE Main-2019, 11 Jan Shift-I]

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Ans. (c) : NaH is an example of ionic hydride which is also known as saline hydride. Metals having electronegativity lower than hydrogen form such hydride. All elements of group-I and group-II when heated, form ionic hydride.

119. The correct statement(s) among I to III with respect potassium ions that are abundant within the cell fluids is/are

(I) They activate many enzymes.
(II) They participate in the oxidation of glucose to produce ATP.
(III) Along with sodium ions, they are responsible for the transmission of nerve signals.

(a) I, and III only
(b) I, II and III
(c) I and II only
(d) III only

[JEE Main-2019, 12 Jan Shift-II]

Ans. (b) : All statements regarding potassium ion are correct because potassium is active metal in many enzymes. They participate in oxidation of glucose to produce ATP and they are responsible for the transmission of nerve signals along with sodium ion.

120. Sodium salt of an organic acid 'X' produces effervescence with conc. H_2SO_4 'X' reacts with the acidified aqueous $CaCl_2$ solution to give a white precipitate which decolourises acidic solution of $KMnO_4$. 'X' is

(a) C_6H_5COONa
(b) $HCOONa$
(c) CH_3COONa
(d) $Na_2C_2O_4$

[JEE Main-2017]

Ans. (d) : Sodium salt of an organic acid X is sodium oxalate $Na_2C_2O_4$. It gives effervescence of CO_2 gas with conc. H_2SO_4

$$Na_2C_2O_4 + H_2SO_4 \rightarrow Na_2SO_4 + H_2O + CO\uparrow + CO_2\uparrow$$

Sodium oxalate reacts with the acidified aqueous $CaCl_2$ solution to give a white precipitate of Calcium oxalate

$$Na_2C_2O_4 + CaCl_2 \rightarrow CaC_2O_4\downarrow + 2NaCl$$

Sodium oxalate decolorizes acidic solution of $KMnO_4$

$$5C_2O_4^{2-} + 16H^+ + 2MnO_4^- \rightarrow 2Mn^{2+} + 10CO_2 + 8H_2O$$

121. The main oxides formed on combustion of Li, Na and K in excess of air respectively are

(a) LiO_2, Na_2O_2 and K_2O
(b) Li_2O_2, Na_2O_2 and KO_2
(c) Li_2O, Na_2O_2 and KO_2
(d) Li_2O, Na_2O_2 and KO_2

[JEE Main-2016]

Ans. (c) : The combustion of Li, Na and K, in excess of air, gives lithium oxide (Li_2O), sodium peroxide (Na_2O_2) and potassium superoxide (KO_2). Thus, Li_2O, Na_2O_2 and KO_2 are main oxides of Li, Na and K.

122. The products obtained on heating $LiNO_3$ will be

(a) $LiNO_2 + O_2$
(b) $Li_2O+NO_2+O_2$
(c) Li_3N+O_2
(d) $Li_2O+OH+O_2$

[AIEEE-2011]

Ans. (b) : $4\ LiNO_3 \rightarrow 2Li_2O + 4\ NO_2 + O_2$

Lithium nitrate on thermal decomposition produces metal oxide, NO_2 and O_2. While other alkali metal nitrates on heating, produces metal nitrite and oxygen.

123. What is the best description of the change that occurs when Na_2O (s) is dissolved in water?

(a) Oxidation number of sodium decreases
(b) Oxide ion accepts a shared pair of electrons
(c) Oxide ion donates a pair of electrons
(d) Oxidation number of oxygen increases

[AIEEE-2011]

Ans. (c) : When Na_2O(s) is dissolved in water, oxide ion donates a pair of electrons.

124. KO_2 is used in space and submarines because it

(a) absorbs CO_2 and increases O_2 concentration
(b) absorbs moisture
(c) absorbs CO_2
(d) Produces ozone

[AIEEE-2002]

Ans. (a) : The main reason behind using potassium superoxide (KO_2) in oxygen cylinder in space and submarines that, it absorbs CO_2 and increases O_2 concentration according to the following reaction;

$4KO_2 + 2CO_2 \rightarrow 2\ K_2\ CO_3 + 3O_2$.

125. The correct order of conductivity of ions in water is

(a) $Na^+ > K^+ > Rb^+ > Cs^+$
(b) $Cs^+ > Rb^+ > K^+ > Na^+$
(c) $K^+ > Na^+ > Cs^+ > Rb^+$
(d) $Rb^+ > Na^+ > K^+ > Li^+$

[JEE Main-2021, 17 March Shift-I]

Ans. (b) : As the size of gaseous ion decreases, it get more hydrated in water and hence the size of aqueous ion increases. When this bulky ion move in solution, it experience greater resistance and hence lower conductivity.

Size of gaseous ion : $Cs^+ > Rb^+ > K^+ > Na^+$

Conductivity : $Cs^+ > Rb^+ > K^+ > Na^+$

126. Match List-I with List-II

List-I (Salt)	**List-II (Flame colour wavelength)**
A. LiCI	1. 455.5 nm
B. NaCl	2. 670.8 nm
C. RbCl	3. 780.0 nm
D. CsCl	4. 589.2 nm

Choose the correct answer from the options given below.

	A	B	C	D
(a)	4	2	3	1
(b)	1	4	2	3
(c)	2	1	4	3
(d)	2	4	3	1

[JEE Main-2021, 24 Feb Shift-II]

Ans. (d) : The correct matching of salt and flame colour wavelength is as follows:

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Salt	Flame colour	Wavelength (in nm)
A . LiCl		670.8
B. NaCl		589.2
C. RbCl		780.0
D. CsCl.		455.5

127. Given below are two statemens: One is labelled as Assertion (A) and the other is labelled as Reason (R).

Assertion (A) Lithium salts are hydrated.

Reason (R) Lithium has higher polarizing power than other alkali metal group members.

In the light of the above statements, choose the most appropriate answer from the options given below

(a) Both (A) and (R) are true but (R) is not the correct explanation of (A).
(b) (A) is true but (R) is not true.
(c) (A) is false but (R) is true.
(d) Both (A) and (R) are true (R) is the correct explanation of (A).

[JEE Main-2021, 31 Aug Shift-II]

Ans. (a) : Lithium salts are generally trihydrated due to its smaller size. The polarizing power of Li is his higher than other alkali metals due to its smaller size because, as size of the ions increases, their polarizing power decreases.

128. Choose the correct statement from the following.

(a) The standard enthalpy of formation for alkali metal bromides becomes less negative on descending the group.
(b) The low solubility of Csl in water is due to its high lattice enthalpy.
(c) Among the alkali metal halides, LiF is least soluble in water.
(d) LiF has least negative standard enthalpy of formation among alkali metal fluorides.

[JEE Main-2021, 27 Aug Shift-II]

Ans. (c) : Hydration energy of lithium is higher than the other alkali metals. Hence, the solubility of LiF in water is lesser.

129. Match List I with List II.

List I	List II
A. Li	I. Photoelectric cell
B. Na	II. Absorbent of CO_2
C. K	III. Coolant in fast breeder nuclear reactor
D. Cs	IV. Treatment of cancer
	V. Bearings for motor engines

Choose the correct answer from the options given below.

	A	B	C	D
(a)	V	I	II	IV
(b)	V	II	IV	I
(c)	IV	III	I	II
(d)	V	III	II	I

[JEE Main-2021, 27 July Shift-II]

Ans. (d) : The correct matching is–
Li – Bearings for motor engines
Na – coolant in fast breeder nuclear reactor
K – Absorbent of CO_2
Cs – Photoelectric cell

130. Given below are two statements. One is labelled as Assertion A and the other labelled as Reason R.

Assertion (A) Lithium halides are some what covalent in nature.

Reason (R) Lithium possess high polarization capability.

According the above statements,

Choose the most appropriate answer from the options given below

(a) A is true but R is false
(b) A is false but R is true
(c) Both A and R are true but R is not the correct explanation of A
(d) Both A and R are true and R is the correct explanation of A

[JEE Main-2021, 27 July Shift-I]

Ans. (d) : Lithium halides are more covalent in nature than other alkali halides due to smaller size. According to Fajan's rule, due to smaller size of lithium, it has high polarizing power which makes LiCl more covalent in nature.

131. Lithium shows diagonal relationship with

(a) Sodium
(b) Magnesium
(c) Calcium
(d) Aluminium.

J & K CET-(2014)

Ans. (b) : In the periodic table, a diagonal relationship is seen between few pairs of nearby elements which are diagonally presents in the second period and third period. The pairs of the elements which show identical properties are Lithium and Magnesium, Boron and Silicon, and Beryllium and Aluminium

132. What colour is imparted into the flame when lithium is burnt?

(a) Golden yellow
(b) Brick red
(c) Crimson red
(d) Grassy green

J & K CET-(2014)

Ans. (c)

Cation	Colour
Na^+	Golden yellow
Ca^{2+}	Brick red
Li^+	Crimson red
$Cu^{2+}, BO_3^{3-}, Ti^{3-}$	Grassy green

133. 'The compound formed upon combustion of potassium metal in excess air is

(a) K_2O_2
(b) KO_2
(c) K_2O
(d) KOH

J & K CET-(2015)

Ans. (b) : Burning potassium in excess of O_2 gives the superoxide (KO_2) reaction with large excess of metal with form the oxide K_2O.

$$K \xrightarrow{O_2} \underset{\text{oxide}}{K_2O} \xrightarrow{O_2} \underset{\text{peroxide}}{K_2O_2} \xrightarrow{O_2} \underset{\text{superoxide.}}{KO_2}$$

@apna_pdf

134. Which of the following statements is false regarding alkali metals?
- (a) Alkali metals are soft and can be cut with the help of knife.
- (b) Alkali metals do not occur in free state in nature.
- (c) Alkali metals are highly electropositive elements.
- (d) Alkali metal hydrides are covalent in character.

J & K CET-(2013)

Ans. (d) : Alkali metal hydrides are covalent in character. Generally hydrides of alkali metals are ionic in nature except Lithium hydride due to its smaller size.

135. Lowest melting point chloride is :
- (a) LiCl
- (b) NaCl
- (c) KCl
- (d) CsCl

JCECE - 2006

Ans. (a) : Lithium chloride has lowest melting point among the alkali metal chlorides. This is because lithium chloride is covalent in nature whereas other alkali metal chlorides are ionic in nature.

136. Alkali metals have high oxidation potential and hence, they behave as:
- (a) Oxidizing agents
- (b) Lewis bases
- (c) Reducing agents
- (d) Electrolytes

JCECE - 2005

Ans. (c) : The substance which oxidized easily behaves like reducing agent since alkali metals have only one valence electron. Hence they act as strong reducing agent.

137. BaO_2 and ozone reacts to produce
- (a) Ba
- (b) Ba_2O_3
- (c) BaO
- (d) $Ba(OH)_3$

JCECE - 2007

Ans. (c) : BaO_2 and ozone reacts to produce BaO and oxygen.

$$BaO_2 + O_3 \rightarrow BaO + 2O_2 \uparrow$$

138. Among the alkali metals cesium is the most reactive because
- (a) its incomplete shell is nearest to the nucleus
- (b) it has a single electron in the valence shell
- (c) it is the heaviest alkali metal
- (d) the outermost electron is more loosely bound than the outermost electron of the other alkali metals

JCECE - 2009

Ans. (d) : On going down the group atomic size increases and hence effective nuclear charge decreases resulting removal of e^- will be more easy, the outermost electron is more loosely bound than the outermost electron of the other alkali metals.

139. Sodium reacts with water more vigorously than Li because it has
- (a) higher atomic mass
- (b) more electropositive character
- (c) metallic nature
- (d) more eletronegative character

JCECE - 2011

Ans. (b) : Sodium is more electropositive than Li, so react more vigorously with water. As the electropositive character increases reactivity of alkali metals increases.

140. When sodium is treated with sufficient oxygen/air, the product obtained is
- (a) Na_2O
- (b) Na_2O_2
- (c) NaO_2
- (d) NaO

JCECE - 2011

Ans. (b) : When sodium is treated with sufficient oxygen it forms sodium peroxide.

$$2Na + O_2 \xrightarrow{\Delta} \underset{\text{Sodium peroxide}}{Na_2O_2}$$

141. Alcoholic KOH is used for
- (a) dehydration
- (b) dehydrogenation
- (c) dehydrohalogenation
- (d) dehalogenation

JCECE - 2012

Ans. (c) : Alcoholic solution of KOH is used for dehydrohalogenation of an haloalkane and results in the formation of Alkenes.

142. The ion which show maximum value of hydration energy is
- (a) Li^+
- (b) K^+
- (c) Na^+
- (d) Cs^+

JCECE - 2016

Ans. (a) : Smaller be the size of cation, more be its effective nuclear charge. Will hydrate more and has more hydration energy.

143. Which of the following atomic and physical properties of hydrogen is false?
- (a) Hydrogen > Deuterium > Tritium; (melting point/K)
- (b) Hydrogen < Deuterium <Tritium; (boiling point/K)
- (c) Hydrogen < Deuterium < Tritium; (density/gL^{-1})
- (d) Hydrogen > Deuterium > Tritium; (%relative abundance)

JIPMER-2015

Ans. (a) : With increase in atomic mass. The melting and boiling point is increases.

144. Sodium sulphite is used in preserving squashes and other mildly acidic foods due to
- (a) Potassium salt has preservative action
- (b) Potassium metabisulphite prevents oxidation
- (c) Potassium metabisulphite is not influcenced by acid
- (d) Sulphur dioxide and sulphurous acid formed kill bacteria and germs

JIPMER-2015

Ans. (d) : Sodium sulphite is used in preserving squashes and other mildly acidic foods due to sulphur dioxide and sulphurous acid kill bacteria and germs. sodium sulphite is anti microbial agent and antioxidant.

145. Among the following the least thermally stable is
- (a) K_2CO_3
- (b) Na_2CO_3
- (c) $BaCO_3$
- (d) Li_2CO_3

JIPMER-2014, 2009

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Ans. (d) : Thermal stability of carbonates increases on moving down a group. Thus Lithium carbonate is least thermally stable

$Li_2CO_3 \xrightarrow{\Delta} Li_2O + CO_2 \uparrow$

146. The metal that produces red-violet colour in the non-luminous flame is

(a) Ba (b) Ag
(c) Rb (d) Pb

JIPMER-2011

Ans. (c) : Alkali metals and their salts impart characteristic colour to flame. The reason for flame colouration is that the energy of the flame causes an excitation of the outermost electrons which when return to their original position, give out the energy absorbed in the visible region.

147. The most stable compound is

(a) LiF (b) LiCl
(c) LiBr (d) LiI

JIPMER-2008

Ans. (a) : LiF is most stable because of the small size of Li and F. It has highest lattice enthalpy and hence most stable.

148. The oxide of potassium that does not exist is

(a) K_2O (b) KO_2
(c) K_2O_2 (d) K_2O_3

Karnataka-CET-2020

Ans. (d) : Potassium generally forms three oxides. K_2O, K_2O_2 and KO_2. K_2O_3 is not formed in normal condition.

149. An alkali metal hydride (NaH) reacts with diborane in A to give a tetrahedral compound B which is extensively used as reducing agent in organic synthesis. The compounds A and B respectively are

(a) C_2H_6 and C_2H_5Na
(b) CH_3COCH_3 and $B_3N_3H_6$
(c) C_6H_6 and $NaBH_4$
(d) $(C_2H_5)_2$ O and $NaBH_4$

Karnataka-CET-2015

Ans. (d) : When alkali metals hydride (NaH) react with diborane (B_2H_6) in the presence of ether $(C_2H_5)_2O$ a tetrahedral compound (metal borohydride) is formed which act as a reducing agent in organic synthesis.

$$2NaH + B_2H_6 \xrightarrow{(C_2H_5)_2O} \underset{\text{Sodium borohydride}}{2NaBH_4}$$

150. Alkali metals have negative reduction potential and hence they behave as

(a) oxidising agents (b) Lewis bases
(c) reducing agents (d) electrolytes

Karnataka-CET-2013

Ans. (c) : Alkali metals have negative reduction potential so that they oxidize easily and act as reducing agents.

151. For alkali metals, which one of the following trends is incorrect?

(a) Hydration energy : Li > Na > K > Rb
(b) Ionization energy : Li > Na > K > Rb
(c) Density : Li < Na < K < Rb
(d) Atomic size : Li < Na < K < Rb

KARNATAKA-CET, 2010

Ans. (c) : In general density increases on moving downward in a group but density of potassium is lesser than that of sodium. This is because of the abnormal increase in atomic size on moving from Na to K. Hence the correct order of density is Li < Na < K < Rb.

152. The oxide of an element whose electronic configuration is $1s^2, 2s^2, 2p^6, 3s^1$ is

(a) Neutral (b) Amphoteric
(c) Basic (d) Acidic

KARNATAKA-CET, 2009

Ans. (c) : $_{11}Na = 1s^2, 2s^2, 2p^6, 3s^1$
It is an alkali metal. Alkali metal oxides are basic in nature.

153. The characteristic not related to alkall metal is

(a) high ionisation energy
(b) their ions are isoelectronic with noble gases
(c) low melting point
(d) low electro negativity

KARNATAKA-CET, 2009

Ans. (a) : Alkali metals have low ionization energy. They posses minimum value of ionisation energy in their period.

154. Which one of the following statements is true for all the alkali metals?

(a) Their nitrates decompose on heating to give NO_2 and O_2
(b) Their carbonates decompose on heating to give CO_2 and the metal oxide
(c) They react with oxygen to give mainly the oxide M_2O
(d) They react with halogens to give the halides MX
(e) They react with nitrogen to give the halides MX

Kerala-CEE-2005

Ans. (d) : All the alkali, metals react with halogen to give halides of general formula MX type. Where M is alkali metals and X is halogen.

155. The low solubility of LiF and that of CsI in water are respectively due to which of the following properties of the alkali metal ions?

(a) Higher hydration enthalpy of Li^+, highter lattice enthalpy of Cs^+
(b) Smaller hydration enthalpy of Li^+, highter lattice enthalpy of Cs^+
(c) Smaller lattice enthalpy of Li^+ highter hydration enthalpy of Cs^+
(d) Smaller hydration enthalpy of Li^+, smaller lattice enthalpy of Cs^+
(e) Higher lattice enthalpy of Li^+, smaller hydration enthalpy of Cs^+

Kerala-CEE-2016

Ans. (e) : Low solubility of LiF and that of CsI in water is due to the fact that though Li^+ is having high hydration energy but it has higher lattice enthalpy when present in LiF, this lattice enthalpy is higher than hydration energy due to which its solubility is less.

156. Li occupies higher position in the electrochemical series of metals as compared to Cu since

@apna_pdf

(a) The standard reduction potential of Li^+/Li is lower than that of Cu^{2+}/Cu
(b) The standard reduction potential of Cu^{2+}/Cu is lower than that of Li/Li
(c) The standard oxidation potential of Li/Li^+ is lower than that of Cu / Cu^{2+}
(d) Li is smaller in size as compared to Cu

WB-JEE-2012

Ans. (a) : In the electrochemical series, metals are arranged in increasing order of their standard reduction potential. The standard reduction potential of Li^+/Li and $Cu^{++}/$ Cu are – 3.05 V and + 0.034 V respectively. Therefore Li occupies higher position in as compared to Cu.

157. Match List-I with List-II and choose correct Answer from the code given below :

List-I	**List-II**
(A) $NaNO_3$	(1) Baking soda
(B) Na (NH_4) HPO_4	(2) Chile salt petre
(C) $NaHCO_3$	(3) Microcosmic salt
(D) $Na_2CO_3 . 10H_2O$	(4) Washing soda

Codes :

	A	**B**	**C**	**D**
(a)	1	2	3	4
(b)	2	3	1	4
(c)	3	1	2	4
(d)	4	1	2	3

Manipal-2020

Ans. (b) : A. $NaNO_3$ – Chile saltpeter
B. Na (NH_4) HPO_4 – Microcosmic salt
C. $NaHCO_3$ – Baking soda
D. $Na_2CO_3.10H_2O$ – Washing soda

158. Which of the following is an organometallic compound?
(a) Lithium acetate
(b) Methyl lithium
(c) Lithium dimethyl amide
(d) Lithium methoxide

Manipal-2020

Ans. (b) : Organometallic compounds is a member of a class of substance containing at least one metal to carbon bond. Methyl lithium is the simplest organolithium and its empirical formula is CH_3Li.

159. In the following reaction
$NaOH + S \rightarrow A + Na_2S + H_2O$; A is :
(a) Na_2SO_4 (b) Na_2SO_3
(c) Na_2S (d) $Na_2S_2O_3$

Manipal-2019

Ans. (d) :

$$\underset{\text{Sodiumhydroxide}}{6NaOH} + \underset{\text{Sulphur}}{4S} \rightarrow \underset{\underset{\text{Sodium Sulphite}}{(A)}}{Na_2S_2O_3} + \underset{\text{Sodium Sulphide}}{2Na_2S} + \underset{\text{Water}}{3H_2O}$$

160. All the s-block elements of the periodic table are placed in the groups ....
(a) IA and IIA (b) IIIA and IVA
(c) B sub groups (d) VA to VIIA

Manipal-2019

Ans. (a) : S –block elements have only two group IA and II–A. In group IA– Alkali metals are present while in II A group alkaline earth metals are present.

161. Which of the following element has maximum photoelectric effect?
(a) Li (b) Na
(c) K (d) Cs

Manipal-2016

Ans. (d) : Cs has maximum photoelectric effect because it has minimum ionization energy (work function). On moving down the group of alkali metals, the ionization potential decreases.

162. What happens when ionic hydrides of s-block elements in molten state are electrolysed?
(a) Hydride ion migrates at cathode
(b) Dihydrogen is liberated at cathode
(c) Hydride ion reforms metal hydride
(d) Dihydrogen is liberated at anode

MHT CET-02.05.2019, SHIFT-III

Ans. (d) : When ionic hydrides of s-block elements are subjected to electrolysis, dihydrogen gas is liberated at anode which confirms the existence of hydrogen in the form of hydride ion (H^-). Following reactions takes place.

$$MH(l) \rightleftharpoons M^+(aq) + H^-(aq)$$

At cathode

$$M^+(aq) + e^- \rightarrow M(s)$$

At anode

$$2H^-(aq) - 2e^- \rightarrow 2H(g)$$

163. Which of following elements does not form amide when reacted with ammonia?
(a) Li (b) Na
(c) K (d) Rb

MHT CET-02.05.2019, SHIFT-II

Ans. (a) : Lithium doesn't form amide when reacted with ammonia. It forms tetraamminelithium, $Li(NH_3)_4$
The equation for the reaction is as follows

$$Li + 4NH_3 \longrightarrow \underset{\text{tetraamminelithium}}{[Li(NH_3)_4]}$$

164. Solubility of which among the following substances in water increases slightly with rise in temperature?
(a) Potassium bromide (b) Potassium chloride
(c) Potassium nitrate (d) Sodium nitrate

MHT CET-2014

Ans. (b) Potassium chloride (KCl) has large hydration energy than its lattice energy so it evolves energy on dissolving in water consequently with rise in temperature its solubility increase.

165. Ionic mobility of which of the following alkali metal ions is lowest when aqueous solution of their salts are put under an electric field?
(a) K (b) Rb
(c) Li (d) Na

NEET-2017

Ans. (c) : Li^+ being smallest has maximum charge density

∴ Li^+ is most heavily hydrated among all alkali metal ions. The effective size of Li^+ in aqueous solution is therefore, largest

∴ Moves slowest under the electric field.

@apna_pdf

166. Which one of the alkali metals, forms only, the normal oxide, M_2O on heating in air?

(a) Rb (b) K
(c) Li (d) Na

NEET-2012

Ans. (c) : Li exist as Li_2O (oxide) due to small size it will pack efficiency with small O^{2-}. Na exist as Na_2O_2 (peroxide) due to large size it can pack efficiency with larger O_2^{2-}

- K exist as KO_2 (superoxide) due to best packing efficiency with O_2^-. Rb also exists as RbO_2.

167. The ease of adsorption of the hydrated alkali metal ions on an ion-exchange resin follows the order

(a) $Li^+ < K^+ < Na^+ < Rb^+$
(b) $Rb^+ < K^+ < Na^+ < Li^+$
(c) $K^+ < Na^+ < Rb^+ < Li^+$
(d) $Na^+ < Li^+ < K^+ < Rb^+$

NEET-2012

Ans. (b) : Smaller is the size of a cation, higher is the charge density on it and thus, higher is the number of water molecules that attach to it.

The ease of adsorption of the hydrated alkali metal ions on as ion-exchange resin follows the order–

$Rb^+ < K^+ < Na^+ < Li^+$

168. The sequence of ionic mobility in aqueous solution is

(a) $Rb^+ > K^+ > Cs^+ < Na^+$
(b) $Na^+ > K^+ > Rb^+ < Cs^+$
(c) $K^+ > Na^+ > Rb^+ < Cs^+$
(d) $Cs^+ > Rb^+ > K^+ > Na^+$

NEET-2008

Ans. (d) : Smaller the size of cation higher will be hydration and its effective size will increase and mobility of aqueous solution will decrease. Hence, small size cation, high degree of hydration, low ionic mobility and large size cation, low degree of hydration high ionic mobility.

So, the correct order is –

$Cs^+ > Rb^+ > K^+ > Na^+$

169. When a substance (A) reacts is with water it produces a combustible gas (B) and a solution of substance (C) in water. When another substance (D) reacts with this solution of (C), it also produces the same gas (B) on warming but (D) can produce gas (B) on reaction with dilute sulphuric acid at room temperature. Substance (A) imparts a deep golden yellow colour to a smokeless flame of Bunsen burner. Then (A), (B), (C) and (D) respectively are

(a) Ca, H_2, $Ca(OH)_2$, Sn
(b) K, H_2, KOH, Al
(c) Na, H_2, NaOH, Zn
(d) CaC_2, C_2H_2, $Ca(OH)_2$, Fe

NEET-1998

Ans. (c) : Substance A is sodium metal. It reacts with water to produce hydrogen (gas B) and sodium hydroxide (compound C).

$2Na + 2H_2O \longrightarrow 2NaOH + H_2 \uparrow$

Another substance D is Zinc
is reacts with solution of sodium hydroxide it produces hydrogen gas on warming.

$Zn + 2NaOH \longrightarrow Na_2ZnO_2 + H_2$

Zinc also reacts with sulphuric acid at room temperature to produce hydrogen gas

$Zn + H_2SO_4 \xrightarrow{\text{room temperature}} ZnSO_4 + H_2 \uparrow$

Thus, substance A, B, C and D respectively are
Na, H_2, NaOH, Zn.

170. Which one of the following properties of alkali metals increases in magnitude as the atomic number rises?

(a) Ionic radius
(b) Melting point
(c) Electronegativity
(d) First ionization energy

NEET-1989

Ans. (a) : With the increase in the atomic number of alkali metals, the ionic radius increases due to the increase in the number of the shell, whereas
the electronegativity, melting point and first ionization potential decrease.

171. In the case of alkali metals, the covalent character decreases in the order

(a) $MF > MCl > MBr > MI$
(b) $MF > MCl > MI > MBr$
(c) $MI > MBr > MCl > MF$
(d) $MCl > MI > MBr > MF$

NEET-2009

Ans. (c) : The covalent character of any compound in general depends upon size of the anion. The larger the anion greater is its polarizability.

Therefore $MI > MBr > MCl > MF$

172. Which compound will show the highest lattice energy?

(a) RbF (b) CsF
(c) NaF (d) KF

NEET-1993

Ans. (c) : NaF compound will be show the highest lattice energy because Na^+ is smallest in size and lattice energy increases as the size of cation decreases.

173. Which of the alkali metal chloride (MCl) forms its dihydrate salt ($MCl.2H_2O$) easily?

(a) LiCl (b) CsCl
(c) RbCl (d) KCl

NEET-Odisha 2019

Ans. (a) : Li^+ having maximum hydration tendency, due to this LiCl forms dehydrated salt $LiCl.\ 2H_2O$ where as other metal chlorides do not form hydrates.

174. The highly reactive alkali metals are kept in

(a) Air (b) Water
(c) Kerosene (d) All of these

UP CPMT-2010

Ans. (c) : Kerosene

Alkali metals are highly reactive, react with air as well as water.

These being unreactive towards Kerosene, are kept in Kerosene.

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175. The formula of Calgon, used for water softening is

(a) $Na_2[Na_4(PO_3)_6]$ (b) $Na_4[Na_2(PO_3)_6]$

(c) $Na_2[Na_4(PO_4)_5]$ (d) $Na_4[Na_4(PO_4)_6]$

UP CPMT-2008

Ans. (a): Calgon is used for water softening. Its formula is $Na_2[Na_4(PO_3)_6]$.

176. Which of the following is a false statement?

(a) Fluorine is more electronegative than chlorine

(b) Nitrogen has greater IE_1 than oxygen

(c) Lithium is amophoteric

(d) Chlorine is an oxidising agent

UP CPMT-2004

Ans. (c) : Key Idea Analyse each of the statement-

(c) Lithium is basic in nature. It has tendency to give out electron. It is not amophoteric. This statement is wrong.

(d) Chlorine is an oxidizing agent due to its tendency to accept electron.

(b) Nitrogen has greater IE_1 than oxygen due to its stable valence shell configuration ($2s^2, 2p^3$).

(a) Fluorine is more electronegative than chlorine because of its smaller size.

177. The formula of potash alum is:

(a) $K_2SO_4.\ Al_2(SO_4)_3.\ 24H_2O$

(b) $K_2SO_4.\ Al(SO_4)_3.18H_2O$

(c) $K_2SO_4.\ (NH_4)_2SO_4.18H_2O$

(d) $Na_2SO_4.\ Al_2(SO_4)_3.\ 24H_2O$

UPTU/UPSEE-2004

Ans. (a) : $K_2SO_4.\ Al_2(SO_4)_3 24H_2O$

$K_2SO_4.\ Al_2(SO_4)_3 24H_2O$: Potash alum or potassium aluminium sulphate.

178. Which is most basic in character?

(a) CsOH (b) KOH

(c) NaOH (d) LiOH

UPTU/UPSEE-2004

Ans. (a) : CsOH

Going from top to bottom in alkali metals the size of atom increases and since removal of OH ion becomes more easy. Hence, CsOH will be most basic.

179. The element which on burning in air gives peroxide is

(a) lithium (b) sodium

(c) rubidium (d) caesium

UPTU/UPSEE-2008

Ans. (b) : Sodium

$$2Na + O_2 \longrightarrow \underset{\text{(Sodium peroxide)}}{Na_2O_2}$$

180. All the following substances react with water. The pair that gives the same gaseous product is

(a) K and KO_2 (b) Na and Na_2O_2

(c) Ca and CaH_2 (d) ba and BaO_2

NEET-1994

Ans. (c) : $Ca + H_2O \longrightarrow CaO + H_2\uparrow$

$$CaH_2 + 2H_2O \longrightarrow Ca(OH) + 2H_2\uparrow$$

Hence, Ca and CaH_2 is the pair that gives same gaseous product (H_2) reaction with water.

181. The function of "Sodium pump" is a biological process operating in each and every cell of all animals. Which of the following biologically important ions is also a constituent of this pump?

(a) K^+ (b) Fe^{2+}

(c) Ca^{2+} (d) Mg^{2+}

NEET-2015, cancelled

Ans. (a) : The function of sodium pump is a biological process in each and every cell of all animals. K^+ ion a biologically important ions is also a constitution of this pump.

Na^+ is a major cation present in blood plasma outside the cells.

K^+ is major cation present in cytoplasm (inside the cells) higher concentration of K^+ and lower concentration of Na^+ ion is present inside cell and tissue.

Lower concentration of K^+ and higher concentration of Na^+ ion is present in fluid. Bathing cells and tissues (Blood plasma).

182. In which of the following processes, fused sodium hydroxide is electrolysed at a 330 ^{0}C temperature for extraction of sodium?

(a) Castner's process (b) Down's process

(c) Cyanide process (d) Both (b) and (c)

NEET-2000

Ans. (a) : In Castner's processes for production of sodium metal, sodium hydroxide (NaOH) is electrolyzed of temperature 330°.

183. Which of the following is known as fusion mixture?

(a) Mixture of $Na_2CO_3 + NaHCO_3$

(b) $Na_2CO_3.10H_2O$

(c) Mixture of $K_2CO_3 + Na_2CO_3$

(d) $NaHCO_3$

NEET-1994

Ans. (c) : A fusion mixture consists of a sodium salt and a potassium salt. The fusion mixture is very much effective for the qualitative analysis for the organic compound for different group.

184. Washing soda has formula

(a) $Na_2CO_3.7H_2O$ (b) $Na_2CO_3.10H_2O$

(c) $Na_2CO_3.3H_2O$ (d) Na_2CO_3

NEET-1990

Ans. (b) : Washing soda: $Na_2CO_3.10H_2O$ (Sodium carbonate decahydrate).

2. Alkaline Earth Metals

185. In the flame test of a mixture of salts, a green flame with blue centre was observed. Which one of the following cations may be present?

(a) Cu^{2+} (b) Sr^{2+}

(c) Ba^{2+} (d) Ca^{2+}

JEE Main-24.06.2022, Shift-II

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Ans. (a) : Cupric salts give green flame with blue center and the color of other salt are as follows.

Sr^{2+}	Crimson red
Ca^{2+}	Brick red
Ba^{2+}	Green

186. The correct order of melting point is:
(a) Be > Mg > Ca > Sr (b) Sr > Ca > Mg > Be
(c) Be > Ca > Mg > Sr (d) Be > Ca > Sr > Mg
JEE Main-26.06.2022, Shift-I

Ans. (d) : The melting point of Be, Mg, Ca and Sr are 1560K, 924K, 1124K and 1062K respectively.
So, the correct order is
Be>Ca>Sr>Mg.

187. The metal which dissolves in liquid ammonia to give a blue-black solution due to formation of solvated electron is
(a) aluminum (b) gallium
(c) calcium (d) silicon
(e) germanium
Kerala CEE -03.07.2022

Ans. (c) : Alkali metals dissolved in anhydrous liquid ammonia to give a blue color solution which are conducting in nature. The blue color of the solution is due to the ammoniated electron which absorbs energy in the visible region of light and thus imports blue color to the solution.

188. Nitrogen gas is obtained by thermal decomposition of
(a) $Ba(NO_3)_2$ (b) $Ba(N_3)_2$
(c) $NaNO_2$ (d) $NaNO_3$
JEE Main-28.06.2022, Shift-I

Ans. (b) : Nitrogen gas is obtained by thermal decomposition of Barium azide [$Ba(N_3)_2$]

$$Ba(N_3)_2 \xrightarrow{\Delta} Ba + 3N_2$$

189. Which one of the following elemental forms is not present in the enamel of the teeth?
(a) Ca^{2+} (b) P^{3+}
(c) F^- (d) P^{5+}
JEE Main-24.06.2022, Shift-I

Ans. (b) : In enamel on the surface of the teeth the compound present is [$3Ca_3(PO_4)_2.CaF_2$] Which contain Ca^{+2}, P^{+5} and F^-.
P^{+3} is not present in enamel of teeth.

190. Addition of H_2SO_4 to BaO_2 produces:
(a) BaO, SO_2 and H_2O (b) $BaHSO_4$ and O_2
(c) $BaSO_4$, H_2, and O_2 (d) $BaSO_4$ and H_2O_2
JEE Main-27.06.2022, Shift-I

Ans. (d) :
$BaO_2.8H_2O(s)+H_2SO_4(aq) \rightarrow BaSO_4+H_2O_2(aq)+8H_2O(l)$

191. $BeCl_2$ reacts with $LiAlH_4$ to give:
(a) Be + Li[$AlCl_4$] + H_2
(b) Be + AlH_3 + LiCl + HCl
(c) BeH_2 + LiCl + $AlCl_3$
(d) BeH_2 + Li[$AlCl_4$]
JEE Main-27.06.2022, Shift-I

Ans. (c) : The reaction using $LiAlH_4$ is an important preparation method for production of hydrides
$2BeCl_2 + LiAlH_4 \rightarrow 2BeH_2 + LiCl + AlCl_3$

192. Which one of the following alkaline earth metal ions has the highest ionic mobility in its aqueous solution?
(a) Be^{2+} (b) Mg^{2+}
(c) Ca^{2+} (d) Sr^{2+}
JEE Main-25.06.2022, Shift-I

Ans. (a) : Ionic mobility of a metal is depend upon its size
$\therefore$ ionic mobility $\propto \frac{1}{\text{size}}$ it denotes that smaller the size of hydrated ions, higher will be the ionic mobility.
$Be^{2+}(aq), Mg^{+2}(aq), Ca^{+2}(aq), Sr^{+2}(aq)$ size of aqueous solution decreases then ionic mobility increases.

193. A white precipitate was formed when $BaCl_2$ was added to water extract of an inorganic salt. Further, a gas 'X' with characteristic odour was released' when the formed white precipitate was dissolved in dilute HCl. The anion present in the inorganic salt is.
(a) I^- (b) SO_3^{2-}
(c) S^{2-} (d) NO_2^-
JEE Main-29.06.2022, Shift-II

Ans. (b) :

$$BaCl_2 + SO_3^{2-} \longrightarrow BaSO_3 \downarrow \xrightarrow{\text{dil.HCl}} \underset{X(gas)}{SO_2} \uparrow$$

Anion is SO_3^{2-}
X (gas) is released with smell of burning sulphur.

194. Anhydrone is :
(a) $KClO_4$ (b) $NaClO_4$
(c) $Mg(ClO_4)_2$ (d) $HClO_4 + H_2SO_4$
CG PET-22.05.2022

Ans. (c) : Anhydrone is $Mg(ClO_4)_2$ i.e. Magnesium Per chlorate. It is an water absorber used in dry batteries.

195. Among the following, basic oxide is :
(a) SO_3 (b) SiO_2
(c) CaO (d) Al_2O_3
JEE Main-28.06.2022, Shift-II

Ans. (c) :

SO_3	Acidic Oxide
SiO_2	Acidic Oxide
CaO	Basic Oxide
Al_2O_3	Amphoteric Oxide

So, option 'c' is correct
Oxide of metal → Basic

196. Besides SiO_2 and Al_2O_3, the other major ingredient in portland cement is
(a) $CaCO_3$ (b) $MgCO_3$
(c) Lime (d) Sodium peroxide
AP EAMCET- 1991

Ans. (c) : Lime
Besides SiO_2 and Al_2O_3 the other major ingredient in Portland cement is nearly 60–62% lime.
Portland cement is obtained by heating limestone and clay or other silicate mixture at high temperature (> 1500°C) in a rotating kiln.

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197. Mg is mainly extracted from

(a) Magnesite (b) Rutile
(c) Diaspore (d) Cryolite

AP EAMCET- 1992

Ans. (a) Magnesite ($MgCO_3$) is an ore of magnesium. The mineral magnesium carbonate ($MgCO_3$) a member of the calcite group of carbonate minerals that is a principal source of magnesium.

198. The chemical formula of bleaching powder is

(a) CaO_2Cl (b) $Ca(OCl)Cl$
(c) $Ca(OH)_2Cl$ (d) $CaCl_2$

AP EAMCET- 1993

Ans. (b) : Ca(OCl) Cl

The chemical formula of bleaching powder is Ca(OCl)Cl

It is known as calcium chlorohypochlorite. Bleaching powder is basic in character.

Calcium chloride and water are formed when bleaching powder reacts with hydrochloric acid.

199. The chemical formula of plaster of Paris is

(a) $CaSO_4 \cdot H_2O$ (b) $CaSO_4 \cdot 2H_2O$
(c) $2CaSO_4 \cdot 2H_2O$ (d) $2CaSO_4 \cdot H_2O$

AP EAMCET- 1993

Ans. (d) : $2CaSO_4.\ H_2O$ –

The chemical formula of plaster of Paris is

$CaSO_4.\frac{1}{2}H_2O$. or $2CaSO_4.\ H_2O$ plaster is a mixture of powdered calcium sulphate (commonly known as gypsum) and water that hardens quickly.

200. Quicklime is represented by the formula

(a) $Ca(OH)_2$ (b) CaO
(c) $CaCO_3$ (d) $CaHCO_3$

AP EAMCET- 1993

Ans. (b) : CaO –

The formula of quicklime is CaO. It is a good dehydrating reagent.

201. The compound formed during the setting of the plaster of Paris is

(a) Cement (b) Gypsum
(c) Anhydrite (d) Morton

AP EAMCET- 1995

Ans. (b) : Gypsum

$$CaSO_4 \cdot \frac{1}{2}HO + \frac{3}{2}H_2O \longrightarrow \underset{\text{Gypsum}}{CaSO_4 \cdot 2H_2O}$$

∴ The setting of the plaster of Paris is gypsum.

202. Beryllium shows diagonal relationship with aluminium. Which one of the following similarity is not correct?

(a) Be_2C like Al_4C_3 yields methane on hydrolysis
(b) Be like Al is rendered passive by HNO_3
(c) $Be(OH)_2$ like $Al(OH)_3$ is strongly basic
(d) Be forms berylliates and Al forms aluminates

AP EAMCET- 1995

Ans. (c) : $Be(OH)_2$ like $Al(OH)_3$ is strongly basic

Beryllium shows diagonal relationship with aluminum.

$Be(OH)_2$ and $Al(OH)_3$ both are amphoteric in nature i.e. they react with acid as well as alkalies.

203. Super phosphate is a mixture of

(a) $Ca(H_2PO_4)_2.H_2O+CaCl_2.2H_2O$
(b) $Ca(H_2PO_4)_2.H_2O+2CaSO_4.2H_2O$
(c) $Ca_3(PO_4)_2\ .H_2O+2CaSO_4.2H_2O$
(d) $Ca_3(PO_4)_2\ .\ H_2O+CaCl_2.2H_2O$

AP EAMCET- 1996

Ans. (b) : $Ca(H_2PO_4)_2 \cdot H_2O + 2(CaSO_4 \cdot 2H_2O)$ –

Superphosphate is mixture of $Ca(H_2PO_2)$ with calcium sulphate and small quantities of other.

204. The compound formed, when gypsum is dissolved in aqueous ammonium sulphate solution, is?

(a) $CaSO_4.NH_4Cl.H_2O$
(b) $CaCl_2.\ (NH_4)2SO_4.H_2O$
(c) $CaSO_4.\ (NH_4)_2SO_4.2H_2O$
(d) $CaCl_2.NH_4Cl.2H_2O$

AP EAMCET- 2002

Ans. (c) : When gypsum is dissolved in aqueous ammonium sulphate solution then the double salt of calcium is formed.

$$\underset{\text{Gypsum}}{CaSO_4.2H_2O} + (NH_4)_2SO4 \rightarrow \underset{\text{double salt}}{CaSO_4(NH_4)_2SO_4.2H_2O}$$

205. What are the products formed, when an aqueous solution of magnesium bicarbonate is boiled?

(a) $MgO,\ H_2O,\ CO_2$ (b) $Mg(HCO_3)_2,\ H_2O$
(c) $Mg(OH)_2,\ H_2O$ (d) $Mg,\ H_2O,\ CO_2$

AP EAMCET- 2003

Ans. (a) : When an aqueous solution of magnesium bicarbonate is boiled the magnesium oxide (MgO) is formed.

$$\underset{\substack{\text{Magnesium}\\\text{bicarbonate}}}{Mg(HCO_3)_2(aq)} \xrightarrow{\Delta} \underset{\substack{\text{Magnesium}\\\text{oxide}}}{MgO} + H_2O + 2CO_2$$

206. In the hardening stage of plaster of Paris, the compound formed is?

(a) $CaSO_4$
(b) Orthorhombic $CaSO_4 \cdot 2H_2O$
(c) $CaSO_4 \cdot H_2O$
(d) Monoclinic $CaSO_4 \cdot 2H_2O$

AP EAMCET- 2004

Ans. (d) : Monoclinic $CaSO_4.2H_2O$.

$$CaSO_4.\frac{1}{2}H_2O \xrightarrow{3/2 H_2O} \underset{\text{monoclinic calcium sulphate}}{CaSO_4.2H_2O}$$

plaster of Paris absorbs water to form monoclinic gypsum is a hardening substance. In these reactions, MgO is not formed.

207. Observe the following statements :

I. Bleaching powder is used in the preparation of chloroform.

II. Bleaching powder decomposes in the presence of $CoCl_2$ to liberate O_2.

III. Aqueous KHF_2 is used in the preparation of fluorine.

The correct combination is

(a) I, II and III are correct
(b) only II is correct
(c) only I and III are correct
(d) only I and II are correct

AP EAMCET- 2006

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Ans. (d) : (i) Bleaching powder is used in the preparation of chloroform.

$$\underset{\text{Bleaching powder}}{CaOCl_2} + H_2O \rightarrow Ca(OH)_2 + Cl_2$$

$$CH_3COCH_3 + 3Cl_2 \rightarrow CCl_3COCH_3 + 3HCl$$

$$2CCl_3COCH_3 + Ca(OH)_2 \rightarrow \underset{\text{Chloroform}}{2CHCl_3} + (CH_3COO)_2Ca$$

Hence, statement is true.

(ii) In the presence of cobalt chloride it loses its oxygen.

$$2CaOCl_2 \xrightarrow{CoCl_2} 5CaCl_2 + \underset{\text{'Oxygen'}}{O_2(g)}$$

(iii) Fused KHF_2 is used in the preparation of fluorine.

208. Which one of the following cations gives a brick red flame by flame test

(a) Ba^{2+} (b) Sr^{2+}

(c) Ca^{2+} (d) Zn^{2+}

MPPET- 2009

Ans. (c) : When calcium ion undergoes flame test the electrons of the calcium emits brick red colour. It is due to the excitation of electrons by the thermal energy which is then followed by de-excitation of an electron to ground state along with the libration of light in the visible range.

Ba^{2+} → Light yellow Sr^{2+} → Crimson red

Ca^{2+} → Brick red Zn^{2+} → Colourless

209. Consider the following statements with regard to magnesium sulphate :

(a) It is sparingly soluble in water.

(b) Its solubility in water is less than calcium sulphate.

(c) When heated to 900°C, it gives magnesium oxide.

Which of the above statements is/are correct?

(a) 1 and 3 (b) 2 only

(c) 3 only (d) 2 and 3

S. C. R. A - 2014

Ans. (c) : When magnesium sulphate is heated to 900°C. It gives a magnesium oxide.

210. Partial dehydration of gypsum at around 150°C affords mainly

(a) $CaSO_4$ (b) $CaSO_4.2H_2O$

(c) $CaSO_4.\frac{1}{2}H_2O$ (d) $CaSO_4.H_2O$

S. C. R. A - 2014

Ans. (c) : Partial dehydration of gypsum at around 150°C turns into the Plaster of Paris whose chemical formula is $CaSO_4.\frac{1}{2}H_2O$

211. Bubbling of CO_2 through lime water results in a turbid solution. This is due to formation of

(a) $Ca(HCO_3)_2$ (b) $CaCO_3$

(c) $Ca(OH)_2$ (d) CaO

S. C. R. A - 2014

Ans. (b) : In the calcinations reaction, $CaCO_3$ decompose in CaO(s) and CO_2(g). The following reaction take place-

$$CaCO_3(s) \rightarrow CaO(s) + CO_2(g)$$

212. Consider the following compounds :

1. $CaCl_2$ **2. $BeCl_2$**

3. $BaCl_2$ **4. $SrCl_2$**

5. $MgCl_2$

What is the correct order of melting point for the above compounds?

(a) 1 > 2 > 3 > 4 > 5 (b) 3 > 4 > 1 > 5 > 2

(c) 2 > 5 > 1 > 4 > 3 (d) 4 > 2 > 5 > 1 > 3

S. C. R. A - 2014

Ans. (b) : The given species are $CaCl_2$, $BeCl_2$, $BaCl_2$, $SrCl_2$ and $MgCl_2$. As we know that melting point is inversely proportional to the polarization i.e.

$$\text{Polarization} \propto \frac{1}{\text{Melting point}}$$

Polarization effect decreases down the group due to increase the size of alkali earth metal. $BaCl_2$ show the least polarization effect and having the high melting point. So, we can say that the melting point increases down the group in alkali earth metal.

213. Which one among the following chemicals is used as washing soda?

(a) Calcium carbonate

(b) Calcium bicarbonate

(c) Sodium carbonate

(d) Sodium bicarbonate

NDA (II)-2017

Ans. (c) : The chemical formula for washing soda is Na_2CO_3 or sodium carbonate. It is used in manufacturing of detergents, soaps, paper.

214. In cement manufacturing, gypsum is added to clinker. Which one of the following is not the function of gypsum?

(a) It decreases the rate of setting of cement

(b) It makes the clinker more brittle

(c) It helps in binding the silicate particles

(d) It helps in facilitating the formation of colloidal gel

SCRA-2010

Ans. (b) : Gypsum is called the retarding agent of cement which is mainly use for regulating the setting time of cement without gypsum. Cement clinker can condense immediately by mixing with water and release heat. So, main purpose of adding gypsum are-

(i) decrease the rate of setting of cement.

(ii) Bind the particles of calcium silicate.

(ii) Facilitate the formation of colloidal gel.

215. When gypsum is heated between 100° C to 120° C, it losses

(a) three-fourth of its water of crystallization

(b) half of its water of crystallization

(c) two-third of its water of crystallization

(d) whole water of crystallization

SCRA-2010

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Ans. (a) : When gypsum is heated to a temperature of 100°C. It losses $\frac{3}{4}$th of its water of crystallization and form Plaster of Paris.

$$\underset{\text{(Gypsum)}}{CaSO_4 \cdot 2H_2O} \xrightarrow{100^\circ C} \underset{\text{(Plaster of Paris)}}{CaSO_4 \cdot \frac{1}{2}H_2O} + \frac{3}{4}H_2O$$

216. The metal constituent of chlorophyll is

(a) Iron (b) potassium
(c) Manganese (d) Magnesium

NDA (II)-2011

Ans : (d) The metal constituent of chlorophyll is magnesium.

- Chlorophyll is a shade that gives establishes their green colour, and it assists plants with making their own food through photosynthesis.

217. Match List-I with List-II and select the correct answer using the code given below the Lists:

	List-I (Compound)		**List-II (Nature)**
A.	**Sodium hydroxide/**	**1.**	**Strong acid**
B.	**Calcium oxide/**	**2.**	**Alkali**
C.	**Acetic acid/**	**3.**	**Weak acid**
D.	**Hydrochloric acid/**	**4.**	**Base**

Code:

	A	**B**	**C**	**D**
(a)	2	3	4	1
(b)	2	4	3	1
(c)	1	4	3	2
(d)	1	3	4	2

NDA (I)-2015

Ans : (b) :

Compound	**Nature**
1. Sodium hydroxide	Alkali
2. Calcium oxide	Base
3. Acetic acid	Weak acid
4. Hydrochloric acid	Strong acid.

218. Which one of the following is NOT true for bleaching powder?

(a) It is used as a reducing agent in chemical industries
(b) It is used for bleaching wood pulp in paper factories
(c) It is used for disinfecting drinking water
(d) It is used for bleaching linen in textile industry

NDA (I)-2018

Ans. (a) Bleaching powder is used in various industries and manufacturing units as an oxidizing agent. It is used for bleaching wood pulp in paper factories and for disinfecting drinking water. Bleaching powder is not used as a reducing agent in chemical industries.

219. Which one of the following is the chemical formula of gypsum?

(a) $CaSO_4.2H_2O$ (b) Ca_2SiO_4
(c) $2CaSO_4.H_2O$ (d) $CaSO_4$

NDA (II)-2018

Ans. (a) : The chemical formula of Gypsum is $CaSO_4$. $2H_2O$. Gypsum is a mineral found in various parts of the world, but it is also produced as a byproduct of flue gas desulfurization in some coal-fired electric power plants.

220. Which one of the following metals does not react with cold water?

(a) Calcium (Ca) (b) Potassium (K)
(c) Magnesium (Mg) (d) Sodium (Na)

NDA (I)-2019

Ans : (c) Magnesium does not react with cold water it reacts with hot water to form magnesium hydroxide and hydrogen.

$$Mg + 2H_2O \rightarrow \underset{\text{Magnesium hydroxide}}{Mg(OH)_2} + H_2$$

221. Which one of the following does not represent the salt, Calcium carbonate?

(a) Lime water (b) Limestone
(c) Chalk (d) Marble

NDA (II)-2019

Ans : (a) Limewater does not represent Calcium carbonate. It contain lime or citrus.

Calcium carbonate ($CaCO_3$) is also called limestone. It is found in nature in the form of chalk, limestone and marble etc.

222. The raw materials used for the manufacture of Portland cement are

(a) Lime, silica and sulphur dioxide
(b) Lime, silica and carbon dioxide
(c) Lime, silica and alumina
(d) Lime, silica and boric acid

NDA (II)-2019

Ans : (c) : Lime, silica and alumina are the raw materials used for the manufacture of Portland cement.

Portland cement is made up of four main compounds are–

(i) tricalcium silicate ($3CaO.\ SiO_2$)
(ii) dicalcium silicate ($2CaO.\ SiO_2$)
(iii) tricalcium aluminate ($3CaO.\ Al_2O_2$)
(iv) tetra-calcium aluminoferrite ($4CaO.\ Al_2O_3Fe_2O_3$)

223. In the following reaction
$I_2 + H_2O + Cl_2 \rightarrow X + Y$, the products X and Y respectively are ______

(a) $HClO_4$, HI (b) I_2O_7 , HCl
(c) HIO_3 , HCl (d) ICl_3 & HCl

AP EAPCET 23-08-2021 Shift-I

Ans. (c) : Chlorine react with iodine and water to produce periodic acid and hydrogen chloride.

$$I_2 + H_2O + Cl_2 \rightarrow \underset{\text{Periodic acid}}{HIO_3} + \underset{\text{Hydrochloric acid}}{HCl}$$

Where, X = HIO_3
Y = HCl

224. Which of the following pairs of reactions give H_2 gas as a product upon hydrolysis?

(a) $Ba \xrightarrow{H_2O} \text{products}$
$BaO_2 \xrightarrow{H_2O} \text{products}$

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(b) $Ca \xrightarrow{H_2O} \text{products}$
$CaH_2 \xrightarrow{H_2O} \text{products}$

(c) $K \xrightarrow{H_2O} \text{products}$
$K_2O \xrightarrow{H_2O} \text{products}$

(d) $Na \xrightarrow{H_2O} \text{products}$
$Na_2O_2 \xrightarrow{H_2O} \text{products}$

AP-EAMCET 25-08-2021 Shift - I

Ans. (b) : (a) $Ba \xrightarrow{2H_2O} Ba(OH)_2 + H_2(g)$
$BaO_2 \xrightarrow{2H_2O} Ba(OH)_2 + H_2O$

(b) $Ca \xrightarrow{H_2O} Ca(OH)_2 + H_2(g)$
$CaH_2 \xrightarrow{H_2O} Ca(OH)_2 + H_2(g)$

(c) $2K \xrightarrow{2H_2O} KOH + H_2(g)$
$K_2O \xrightarrow{H_2O} 2KOH$

(d) $Na \xrightarrow{H_2O} NaOH + H_2(g)$
$2Na_2O_2 \xrightarrow{2H_2O} 4NaOH + O_2$

225. Which of the following metals produces Hydrogen gas on reacting with cold dilute Nitric acid

(a) Al (b) Fe
(c) Mg (d) Cu

AP-EAMCET 25-08-2021 Shift - I

Ans. (c) : $3Al \xrightarrow{dil.8HNO_3} 3Al(NO_3)_2 + 2NO + 4H_2O$

$3Fe \xrightarrow{dil.8HNO_3} 3Fe(NO_3)_2 + 4H_2O + 2NO$

$Mg \xrightarrow{dil.2HNO_3} Mg(NO_3) + H_2(g)$

$3Cu \xrightarrow{dil.8HNO_3} 3Cu(NO_3)_2 + 2NO + 4H_2O$

In the given metal, only Mg reacts with cold dilute nitric acid to evolve the hydrogen gas.

226. Which one of the following will not give flame test?

(a) Ca (b) Ba
(c) Sr (d) Be

TS-EAMCET-2016

Ans. (d) : Be and Mg do not give flame test because the electrons are strongly bound that it cannot get excited by flame. Except Be and Mg, other alkali and alkaline earth metals give flame test.

227. The alkaline earth sulphate, which has its hydration enthalpy greater than its lattice energy is

(a) $BeSO_4$ (b) $BaSO_4$
(c) $CaSO_4$ (d) $SrSO_4$

TS-EAMCET (Engg.), 05.08.2021 Shift-II

Ans. (a) : Beryllium sulphate $BeSO_4$ has its hydration enthalpy greater than its lattice enthalpy. Hence, it is highly soluble in water.

When we are moving from top to bottom in the periodic table the size of the atom increases means Beryllium has low atomic size. So, because of less atomic size Beryllium sulphate breaks easily and has less lattice enthalpy. Therefore, beryllium sulphate has high hydration and less lattice energy.

228. Tincture of iodine is the common name for

(a) iodoform
(b) 2-iodopropane
(c) 2-3% iodine solution in alcohol-water
(d) iodobenzene

AP EAMCET (Engg.) 21.09.2020, Shift-I

Ans. (c) : Tincture of iodine is usually 2-3% elemental iodine, alongwith potassium iodide or sodium iodide, dissolved in a mixture of ethanol and water. Tincture solutions are characterised by the presence of alcohol.

229. The tendency of forming chloride hydrates of alkaline earth metals is in the order of ———

(a) Ba > Sr, Ca > Mg (b) Sr > Ba, Mg > Ca
(c) Mg > Ca, Sr > Ba (d) Mg > Sr > Ca > Ba

AP EAPCET 25.08.2021, Shift-II

Ans. (c) : On going from top to bottom in alkaline earth metal the tendency of chloride is decreases.
So, the order is – Mg > Ca, Sr > Ba

230. Choose the smallest ion from the following.

(a) Mg^{2+} (b) S^{2-}
(c) Na^{+} (d) Cl^{-}

AP EAMCET (Engg.) 17.09.2020 Shift-I

Ans. (a) : Mg^{2+}
For is electronic ions, size $\propto$ charge on anion $\propto \frac{1}{\text{charge on cation}}$.
$\therefore$ Mg^{2+} is the smallest out of given.

231. Consider the following compounds :
1. $Ba(OH)_2$ 2. $Mg(OH)_2$ 3. $Ca(OH)_2$
What is the correct order of their alkalinity ?

(a) $Ba(OH)_2 > Mg(OH)_2 > Ca(OH)_2$
(b) $Mg(OH)_2 > Ca(OH)_2 > Ba(OH)_2$
(c) $Mg(OH)_2 > Ba(OH)_2 > Ca(OH)_2$
(d) $Ba(OH)_2 > Ca(OH)_2 > Mg(OH)_2$

SCRA - 2009

Ans. (d) : The increasing order of basic character of alkaline earth metals Mg, Ca and Ba are Ba > Ca > Mg
So, correct order of their alkalinity-

$$\boxed{Ba(OH)_2 > Ca(OH)_2 > Mg(OH)_2}$$

232. Reaction of calgon with hard water containing Ca^{2+} ions produce

(a) $[Na_2CaP_6O_{18}]^{2-}$ (b) $Ca_2(PO_4)_3$
(c) $CaCO_3$ (d) $CaSO_4$

TS EAMCET-2017

Ans. (a): Calgon is the name of complex salt, sodium hexametaphosphate $(NaPO_3)_6$. It is give a complex anion.

$$Na_2(Na_4P_6O_{18}) \longrightarrow 2Na^+ + \underset{\text{(Complex anion)}}{Na_4P_6O_{18}^{2-}}$$

$$\underset{\text{(Hard water)}}{Ca^{2+}} + \underset{\text{(anion of Calgon)}}{Na_4P_6O_{18}^{2-}} \longrightarrow CaNa_2P_6O_{18}^{2-} + 2Na^+$$

@apna_pdf

233. Bleaching powder can be obtained by which of the following reactions ?

(a) $Mg(OH)_2 + F_2 \xrightarrow{\Delta} MgOF_2 + H_2O$

(b) $Ca(OH)_2 + Cl_2 \xrightarrow{\Delta} CaOCl_2 + H_2O$

(c) $Ba(OH)_2 + Br_2 \xrightarrow{\Delta} BaOBr_2 + H_2O$

(d) $Ca(OH)_2 + F_2 \xrightarrow{\Delta} CaOF_2 + H_2O$

AP EAPCET 24.08.2021 Shift-II

Ans. (b): Calcium hydroxide react with chlorine in presence of heat. It will produce bleaching powder ($CaOCl_2$).

$Ca(OH)_2 + Cl_2 \xrightarrow{\Delta} CaOCl_2 + H_2O$ (Bleaching powder)

234. $CaOCl_2 + H_2O \rightarrow Ca(OH)_2 + X$

$X + CH_3CHO \rightarrow Y$

$Y + Ca(OH)_2 \rightarrow CHCl_3$

What is 'Y'?

(a) $CH_3CH(OH)_2$ (b) CH_2Cl_2

(c) CCl_3CHO (d) CCl_3COCH_3

AP EAMCET (Engg.) -2007

Ans. (c) : The basic method of formation of chloroform:

$$CaOCl_2 + H_2O \longrightarrow Ca(OH)_2 + \underset{X}{Cl_2}$$

$$\underset{Y}{CH_3CHO} + 3Cl_2 \longrightarrow CCl_3CHO + 3HCl$$

$$3CCl_3CHO + (aCOH) \longrightarrow 2CHCl_3\,(Chloroform)$$

x = Cl_2

y = CCl_3 CHO.

235. Which of the following metal ion play an important role in muscle contraction ?

(a) Fe^{2+} (b) Ca^{2+}

(c) Au^{+} (d) Na^{+}

AP EAPCET 24.08.2021, Shift-I

Ans. (b) : The Ca^{2+} metal ion plays an important role in muscle contraction due to which will charge thin filement into activated state. The binding of calcium to the troponin charges its shape so that the myosin binding sites on the actin are exposed causing a muscle contraction.

236. The main constituent of enamel on the surface of teeth is:

(a) $[3\,Ca_3\,(PO_4)_2 \cdot CaF_2]$

(b) $Ca_3\,(PO_4)_2 \cdot H_2O$

(c) $[3Ca_3(PO_4)_2 \cdot Ca\,(OH)_2]$

(d) CaF_2

AP EAPCET 20.08.2021 Shift-II

Ans. (c): The main constituent of enamel on the surface of teeth is $[3Ca_3(PO_4)_2.\ Ca(OH)_2]$

237. The experimentally determined molar mass of a non-volatile solute, $BaCl_2$ in water by Cottrell's method, is

(a) equal to the calculated molar mass

(b) more than the calculated molar mass

(c) less than the calculated molar mass

(d) double of the calculated molar mass

AP EAMCET (Engg.) 2012

Ans. (c) : The calculated molar mass of $BaCl_2$ is greater than the experimentally determined molar mass of $BaCl_2$ because $BaCl_2$ is ionised in water.

So, option 'c' is correct.

238. Which of the following substances is used, in laboratory, for fast drying of neutral gases?

(a) Phosphorus pentoxide

(b) Anhydrous calcium chloride

(c) Active charcoal

(d) Sodium phosphate

COMEDK 2016

Ans. (b) : Anhydrous calcium chloride ($CaCl_2$) is commonly used dehydrating agent in laboratory for drying of neutral gases.

239. Which of the following has correct increasing basic strength?

(a) MgO < BeO<CaO<BaO

(b) BeO<MgO<CaO<BaO

(c) BaO<CaO<MgO<BeO

(d) CaO<BaO<BeO<MgO

COMEDK 2016

Ans. (b) : The basic strength of oxides increases gradually from top to bottom.

BeO < MgO < CaO < SrO < BaO

240. Mg is an important component of

(a) haemoglobin (b) chlorophyll

(c) ATP (d) florigen.

COMEDK-2015

Ans. (b) : Chlorophyll molecule consists of a central magnesium atom surrounded by a nitrogen-containing structure called a prophyrin ring.

Chlorophyll also known as the green pigment. It harvests light for photosynthesis.

241. Which of the following is an epsom salt?

(a) $MgSO_4.2H_2O$ (b) $2CaSO_4.\ H_2O$

(c) $BaSO_4.\ 2H_2O$ (d) $MgSO_4.\ 7H_2O$

COMEDK-2020

Ans. (d) : Chemical formula of Epsom salt is $MgSO_4.7H_2O$.

242. Which one of the following compounds helps in achieving equilibrium between O_2 and $CO_2(g)$ in atmosphere?

(a) Chlorophyll

(b) Vitamin-B_{12}

(c) Porphyrin

(d) Acetyl salicylic acid

AP-EAMCET (Medical), 2008

Ans. (a) : In atmosphere, the equilibrium between oxygen (O_2) and carbon dioxide (CO_2) is maintained by photosynthesis and chlorophyll is necessary green pigment (present in plants) for photosynthesis thus, chlorophyll help in achieving equilibrium between O_2 and CO_2 in atmosphere.

243. $$\underset{(dry)}{Ca(OH)_2} \xrightarrow[-H_2O]{Cl_2} A \xrightarrow{\text{Auto-oxidation}} CaCl_2 + B$$

Identify B in the above reaction.

(a) $CaOCl_2$ (b) $Ca\,(ClO_3)_2$

(c) $Ca\,(OH)_2$ (d) $Ca\,(ClO_2)_2$

AP-EAMCET (Medical), 2008

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Ans. (b) : When calcium hydroxide $Ca(OH)_2$ reacts with Cl_2 to give bleaching powder ($CaOCl_2$). Bleaching powder on auto-oxidation gives calcium chlorate $[Ca(ClO_3)]$

$$\underset{\text{Bleaching powder 'A'}}{Ca(OH)_2} \xrightarrow[-H_2O]{Cl_2} CaOCl_2 \xrightarrow{\text{auto-oxidation}} 5CaCl_2 + \underset{\text{Calcium chlorate 'B'}}{Ca(ClO_3)_2}$$

244. Which one of the following is the correct order for the decomposition temperature of $CaCO_3$(X), $MgCO_3$(Y) and $BaCO_3$ (Z)?

(a) Z > X > Y
(b) X > Y > Z
(c) Y > Z > X
(d) X > Z > Y

AP-EAMCET (Medical), 2002

Ans. (a) : The stability of carbonate of alkaline earth metal increases from top to bottom due to increase of atomic size. So, the correct decreasing order of stability is : $BaCO_3 > CaCO_3 > MgCO_3$

245. Powdered Berilium burns in air to give

(a) BeO; Be_2N_2
(b) Be_2O_3;Be_3N_2
(c) BeO; Be_3N_2
(d) BeO; Be_2N

TS EAMCET 05.08.2021, Shift-I

Ans. (c) : When powdered berilium burns in air. It give BeO, Be_3N_2.

$Be (s) + 1/2O_2 (g) \rightarrow BeO (s)$ (Beryllium oxide)

$3Be (s) + N_2(g) \rightarrow Be_3N_2 (s)$ (Beryllium nitride)

246. Assertion: Among alkaline earth metals, Be predominantly forms compounds with covalent bond.

Reason: Be is larger in size and hence has greater polarizing power.

(a) If both Assertion and Reason are correct and Reason is the correct explanation of Assertion.
(b) If both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.
(c) If Assertion is correct but Reason is incorrect.
(d) If both the Assertion and Reason are incorrect.

AIIMS 25 May 2019 (Evening)

Ans. (c): Covalent nature is determined by polarization power.

Covalent nature ∝ polarization property

$$\propto = \frac{\text{Charge on cation}}{\text{Size of cation}}$$

Be has smaller size among the alkaline earth metals and hence has greater polarizing power. Hence (A) is correct but (R) is incorrect.

247. $MgCl_2$. $6H_2O$ when heated gives

(a) Magnesium dichloride
(b) Magnesium oxide
(c) Magnesium oxychloride
(d) Magnesium chloride

AIIMS-1994

Ans. (b): When $MgCl_2.6H_2O$ is heated then it will give magnesium oxide.

$MgCl_2.6H_2O \xrightarrow{heat} MgO + 5H_2O + 2HCl$.

248. Hydrolysis of beryllium carbide produces

(a) acetylene
(b) methane
(c) ethene
(d) none of these

AIIMS-1996

Ans. (b): The reaction can be written as –

$$Be_2C + 4H_2O \longrightarrow 2Be(OH)_2 + \underset{\text{(Methane)}}{CH_4}$$

249. In the reaction sequence: $CaC_2 \xrightarrow{H_2O} A \xrightarrow[H_2SO_4]{dil.H_2SO_4} B \xrightarrow{H_2/Ni} C$, the term 'C' is

(a) CH_3CHO
(b) HCHO
(c) C_2H_5OH
(d) CH_3OH

AIIMS-1996

Ans.(c) **(c):**

$$CaC_2 \xrightarrow{H_2O} \underset{\substack{\text{(A)}\\\text{Acetlylene}}}{CH \equiv CH} \xrightarrow[HgSO_4]{dil.H_2SO_4} \underset{\substack{\text{(B)}\\\text{Acetaldehyde}}}{CH_3CHO} \xrightarrow{H_2/Ni} \underset{\substack{\text{(C)}\\\text{Ethanol}}}{CH_3CH_2OH}$$

Calcium carbide reacts with water to form acetylene. Acetylene reacts with dil H_2SO_4 in the presence of $HgSO_4$ to form Acetaldehyde and Acetaldehyde reacts with H_2/Ni to form ethanol and it is the final product (i.e. CH_3CH_2OH).

250. Match List -I with List -II for the compositions of substances and select the correct answer using the code given below the lists:

	List -I **Substances**		**List -II** **Composition**
(A)	Plaster of paris	**(i)**	$CaSO_4.2H_2O$
(B)	Epsomite	**(ii)**	$CaSO_4.{}^1/_2H_2O$
(C)	Kieserite	**(iii)**	$MgSO_4.7H_2O$
(D)	Gypsum	**(iv)**	$MgSO_2.H_2O$
		(v)	$CaSO_4$

Code:

	(A)	**(B)**	**(C)**	**(D)**
(a)	(iii)	(iv)	(i)	(ii)
(b)	(ii)	(iii)	(iv)	(i)
(c)	(i)	(ii)	(iii)	(v)
(d)	(iv)	(iii)	(ii)	(i)

(AIIMS-2015), VITEEE-2012

Ans. (b):

Plaster of paris	$CaSO_4.\frac{1}{2}H_2O$
Epsomite	$MgSO_4.7H_2O$
Kieserite	$MgSO_4.\ H_2O$
Gypsum	$CaSO_4.\ 2H_2O$

251. Assertion: $Mg(CH)_3$ behave as a polymer.

Reason: CH_3 can form a very good bridge bond.

(a) If both Assertion and Reason are correct and the Reason is the correct explanation of Assertion.
(b) If both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.
(c) If Assertion is correct but Reason is incorrect.
(d) If both the Assertion and Reason are incorrect.

(AIIMS-27 May, 2018-Morning)

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Ans. (d):– Mg(CH)$_3$ does not behave as a polymer and CH$_3$ is a monovalent and does not acts as bridge bond.

252. Assertion: Of the various chlorides of alkaline earth metals BeCl$_2$ is covalent in nature, whereas MgCl$_2$ and CaCl$_2$ are ionic compounds.

Reason: Be is the first member of group 2.

(a) If both Assertion and Reason are correct and the Reason is the correct explanation of Assertion.
(b) If both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.
(c) If Assertion is correct but Reason is incorrect.
(d) If both the Assertion and Reason are incorrect.

(AIIMS-2012)

Ans. (b): The ionic nature of MgCl$_2$ and CaCl$_2$ is due to the large difference in electro negativity values of Mg. Ca to that of Chlorine.

253. Assertion: Best diagonal relationship is shown between Be and Al.

Reason: Ionization energy of Be is almost the same as that of Al.

(a) If both Assertion and Reason are correct and the Reason is the correct explanation of Assertion.
(b) If both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.
(c) If Assertion is correct but Reason is incorrect.
(d) If both the Assertion and Reason are incorrect.

(AIIMS-2013)

Ans. (a): On moving diagonally in the modern periodic table the elements show contain similarities. This is due to the fact that on moving across a period from left to right electro negativity of the atom decreases. On the other hand on moving down the group electro positivity increases.

Hence the elements present diagonally show similar properties. As a result diagonal elements have same ionization energy.

254. Assertion: Both Be and Al can form complexes such as BeF_4^{2-} and AlF_6^{3-} respectively, BeF_6^{3-} is not formed.

Reason: In case of Be, no vacant d-orbitals are present in its outermost shell.

(a) If both Assertion and Reason are correct and the Reason is the correct explanation of Assertion.
(b) If both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.
(c) If Assertion is correct but Reason is incorrect.
(d) If both the Assertion and Reason are incorrect.

(AIIMS-2009)

Ans. (a): Due to absence of d-orbitals in Be, it does not BeF_6^{3-} Whereas AlF_6^{3-} is formed due to presence of d-orbitals in Al.

255. Which one of the following hydrides is more acidic?

(a) H_2S (b) H_2O
(c) H_2Se (d) H_2Te

AP EAMCET (Medical) -1998

Ans. (d): Stability of hydride decreases down the group and electropositive character increases down the group. Therefore, acidic character increases down the group. Hence, the order is $H_2O < H_2S < H_2Se < H_2Te$.

256. Assertion: Barium is not required for normal biological function in human

Reason: Barium does not show variable oxidation sate.

(a) If both Assertion and Reason are correct and the Reason is a correct explanation of the Assertion.
(b) If both Assertion and Reason are correct but Reason is not a correct explanation of the Assertion.
(c) If the Assertion is correct but incorrect.
(d) If both the Assertion and Reason are incorrect.
(e) If the Assertion is incorrect but the Reason is correct.

(AIIMS-2003)

Ans. (b): For biological function of the human body, we need monovalent Na and K ions and divalent Mg and Ca ions, which are found in large properties in biological fluids.

257. Assertion: BaCO$_3$ is more soluble in HNO$_3$ than in plain water.

Reason: Carbonate is a weak base and reacts with the H$^+$ from the strong acid, causing the barium salt to dissociate.

(a) If both Assertion and Reason are correct and the Reason is a correct explanation of the Assertion.
(b) If both Assertion and Reason are correct but Reason is not a correct explanation of the Assertion.
(c) If the Assertion is correct but incorrect.
(d) If both the Assertion and Reason are incorrect.
(e) If the Assertion is incorrect but the Reason is correct.

(AIIMS-2003)

Ans. (a): Barium carbonate is more soluble in water because carbonate is a weak base and reacts with the H$^+$ ion of HNO$_3$ causing the barium salt to dissociate.

258. Assertion: Mg is not present in enamel of human teeth.

Reason: Mg is an essential element for biological functions of human.

(a) If both Assertion and Reason are correct and the Reason is a correct explanation of the Assertion.
(b) If both Assertion and Reason are correct but Reason is not a correct explanation of the Assertion.
(c) If the Assertion is correct but incorrect.

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(d) If both the Assertion and Reason are incorrect.
(e) If the Assertion is incorrect but the Reason is correct.

(AIIMS-2004)

Ans. (e): Enamel is the hardest substance in the human body and contains the highest percentage of minerals. with water and organic minerals composing the rest the primary mineral is hydroxyapatite which is a crystalline calcium phosphate.

Magnesium is not present in human enamel. However magnesium is an essential mineral for human health magnesium is a cofactor for more than 300 enzyme systems and is involved in both aerobic and anaerobic energy generation and in glycol sis, either directly as an enzyme activator or as a part of the magnesium is required for mitochondria to carry out oxidative. Phosphory lation. It plays areole in regulating potassium fluxes and in the metabolism of calcium.

259. Nitrolium is a mixture of :
(a) Ca $(CN)_2$ and graphite
(b) Ca C_2 and graphite
(c) Ca CN_2 and graphite
(d) Ca CN_2 and N_2

AP EAMCET (Medical) -1998

Ans. (c): Nitrolium is used as fertilizer. It is prepared when calcium carbide is heated with N_2 at 1000ºC.

$$CaC_2 + N_2 \xrightarrow{1000°C} \underbrace{CaCN_2 + C}_{\text{Nitrolium}}$$

Nitrolium is a mixture of calcium cyanamide and carbon $\left(CaCN_2 + C\right)$

260. What is product of reaction:

$$\mathbf{Ba(OH)_2 + H_2O_2 + ClO_2 \longrightarrow}\text{(dilute)}$$

(a) HOCl (b) $Ba(OCl)_2$
(c) $Ba(ClO_3)_2$ (d) $Ba(ClO_2)_2$

(AIIMS-27 May, 2018-Morning)

Ans. (d): Product of reaction–

$$Ba(OH)_2 + H_2O_2 + ClO_2 \longrightarrow Ba(ClO_2)_2 + O_2 + 2H_2O.$$

261. The following compounds have been arranged in order of their increasing thermal stabilities. Identify the correct order.
(I) K_2CO_3 (II) $MgCO_3$
(III) $CaCO_3$ (IV) $BeCO_3$
(a) I < II < III < IV (b) IV < II < III < I
(c) IV < II < I < III (d) II < IV < III < I

(AIIMS-2012)
J&K CET-1999

Ans. (b): According to Fajan's rule, the thermal stability is inversely proportional to the no. of charge on cation and directly proportional to the size of cation.

$BeCO_3 < MgCO_3 < CaCO_3 < K_2CO_3$

For particulars set of group (i.e. 1 or 2) the thermal stability increases form top to bottom of the group.

262. A metal salt solution forms a yellow precipitate with potassium chromate in acetic acid, a white precipitate with dil H_2SO_4, but given no precipitate with NaCl. The metal salt solution will consist of
(a) $PbCO_3$ (b) $BaCO_3$
(c) $MgCO_3$ (d) $CaCo_3$

(AIIMS-2011)

Ans. (b): The white precipitate obtained when sodium carbonate is added to the metal salt solution consists of barium carbonate.

Potassium chromate (K_2CrO_4) solution gives a yellow precipitate of barium chromate when the solution of fifth group precipitate in acetic acid is treated with it.

$$BaCO_3 + 2CH_3COOH \rightarrow Ba(CH_3COO)_2 + CO_2 + H_2O$$
$$Ba(CH_4COO)_2 + K_2CrO_4 \rightarrow BaCrO_4 + 2KCH_3COOK$$
$$BaCO_3 + H_2SO_4 \rightarrow BaSO_4 \downarrow + 2CO_2 + 2H_2O$$

263. The correct sequence of increasing melting points of $BeCl_2$, $MgCl_2$, $CaCl_2$, $SrCl_2$ and $BaCl_2$ is
(a) $BaCl_2 < SrCl_2 < CaCl_2 < MgCl_2 < BaCl_2$
(b) $BeCl_2 < MgCl_2 < CaCl_2 < SrCl_2 < BaCl_2$
(c) $BeCl_2 < CaCl_2 < MgCl_2 < SrCl_2 < BaCl_2$
(d) $MgCl_2 < BeCl_2 < SrCl_2 < CaCl_2 < BaCl_2$

(AIIMS-2011)

Ans. (b): Large the size of cation and smaller the size of anion. more will be the electronegative difference. More will be the ionic character and more will be the melting point.

$BeCl_2 < MgCl_2 < CaCl_2 < SrCl_2 < BaCl_2$

264. Which one of the alkaline earth metals shows some anomalous behaviour and has the same electronegativity as aluminium?
(a) Sr (b) Ca
(c) Ba (d) Be

(AIIMS-2011)

Ans. (d): Due to diagonal relationship Be shows similar properties to Al.

265. Among the following components of cement which is present in highest amount?
(a) Ca_2SiO_4 (b) Ca_3SiO_5
(c) Al_2O_3 (d) $Ca_3Al_2O_6$

(AIIMS-2007)

Ans. (b): A cement is a binder, a substance used for construction that sets, hardness and adheres to other materials to bind them together.

The amount of component of cement depends upon its type. Portland cement is most common kind and contains 51%, tricalcium silicate, 24% of dicalcium silicate and 6% of tricalcium aluminate.

266. Which one of the following hydroxide is insoluble in water?
(a) $Ca(OH)_2$ (b) $Ba(OH)_2$
(c) $Be(OH)_2$ (d) $Mg(OH)_2$

(AIIMS-2001)

Ans. (c): Solubility of alkaline earth metal hydroxide increases down the group. $Be(OH)_2$ is insoluble in water while hydroxide of other alkaline earth metals are soluble.

267. Chemical 'A' is used for softening of water to remove temporary hardness. A reacts with sodium carbonate to produce caustic soda. When CO_2 is bubbled through 'A' it turns cloudy. Chemically 'A' is:

@apna_pdf

(a) CaO (b) $CaCO_3$
(c) $Ca(HCO_3)_2$ (d) $Ca(OH)_2$

(AIIMS-1999, 2013)

Ans. (d): The Chemical A is calcium hydroxide $Ca(OH)_2$ used to water softening to remove tempory hardness. It reacts with sodium carbonate to form caustic soda.

$$Na_2CO_3 + Ca(OH)_2 \longrightarrow \frac{1}{\text{molar mass}}$$

with carbon dioxide gas it forms calcium carbonate which turns lime water milky.

$$Ca(OH)_2 + CO_2 \longrightarrow CaCO_3 \downarrow + H_2O.$$

268. Match List-I with List-II for the compositions of substances and select the correct answer using the codes given below the lists.

List-I (Substances)	**List-II (Composition)**
A. Plaster of Paris	**1. $CaSO_4.2H_2O$**
B. Epsomite	**2. $CaSO_4.\frac{1}{2}H_2O$**
C. Kieserite	**3. $MgSO_4.7H_2O$**
D. Gypsum	**4. $MgSO_4.H_2O$**
	5. $CaSO_4$

Codes :

	A	B	C	D
(a)	3	4	1	2
(b)	2	3	4	1
(c)	1	2	3	5
(d)	4	3	2	1

VITEEE- 2012

Ans. (b) : Plaster or Paris $= CaSO_4 \cdot \frac{1}{2}H_2O$

Epsomite $= MgSO_4 \cdot 7H_2O$

Kieserite $= MgSO_4 \cdot H_2O$

Gypsum $= CaSO_4 \cdot 2H_2O$

269. Mg is an important component of which biomolecule occurring extensively in living world?

(a) Haemoglobin (b) Chlorophyll
(c) Florigen (d) ATP

VITEEE- 2010

Ans. (b) : Chlorophyll is a fundamental component of PSI. Chlorophyll is a porphyrin complex of magnesium and is responsible for the green colors of leaves. It plays an important role in receiving light energy and transferring it to redox reaction systems.

270. Diamond is hard because

(a) all the four valence electrons are bonded to each carbon atoms by covalent bonds
(b) it is a giant molecule
(c) it is mode up of carbon atoms
(d) it cannot be burnt

VITEEE- 2008

Ans. (a) : In the structure of diamond each carbon atom in sp^3 hybridised & is covalently bonded with four other carbon atom held at the corners of a regular tetrahedron by covalent bonds. This results in a very big three dimensional polymeric structure in which C–C distance is 154 pm and bond angle is 109.5°. Owing to very strong covalent bonds by which atoms are held to greater, diamond is the hardest substance known.

271. Which one of the following reactions does not occur?

(a) $BaO + O_3 \longrightarrow BaO_2 + O_2$
(b) $PbS + 4O_3 \longrightarrow PbSO_4 + 4O_2$
(c) $H_2O_2 + O_3 \longrightarrow H_2O + 2O_2$
(d) $2Hg + O_3 \longrightarrow Hg_2o + O_2$

AP - EAMCET(MEDICAL) - 2009

Ans. (a) : BaO is not react with O_3 only BaO_2 reacts with O_3. Here (— O — O —) acts as oxidising as well as reducing agent.

$$BaO_2 + O_3 \longrightarrow BaO + 2O_2$$

272. $BaSO_4$ is insoluble in water due to its

(a) high hydration energy
(b) high lattice energy
(c) high ionisation energy
(d) high kinetic energy

AP - EAMCET(MEDICAL) - 2009

Ans. (b) : Barium sulphate ($BaSO_4$) has the high lattice enthalpy due to which $BaSO_4$ is insoluble in water.

273. Element with atomic number 38, belongs to

(a) II A group and 5th period
(b) II A group and 2nd period
(c) V A group and 2nd period
(d) III A group and 5th period

AP - EAMCET (Medical) - 2007

Ans. (a) : The electronic configuration of atomic number 38 is :

$${}_{38}X = [Kr], 5s^2$$

Hence, two electron present in outer shell of s-orbital. It is belongs to IIA group and 5th period. It's name is strontium (Sr). It's an alkaline metal and is located in group-II of periodic table.

274. Which of the following is incorrect?

(a) In the Castner's process of sodium extraction, NaCl is used as an electrolyte
(b) Sodium reduces CO_2 to carbon
(c) Mg reacts with cold water and liberate hydrogen gas
(d) Magnesium is an alloy of Mg and Zn

AP-EAMCET (Engg.)-2005

Ans. (c) : Magnesium does not react with cold water. It reacts with hot water to form magnesium hydroxide and hydrogen.

$$Mg + 2H_2O \xrightarrow{\text{Hot water}} Mg(OH)_2 + H_2$$

Hence, statement is false.

- The Castner's Kellner process is a method of electrolysis of sodium chloride solution to produce alkali hydroxide. It uses electrolyte of NaCl solution graphite anode and mercury cathode. Hence, statement is true.

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- When alkali metal reacts with CO_2 then carbon is formed.

  $4Na + CO_2 \longrightarrow 2Na_2O + C$
- Magnesium alloys are mixtures of magnesium with other metals often Aluminium, Zinc, Manganese, Silicon, Copper, rare earths and Zirconium.

275. Philosopher's wool when heated with BaO at 1100°C gives a compound. Identify the compound.

(a) $BaZnO_2$ (b) $Ba + ZnO_2$
(c) $BaCdO_2$ (d) $BaO_2 + Zn$

SRMJEEE-2014

Ans. (a) : ZnO is called philoshper wool which is heated with BaO at 1100ºC gives the $BaZnO_2$

$$\underset{\text{philospher's wool}}{ZnO} + BaO \xrightarrow{1100^\circ C} BaZnO_2$$

276. Which of the following oxides is most acidic in nature ?

(a) BeO (b) MgO
(c) CaO (d) BaO.

AMU – 2009

Ans. (a) : Acidity of oxides increases with decrease in electropositive character of central atom. Be is least electropositive. So, It will produce most acidic oxide.

277. Zinc phosphide and barium carbonate are well known

(a) germicides (b) fungicides
(c) herbicides (d) rhodenticides

AMU–2003

Ans. (d) : Rhodenticides are chemicals used for killing rodents.
(e.g., rats, mice etc)

278. Dolomite constitutes

(a) Fe_2O_3, FeO (b) $CaCO_3$, $Ca(OH)_2$
(c) CuS, FeS (d) $MgCO_3$, $CaCO_3$

AMU–2003

Ans. (d) : Dolomite is a magnesium are with general formula $MgCO_3CaCO_3$

279. The wire in the flash bulbs is made up of

(a) Ag (b) Cu
(c) Ba (d) Mg

AMU 2002

Ans. (d) : Mg (Magnesium) is used to make the wire of flash bulb.

280. Which out of the following is called 'Blue john'?

(a) CaF_2 (b) CaO
(c) CaH_2 (d) Ca_3P_2

AMU 2002

Ans. (a) : Blue John is a semi-precious mineral, a rare form of fluorite with bands of a purple-blue or yellowish color CaF_2 is called as Blue John.

281. Mortar is a mixture of slaked lime and sand in the ratio

(a) 1:4 (b) 2:3
(c) 1:3 (d) 3:1

AMU 2002

Ans. (c) : Mortor is a mixture of 1 part of slaked lime, 3 parts of sand and water.

282. Which of the following carbonates is least soluble in water?

(a) $NaHCO_3$ (b) $CaCO_3$
(c) $MgCO_3$ (d) $NaCO_3$

AMU 2002

Ans. (b) : As we know the solubility of carbonates in water depends upon the lattice energy. The calcium carbonate has the high lattice energy due to the big size of metal among the options. Hence $CaCO_3$ is least soluble in water due to high lattice energy.

283. The order of hydration enthalpies of alkaline earth metal ions

(a) $Be^{2+} > Mg^{2+} > Ca^{2+} > Sr^{2+}$
(b) $Sr^{2+} > Ca^{2+} > Mg^{2+} > Be^{2+}$
(c) $Mg^{2+} > Be^{2+} > Ca^{2+} > Sr^{2+}$
(d) $Be^{2+} > Mg^{2+} > sr^{2+} > Ca^{2+}$

Assam CEE-2019

Ans. (a) : The hydration enthalpy of ion is more when the size of cation is smaller. When we move top to bottom in the group the size of the atom increases so, hydration enthalpy decreases.
So, the increasing order of the size of the ions is as follows.
$Be^{2+} < Mg^{2+} < Ca^{2+} < Sr^{2+}$
And reversing of this order is true for the hydration enthalpy.
$Be^{2+} > Mg^{2+} > Ca^{2+} > Sr^{2+}$

284. On heating ammonium dichromate and barium azide separately, we get

(a) N_2 in both cases
(b) N_2 from ammonium dichromate and NO from barium azide
(c) N_2O form ammonium dichromate and N_2 from barium azide
(d) N_2O from ammonium dichromate and NO_2 from barium azide

Assam CEE-2018

Ans. (a) : When we supplied heat to ammonium dichromate and barium azide separately we get N_2 in both cases.
$(NH_4)_2 Cr_2O_7 \rightarrow Cr_2 O_3 + 4H_2O + N_2$
$Ba(N_3)_2 \rightarrow Ba + 3N_2$
The correct option is (a).

285. The chemical formula of Plaster of Paris is–

(a) $CaSO_4 \cdot \frac{1}{2} H_2O$ (b) $CaSO_4 \cdot H_2O$
(c) $CaSO_4 \cdot 2H_2O$ (d) $CaSO_4 \cdot 3H_2O$

JIPMER-2008, 2018
Karnataka-CET-2017
BCECE-2007, 2010
JCECE-2007
UPTU/UPSEE-2005
(AIIMS-2000)

Ans. (a) : Plaster of Paris- $CaSO_4 \frac{1}{2} H_2O$ (Calcium sulphate hemidaydrate)

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286. Which of the following radicals gives the apple green flame during flame test?

(a) Ba^{2+} (b) Sr^{2+}
(c) Ca^{2+} (d) Cr^{3+}

BCECE-2006

Ans. (a) :
$Ba^{2+} \rightarrow$ apple green
$Ca^{2+} \rightarrow$ brick red
$Sr^{2+} \rightarrow$ crimson red
$Cr^{2+} \rightarrow$ Green

287. Important ore of Mg is :

(a) Gypsum (b) Carnallite
(c) Magnatide (d) Carnolite

BCECE-2005

Ans. (b) : formula- $KCl.MgCl_2.6H_2O$ carnallite ore.

288. On strong heating $MgCl_2.6H_2O$, the product obtained is :

(a) $MgCl_2$ (b) MgO
(c) $MgCl_2.2H_2O$ (d) $MgCl_2.4H_2O$

BCECE-2004

Ans. (b) : On strong heating $MgCl_2.6H_2O$, is hydrolysed by its own of crystallization.

$MgCl_2.6H_2O \xrightarrow{\Delta} MgO + 2HCl + 5H_2O$

289. The salt responsible for permanent hardness of H_2O is–

(a) Na_2SO_4 (b) $MgHCO_3$
(c) $NaCl$ (d) $MgCl_2$

BCECE-2009

Ans. (d) : The salt responsible for permanent hardness of H_2O is $MgCl_2$.

- Permanent hardness of water is caused by the presence of soluble salts like calcium and magnesium in the form of chlorides and sulphides in water.

290. The least ionic chloride is formed by

(a) Mg (b) Ca
(c) Be (d) Sr

BCECE-2009

Ans. (c) :Be^{2+} ion is small in size and has high charge. Therefore, it has high polarizing power and it forms covalent halides. Thus, $BeCl_2$ is covalent in nature. Other alkaline earth metals form ionic halides.

291. Colemanite is

(a) $Na_2B_4O_7 \cdot 10H_2O$ (b) $Ca_2B_6O_{11} \cdot 5H_2O$
(c) $NaBO_2$ (d) H_3BO_3

BCECE-2011

Ans. (b) : Colemanite ($Ca_2B_6O_{11}.5H_2O$) is a borate mineral found in evaporate deposits of alkaline lacustrine environments. It is also an ore of boron.

Calemanite is a secondary mineral that forms by alteration of borax and ulexite.

292. The value of x is maximum for

(a) $MgSO_4.xH_2O$ (b) $CaSO_4.xH_2O$
(c) $BaSO_4.xH_2O$
(d) All have the same value of x

BCECE-2011
BITSAT-2009

Ans. (a) : As the size of the metal atom increases, the degree of hydration decreases. Thus small sized Mg^{2+} ion gets more hydrated. Hence, x is maximum for $MgSO_4.xH_2O$.

$MgSO_4$ has 7 moles of water of hydration. Thus the value of x is 7 which is greater than other.

293. When NH_3 is passed over heated metal A. Its amide is formed. The metal is

(a) Mg (b) K
(c) Al (d) Pb

[BITSAT-2013]

Ans. (b) : As NH_3 passed over heated Potassium than Potassium amide is obtained.

$K + NH_3 \longrightarrow KNH_2 + \frac{1}{2}H_2$

294. Portland cement does not contain

(a) Ca_2SiO_4 (b) Ca_2SiO_5
(c) $Ca_2Al_2O_6$ (d) $Ca_3(PO_4)_2$

BITSAT-2008, 2017

Ans. (d) : Portland cement does not contain calcium phosphate. The composition of Portland cement is 62% calcium oxide, 22% silica, 7.5% alumina, 2.5% magnesia and 2.5% ferric oxide calcium oxide is present in the form of calcium silicates and calcium aluminates.

295. Which of the following has correct increasing basic strength?

(a) $MgO < BeO < CaO < BaO$
(b) $BeO < MgO < CaO < BaO$
(c) $BaO < CaO < MgO < BeO$
(d) $CaO < BaO < BeO < MgO$

BITSAT-2012

Ans. (b) : On moving down the group the basic nature of oxides increases.

Therefore, the correct order of increasing basic strength $BeO < MgO < CaO < BaO$

296. BeF_2 is soluble in water whereas fluorides of other alkaline earth metals are insoluble because of

(a) Ionic nature of BeF_2
(b) Covalent nature of BeF_2
(c) Greater hydration energy of Be^{2+} ion as compared to its lattice energy
(d) None of these

BITSAT-2020

Ans. (c) : BeF_2 is soluble in water because it has greater hydration energy of Be^{2+} ion as compared to the crystal lattice. The other fluorides are almost insoluble in water. Since, on descending the group lattice energy decreases more rapidly than the hydration energy.

297. Which of the following alkaline earth metal hydroxides in amphoteric in character?

(a) $Be(OH)_2$ (b) $Ca(OH)_2$
(c) $Sr(OH)_2$ (d) $Ba(OH)_2$

BITSAT-2019

Ans. (a) : $Be(OH)_2$ (Beryllium hydroxide) is an amphoteric hydroxide which dissolve in both acids and alkalis.

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298. Dead burnt plaster is

(a) $CaSO_4.2H_2O$ (b) $MgSO_4.7H_2O$
(c) $CaSO_4.½H_2O$ (d) $CaSO_4$

Karnataka-CET-2018
BITSAT-2017

Ans. (d) : Dead burnt plaster is known as anhydrous calcium sulphate ($CaSO_4$). It is called as dead burnt because it does not set like Plaster of Paris when it is moisten with water.

299. The substance not likely to contain $CaCO_3$ is

(a) Marble statue (b) Calcined gypsum
(c) Sea shells (d) Dolomite

CG PET- 2013

Ans. (b) : The chemical formula of calcined gypsum is $CaSO_4.2H_2O$. Here, the chemical formula is not contains $CaCO_3$ group.

- The chemical name of marble statue is calcium carbonate ($CaCO_3$).
- The sea shells are made of calcium carbonate ($CaCO_3$)
- The chemical formula of dolomite is $CaCO_3.MgCO_3$.

300. The molecular formula of bleaching powder is

(a) $CaCl_2$ (b) Ca_2OCl_2
(c) $CaOCl_2$ (d) $CaCl_2.CaOCl$

CG PET -2007
JIPMER-2006

Ans. (c) : Calcium hypochlorite ($CaOCl_2$) is commonly known as bleaching powder.

301. Calcium carbide reacts with water to produce

(a) Methane (b) Ethane
(c) Ethylene (d) Acetylene

CG PET -2004

Ans. (d) : acetylene

$CaC_2 + 2H_2O \longrightarrow CH \equiv CH + Ca\,(OH)_2$

Calcium carbide on reacting with water gives acetylene.

302. In the reaction $3Mg + N_2 \rightarrow Mg_3N_2$

(a) Magnesium is reduced
(b) Magnesium is oxidised
(c) Nitrogen is oxidised
(d) None of the above

CG PET -2004

Ans. (b) : For the reaction–

$$3\overset{0}{Mg} + \overset{0}{N_2} \rightarrow \overset{+2}{Mg_3}\overset{-3}{N_2}$$

Let, x b the O.S. of Mg.

$\therefore\ 3x + 2\,(-3) = 0$

$x = +2$

And let, y be the O.S of N.

$\therefore 3(2) + 2x = 0$

or $x = -3$

Here, Mg is oxidized because oxidation state of Mg changes from 0 to +2. Nitrogen is reduced because oxidation state of N changes from 0 to –3.

303. When Zeolite which is hydrated sodium aluminum silicate is treated with hard water, the sodium ions are exchanged with which of the following ions?

(a) H^+ (b) Mg^{2+}
(c) Cu^{2+} (d) SO_4^{2-}

HP CET-2018

Ans. (b) : The chemical formula of zeolite is $Na_2Al_2Si_2O_8$

Zeolite is treated with hard water. In reaction the sodium ions are exchange with Ca^{2+} and Mg^{2+} ions (present in hard water).

304. Which one of the following alkaline earth metal sulphates has its hydration enthalpy greater than its lattice enthalpy?

(a) $CaSO_4$ (b) $BeSO_4$
(c) $BaSO_4$ (d) $SrSO_4$

[JEE Main-2015]

Ans. (b) : $BeSO_4$

Lattice energy of $BeSO_4$ is less than its hydration enthalpy. Hence, it is highly soluble in water.

On moving down the group, the solubility of alkaline earth metal sulphates decreases. Thus barium sulphate and radium sulphate are practically insoluble.

305. Which of the following on thermal decomposition yields a basic as well as acidic oxide?

(a) $NaNO_3$ (b) $KClO_3$
(c) $CaCO_3$ (d) NH_4NO_3

[AIEEE-2012]

Ans. (c) $CaCO_3$ is the only compound which on thermal decomposition gives both acidic as well as basic compound. Here CaO is basic oxide.

It is processed in which a compound breaks into two or more products when the heat is supplied.

This reaction is used for the production of oxygen.

This reaction is also used for production of acidic as well as basic oxides

$$CaCO_3 \xrightarrow{\Delta} \underset{\text{(Basic oxide)}}{CaO} + \underset{\text{(Acidic oxide)}}{CO_2}$$

306. One mole of magnesium nitride on reaction with an excess of water gives

(a) One mole of ammonia
(b) One mole of nitric acid
(c) Two moles of ammonia
(d) Two moles of nitric acid

[AIEEE-2004]

Ans. (c) : Two moles of ammonia

Formula of magnesium nitride

The formula for magnesium nitride will be $Mg_3\,N_2$

Reaction of magnesium nitride with excess of water

$Mg_3N_2 + 6H_2O \longrightarrow 3Mg\,(OH)_2 + 2NH_3$

307. The solubilities of carbonates decrease down the magnesium group due to a decrease in

(a) Lattice energies of solids
(b) Hydration energies of cations
(c) Inter ionic attraction
(d) Entrophy of solution formation

[AIEEE-2003]

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Ans. (b) : Hydration energy should be greater than lattice energy.
The solubilities of carbonates decrease down the magnesium group due to a decrease in the hydration energy of the cation.

308. The substance used in Holmes signals of the ship is a mixture of
(a) $CaC_2 + Ca_3P_2$ (b) $Ca_3(PO_4)_4 + Pb_3O_4$
(c) $H_3PO_4 + CaCl_2$ (d) $NH_3 + HOCl$
[AIEEE-2003]

Ans. (a) : $CaC_2 + Ca_3P_2$
The spontaneous combustion of phosphine is technically used in holme's signals. Containers containing CaC_2 & Ca_3P_2 are pierced and thrown in the sea when the gases evolved burn and serve as a signal. It is also used in smoke screens.

309. A metal M forms water soluble sulphate MSO_4 and inert MO. MO in aqueous solution forms insoluble $M(OH)_2$, which is soluble in NaOH. Metal M is
(a) Be (b) Mg
(c) Ca (d) Sr
[AIEEE-2002]

Ans. (a) Beryllium form Berillium sulfate ($Be(OH)_2$) which is water insoluble
Berillium form Berillium oxide (BeO) which becomes inert on heating $Be(OH)_2$ being amphoteric reacts with NaOH

310. The correct sequence of thermal stability of the following carbonates is
(a) $BaCO_3 < CaCO_3 < SrCO_3 < MgCO_3$
(b) $MgCO_3 < CaCO_3 < SrCO_3 < BaCO_3$
(c) $MgCO_3 < SrCO_3 < CaCO_3 < BaCO_3$
(d) $BaCO_3 < SrCO_3 < CaCO_3 < MgCO_3$
[JEE Main-2019, 12 April Shift-I]

Ans. (b) : $MgCO_3 < CaCO_3 < SrCO_3 < BaCO_3$
The thermal stability of alkaline earth metals carbonates increases down the group because down the group polarizing power of cation decreases, So thermal stability increases.

311. The alkaline earth metal nitrate that does not crystallise with water molecules, is
(a) $Ca(NO_3)_2$ (b) $Sr(NO_3)_2$
(c) $Ba(NO_3)_2$ (d) $Mg(NO_3)_2$
[JEE Main-2019, 9 Jan Shift-I]

Ans. (c) : Smaller the size of alkaline earth metals, greater is the tendency of their nitrate to crystallise with water molecule. Since Ba is the biggest among alkaline earth metal so its nitrate does not crystallse with water molecule.

312. The metal used for making X-ray tube window is
(a) Na (b) Be
(c) Mg (d) Ca
[JEE Main-2019, 10 Jan Shift-I]

Ans. (b) : Be metal is used in X-ray window because it is transparent to X-rays.

313. The amphoteric hydroxide is
(a) $Be(OH)_2$ (b) $Ca(OH)_2$
(c) $Sr(OH)_2$ (d) $Mg(OH)_2$
[JEE Main-2019, 11 Jan Shift-I]

Ans. (a) : $Be(OH)_2$
An amphoteric hydroxide is one that can react with acid as well as a base
Metal hydroxides are usually basic where as that of non-metals are acidic.
Beryllium shows the diagonal relationship with Aluminium.
Therefore, like Aluminium its hydroxide is also amphoteric in nature.

314. When gypsum is heated to 393 K, it forms :
(a) Dead burnt plaster (b) $CaSO_4. 0.5H_2O$
(c) $CaSO_4.5H_2O$ (d) Anhydrous $CaSO_4$
[JEE Main-2020, 8 Jan Shift-I]

Ans. (b) : The chemical formula of gypsum is $CaSO_4. 2H_2O$.
When gypsum is heated to 393K, it forms, plaster of Paris $CaSO_4.0.5H_2O$
The reaction is as follows
$CaSO_4. 2H_2O \xrightarrow[393K]{\Delta} CaSO_4.0.5H_2O$

315. A metal (A) on heating in nitrogen gas gives compounds B. B on treatment with H_2O gives a colourless gas, which when passed through $CuSO_4$ solution gives a dark blue-violet coloured solution. A and B respectively, are
(a) Na and Na_3N (b) Mg and Mg_3N_2
(c) Mg and $Mg(NO_3)_2$ (d) Na and $NaNO_3$
[JEE Main-2020, 8 Jan Shift-II]

Ans. (b) : The given metal is Mg. It gives Mg_3N_2 when heated with nitrogen gas.
$3Mg + N_2 \xrightarrow{\Delta} Mg_3N_2$
Mg_3N_2 on treating with water gives colourless ammonia.
$Mg_3N_2 + 6H_2O \longrightarrow 3Mg(OH)_2 + 2NH_3$
Ammonia reacts with $CuSO_4$ to form blue complex $\left[Cu(NH_3)_4\right]SO_4$.
$CuSO_4 + 4NH_3 \longrightarrow \left[Cu(NH_3)_4\right]SO_4$

316. The covalent alkaline earth metal halide (X = Cl, Br, I) is
(a) SrX_2 (b) CaX_2
(c) MgX_2 (d) BeX_2
[JEE Main-2019, 8 April Shift-II]

Ans. (d) : According to the Fajan's rule, the covalent character is directly proportional to the no. of charge of cation and inversely proportional to size of cation.
As we move down the group in the alkaline earth metal the ionic characteristics increases and the covalent characteristics decreases.

317. Magnesium powder burns in air to give
(a) MgO and Mg_3N_2
(b) $Mg(NO_3)_2$ and Mg_3N_2
(c) MgO only
(d) MgO and $Mg(NO_3)_2$
[JEE Main-2019, 9 April Shift-I]

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Ans. (a) : MgO and Mg_3N_2 Magnesium powder burns in air to give MgO and Mg_3N_2 MgO does not combine with excess oxygen to given any superoxide. Mg reacts with nitrogen to form magnesium nitride (Mg_3N_2)

$Mg + O_2 \rightarrow MgO$

$3Mg + N_2 \rightarrow Mg_3N_2$

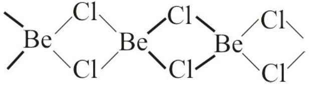
318. The structures of beryllium chloride in the solid state and vapour phase, respectively are

(a) dimeric and dimeric (b) chain and chain

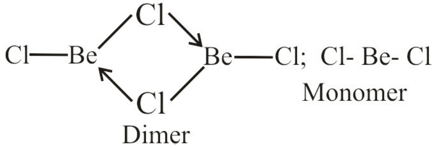
(c) dimeric and chain (d) chain and dimeric

[JEE Main-2019, 9 April Shift-II]

Ans. (d) In solid state, $BeCl_2$ has polymeric chain structure with chlorine bridge.



In vapour phase, it forms a chloro bridged dimer which dissociates into the linear monomer at high temperature (at nearly 1200K).



319. The major component/ ingredient of Portland cement is

(a) tricalcium aluminate (b) tricalcium silicate

(c) dicalcium aluminate (d) dicalcium silicate

[JEE Main-2021, 31 Aug Shift-I]

Ans. (b) : Major component of portland cement is "Tricalcium silicate (51%, 3 CaO. SiO_2)

320. The number of water molecules in gypsum, dead burnt plaster and plaster of Paris, respectively are

(a) 2,0 and 1 (b) 0.5, 0 and 2

(c) 5, 0 and 0.5 (d) 2, 0 and 0.5

[JEE Main-2021, 27 Aug Shift-I]

Ans. (d) : (i) Gypsum $-CaSO_4.2H_2O$

(ii) Dead burnt plaster – $CaSO_4$

(iii) Plaster of Paris $-CaSO_4\frac{1}{2}H_2O$

$\therefore$The number of water molecules in gypsum, dead burnt plaster and plaster of Paries are respectively. 2,0 and 0.5,

321. Given below are two statements: One is labelled as Assertion (A) and the other is labelled as Reason (R).

Assertion (A): Barium carbonate is insoluble in water and is highly stable.

Reason (R): The thermal stability of the carbonates increases with increasing cationic size.

(a) Both (A) and (R) are true and (R) is the correct explanation of (A).

(b) (A) is true but (R) is false.

(c) Both (A) and (R) are true and (R) is not the true explanation of (A).

(d) (A) is false but (R) is true.

[JEE Main-2021, 26 Aug Shift-II]

Ans. (a) : Carbonates of alkaline earth metals are insoluble in water and can be precipitated by addition of a sodium or ammonium carbonate solution to a solution of a soluble salt of these metals. The solubility of carbonates in water decreases as the atomic number of the metal ion increases. Beryllium carbonate is unstable and can be kept only in the atmosphere of CO_2. The thermal stability increases with increasing cationic size.

322. What are the products formed in sequence when excess of CO_2 is passed in slaked lime?

(a) $Ca(HCO_3)_2$, $CaCO_3$

(b) $CaCO_3$, $Ca(HCO_3)_2$

(c) CaO, $Ca(HCO_3)_2$

(d) CaO, $CaCO_3$

[JEE Main-2021, 26 Aug Shift-I]

Ans. (b) : $CaCO_3, Ca(HCO_3)_2$

$$Ca(OH)_2 + CO_2 \longrightarrow CaCO_3 \downarrow + H_2O$$

$$CaCO_3\downarrow + CO_2 + H_2O \longrightarrow \underset{\text{Water soluble}}{Ca(HCO_3)_2}$$

323. The conversion of hydroxyapatite occurs due to presence of F^- ions in water. The correct formula of hydroxyapatite is

(a) $[3Ca_3(PO_4)_2Ca(OH)_2]$ (b) $[3Ca(OH)_2CaF_2]$

(c) $[Ca_3(PO_4)_2CaF_2]$ (d) $[3Ca_3(PO_4)_2CaF_2]$

[JEE Main-2021, 26 Aug Shift-I]

Ans. (a) : $\left[3Ca_3(PO_4)_2Ca(OH)_2\right]$

The F^- ions make the enamel on teeth much harder by Converting hydroxyapatite, $\left[3(Ca_3(PO_4)_2\right].Ca(OH)_2\right]$, the enamel on the surface of the teeth into much hander fluroappatite. $\left[3Ca_3(PO_4)_2.CaF_2\right]$

324. Match list- with List-II.

	List-I		List-II
A.	$Ca(OCl)_2$	(i)	Antacid
B.	$CaSO_4 . \frac{1}{2} H_2O$	(ii)	Cement
C.	CaO	(iii)	Bleach
D.	$CaCO_3$	(iv)	Plaster of Paris

Choose the most appropriate answer from the options given below.

	A	B	C	D
(a)	(i)	(iv)	(iii)	(ii)
(b)	(iii)	(ii)	(iv)	(i)
(c)	(iii)	(iv)	(ii)	(i)
(d)	(iii)	(ii)	(i)	(iv)

[JEE Main-2021, 18 March Shift-I]

Ans. (c) :

S.no.	List-I	S.no.	List-II
(A)	$Ca(OCl)_2$	(i)	Bleach
(B)	$CaSO_4\frac{1}{2}H_2O$	(ii)	Plaster of Paris
(C)	CaO	(iii)	Cement
(D)	$CaCO_3$	(iv)	Antacid

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325. One of the by-products formed during the recovery of NH_3 from solvay process is

(a) $Ca(OH)_2$ (b) $NaHCO_3$

(c) $CaCl_2$ (d) NH_4Cl

JEE Main-2021, 17 March Shift-II

BITSAT-2015

Ans. (c) : Calcium hydroxide is reacted with the ammonium chloride separated out of the carbonating tower by filtration.

$$Ca(OH)_2 + 2NH_4Cl \longrightarrow CaCl_2 + 2H_2O + 2NH_3$$

- This process is also termed as ammonia recovery. Ammonia is recycled back into the process to form ammoniated brine.
- $CaCl_2$ is formed as a by-product of the Solvay process.

326. Given below are two statements.

Statement I Both $CaCl_2.6H_2O$ and $MgCl_2.8H_2O$ undergo dehydration on heating.

Statement II BeO is amphoteric, whereas the oxides of other elements in the same group are acidic.

In the light of the above statements, choose the correct answer from the options given below.

(a) Statement I is false but statement II is true

(b) Both statement I and statement II are false

(c) Both statement I and statement II are true

(d) Statement I is true but statement II is false

[JEE Main-2021, 16 March Shift-I]

Ans. (b) : Both statement I and statement II are false.

$$CaCl_2.6H_2O \xrightarrow{\Delta} CaCl_2 + 6H_2O$$

$$MgCl_2.6H_2O \longrightarrow MgCl(OH) + HCl + 5H_2O$$

The dehydration of $CaCl_2.\ 6H_2O$ can be achieved on heating undergoes hydrolysis $MgCl_2.\ 8H_2O$ on heating suffer hydrolysis.

Among alkaline earth metal, BeO is amphoteric and the rest are basic oxides.

327. Number of amphoteric compounds among the following is.......

(a) BeO (b) BaO

(c) $Be(OH)_2$ (d) $Sr(OH)_2$

[JEE Main-2021, 24 Feb Shift-I]

Ans. (a) : Both Beryllium compounds (BeO) and $Be(OH)_2$ are amphoteric in nature and compounds BaO and $Sr(OH)_2$ are basic in nature, they form alkaline solution in water.

328. The element with Z = 120 (not yet discovered) will be an/a

(a) transition metal

(b) inner-transition metal

(c) alkaline earth metal

(d) alkali metal

(JEE Main 2019, 12 Jan Shift-I)

Ans. (c) : The element with Z = 120 will be an alkaline earth metal. Recently oganesson (Og) with atomic number 118 is named by IUPAC is a noble gas and placed just two places before 120.

Z = 120 exist as an alkaline earth metal.

329. The alkaline earth metal sulphate which is most soluble in water among the following is

(a) $BaSO_4$ (b) $CaSO_4$

(c) $SrSO_4$ (d) $BeSO_4$

J & K CET-(2016)

Ans. (d) : Alkaline earth metal are also capable to form sulphates such as $BeSO_4$, $MgSO_4$. Beryllium sulphate and magnesium sulphate is soluble in water as compared to other sulphates of alkaline earth metals.

$BeSO_4$ is most soluble. As the size of the metal atom is less its solubility is more.

330. When powdered plaster of Paris is mixed with correct amount of water it sets into a solid mass of

(a) $CaSO_4.\ 5H_2O$ (b) $CaSO_4.\ 3H_2O$

(c) $CaSO_4.\ 2H_2O$ (d) $CaSO_4.1/2H_2O$

J & K CET-(2015)

Ans. (c) : The formula of plaster of Paris is $CaSO_4{\cdot}2H_2O$.

On mixing with water, plaster of paris takes up water of crystallization to form orthorhombic calcium sulphate dehydrate. This sets to a hard mass which is monoclinic calcium sulphate dehydrate on gypsum. This is the final product of setting of Plaster of Paris. Its composition is $CaSO_4.2H_2O$.

331. Calcium carbide on reaction with water yields

(a) Methane (b) ethane

(c) ethene (d) Acetylene

J & K CET-(2005)

J & K CET-(2014)

Ans. (d) : $CaC_2 + 2H_2O \rightarrow \underset{\text{Acetylene}}{CH \equiv CH} + Ca\ (OH)_2$

Calcium carbide on reacting with water gives Acetylene.

332. $CaC_2 + 2H_2O \rightarrow X + Ca(OH)_2$.

$$X + H_2O \xrightarrow{H_2SO_4 + HgSO_4 (60°C)} Y$$

Identify X and Y in the above reaction sequence.

(a) CH_4 and $H_2C = O$

(b) C_2H_2 and CH_3CHO

(c) C_2H_4 and CH_3COOH

(d) C_2H_4 and HCOOH

J & K CET-(1998)

Ans. (b) : $CaC_2 + 2H_2O \rightarrow C_2H_2 + Ca(OH)_2$

$$C_2H_2 + H_2O \xrightarrow{H_2SO_4 + HgSO_4 (60^\circ C)} CH_3CHO$$

333. Bleaching powder is obtained by treating chlorine with:

(a) $CaCO_3$ (b) $Ca(OH)_2$

(c) CaO (d) none of these

JIPMER-2008

JCECE-2007, 2003

NEET-1988

Ans. (b): Bleaching powder is obtained by treating chlorine with dry slaked lime on $Ca(OH)_2$.

$$\underset{\text{Dry slaked lime}}{Ca\ (OH)_2} + Cl_2 \rightarrow \underset{\text{Bleaching powder}}{CaOCl_2} + H_2O$$

@apna_pdf

334. Epsom salt is:

(a) $MgSO_4.2H_2O$ (b) $BaSO_4.2H_2O$
(c) $MgSO_4.7H_2O$ (d) $CaSO_4.2H_2O$

JCECE - 2003, 2007

Ans. (c): It is often encountered as the heptahydrate sulfate mineral epsomite commonly called Epsom salt $MgSO_4.\ 7H_2O$. It has enormous health benefits.

335. Which of the following carbonate decompose most easily on heating?

(a) Rb_2CO_3 (b) K_2CO_3
(c) Na_2CO_3 (d) $MgCO_3$

JCECE - 2003

Ans. (d): Alkali metal carbonates are not decomposed on heating

$$MgCO_3 \xrightarrow{\Delta} MgO + CO_2$$

336. Gypsum is :

(a) $CaSO_4 \cdot 2H_2O$ (b) $CaSO_4.\frac{1}{2}H_2O$
(c) $MgSO_4 \cdot 2H_2O$ (d) $CuSO_4$

JCECE - 2006
MHT CET-2012

Ans. (a) : The molecular formula of gypsum salt $CaSO_4.\ 2H_2O$. Gypsum is a soft sulfate mineral composed of calcium sulfate dehydrate, with the chemical formula $CaSO_4.2H_2O$. It is widely mined and is used as a fertilizer and as the main constituent in many forms of plaster, blackboard / sidewalk chalk, and drywall.

337. $CaC_2 + N_2 \rightarrow A$, product A is

(a) $CaCN_2$ (b) $CaCN_2$ and C
(c) $CaCN_2 + N_2$ (d) None of these

JCECE - 2008

Ans. (b) : The product obtained as a result of a reaction of nitrogen with the calcium carbide (CaC_2) is Calcium cyanide

The reaction takes place of temperature around 300°C to 350°C.

$$CaC_2 + N_2 \xrightarrow{300-350°C} Ca(CN)_2 + C$$

338. A nuclide of an alkaline earth metal undergoes radioactive decay by emission of three α-particles in succession. The group of the periodic table to which the resulting daughter element would belong is

(a) group 14 (b) group 16
(c) group 4 (d) group 6

JCECE - 2012

Ans. (a) : After decay of radioactive element, the last element (stable) Pb is obtained which belongs to group 14 of periodic table.

339. The difference of water molecules in gypsum and plaster of Paris is

(a) $\frac{5}{2}$ (b) 2
(c) $\frac{1}{2}$ (d) $1\frac{1}{2}$

JCECE - 2015

Ans. (d) : Formula of gypsum = $CaSO_4 \cdot 2H_2O$

Formula of Plaster of Paris = $CaSO_4 \cdot \frac{1}{2}H_2O$

Thus, difference of water molecule in gypsum and plaster of Paris

$$= 2H_2O - \frac{1}{2}H_2O = 1\frac{1}{2}H_2O$$

340. Which of the following alkaline earth metal sulphates has hydration enthalpy higher than the lattice enthalpy?

(a) $SrSO_4$ (b) $CaSO_4$
(c) $BeSO_4$ (d) $BaSO_4$

JCECE - 2015

Ans. (c) : Hydration energy decreases down the group, whereas lattice energy remains almost constant. Thus, hydration enthalpy is higher than the lattice enthalpy in the case of $BeSO_4$.

341. Which one of the following is present as an active ingredient in bleaching powder for bleaching action?

(a) $Ca(OCl)_2$ (b) CaO_2Cl
(c) $CaCl_2$ (d) $CaOCl_2$

JIPMER-2014

Ans. (a) : The molecular formula of bleaching powder is $Ca(ClO_2)_2$ Calcium hypochlorite is an inorganic compound with formula $Ca(OCl)_2$. It is the main active ingredient of commercial products called bleaching powder, chlorine powder, or chlorinated lime, used for water treatment as a bleaching agent.

$$3Ca(OH)_2 + 2Cl_2 \xrightarrow[35^{o}C]{below}$$

$$\underset{\text{Bleaching powder}}{Ca(OCl)_2.CaCl_2.Ca(OH)_2.2H_2O}$$

342. Which of the following compounds has the lowest melting point?

(a) $CaBr_2$ (b) CaI_2
(c) CaF_2 (d) $CaCl_2$

JIPMER-2014

Ans. (b) : As the size of the halogen increases from F to I covalent character increases from CaF_2 to CaI_2 and melting point decreases. So, CaI_2 has the lowest melting point.

Melting Points.	
CaF_2	1360°C
$CaBr_2$	730°C
$CaCl_2$	772°C
CaI_2	740°C

343. Which of the following metal carbonates decomposes on heating?

(a) $MgCO_3$ (b) Na_2CO_3
(c) K_2CO_3 (d) Rb_2CO_3

JIPMER-2012

Ans. (a) : $MgCO_3 \xrightarrow{Heat} MgO + CO_2$

The metal whose oxide is stable, it's carbonate is unstable.

@apna_pdf

344. BaO_2 and ozone reacts to produce

(a) Ba (b) Ba_2O_3

(c) BaO (d) $Ba(OH)_3$

JIPMER-2008

Ans. (c) : BaO_2 and ozone reacts to produce BaO and oxygen gas is liberated.

$$BaO_2 + O_3 \longrightarrow BaO + 2O_2$$

345. Which of the following ions, has smallest Size?

(a) Ca^{2+} (b) Cl^-

(c) S^{2-} (d) K^+

JIPMER-2004

Ans. (a) : In isoelectronic species ion with higher positive charge is considered to be the smallest in size and ion with highest negative charge is considered to be highest in size.

Hence, option (a) is the correct answer.

346. Which one of the following elements, is a component of a compound essential for photosynthesis?

(a) Iron (b) Calcium

(c) Barium (d) Magnesium

JIPMER-2004

Ans. (d) : Magnesium is found in chlorophyll, the green pigment, essential for photosynthesis. Chlorophyll is a green coloured pigment that is found in plants and help in photosynthesis.

347. Beryllium differs in properties from other elements of its own group but shows resemblance with aluminium because of

(a) relatively bigger ionic radius and high polarising power of Be

(b) relatively smaller ionic radius and high polarising power of Be

(c) relatively bigger ionic radius is the only reason behind this

(d) None of the above

JIPMER-2016

Ans. (b) : Relatively smaller ionic radius and high polarising power of Be because Beryllium (Be) differ in properties from elements of its own group due to relatively smaller ionic radius and high polarising power. Polarising powers of Be^{2+} and Al^{3+}.ions are almost the same, thus they show similarities in their properties.

348. The third ionization enthalpy is highest in

(a) Alkali metals

(b) Alkaline earth metals

(c) Chalcogens

(d) Pnictogens

Karnataka-CET-2021

Ans. (b) : Alkaline earth metal have ns^2 configuration. And after the removal of 2^{nd} electron, they get stable noble gas configuration.

349. The characteristic colours given by calcium, strontium and barium in the flame test are respectively:

(a) Brick red, apple green, crimson

(b) Crimson, apple green, brick red

(c) Crimson, brick red, apple green

(d) Brick red, crimson, apple green

(e) Applel green, brick red, crimson

Kerala-CEE-2004

Ans. (d) In flame the electrons are excited to higher energy levels and when they drop back to the ground state energy is emitted in the form of visible light. Hence, The characteristic colours given by calcium, strontium and barium in the flame test are respectively. Brick red, crimson, apple green

Calcium → Brick red
Strontium → Crimson
Barium → Apple green

350. The alkaline earth metal with the least density value is

(a) Mg (b) Be

(c) Sr (d) Ca

(e) Ba

Kerala-CEE-2012

Ans. (d) : Since Ca is a elements of II A group, the density of elements of II A group first decreases from Be to Ca and then steadily increases from Ca to Ba. Thus, Ca has the least density.

351. The carbon atoms in calcium carbide are held by

(a) Ionic bonds

(b) Two sigma bonds

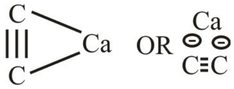
(c) Tow sigma and one coordinate bond

(d) One sigma and two π bonds

(e) One sigma and one π bond

Kerala-CEE-2019

Ans. (d) : The carbon atom in Calcium carbide (CaC_2). held together by one sigma and two π-bonds.



352. Which of the following statement is incorrect about beryllium?

(a) Beryllium hydroxide is amphoteric

(b) Beryllium compounds are largely covalent

(c) Beryllium is not easily attacked by acids

(d) Beryllium exhibit coordination number of six

(e) Beryllium hydroxide dissolves in excess of alkali to give a beryllate ion.

Kerala-CEE-2020

Ans. (d) : Be $(OH)_2$ is an amphoteric hydroxide, reacts with both acid and base. Beryllium is having only 4 valency in its valence orbital. Hence, it can not exceed to octet and show only six coordination number.

353. When CO_2 is passed through solution of calcium hydroxide, which one of the following compound is precipitated?

(a) $Ca(HCO_3)_2$ (b) CaO

(c) $CaCO_3$ (d) $Ca(OH)_2$

Manipal-2019

@apna_pdf

Ans. (c) :

$$\mathrm{Ca(OH)_2(aq) + CO_2(g) \longrightarrow CaCO_3(s) + H_2O}$$

When carbon dioxide is passed through lime water, it turns milky due to formation of white precipitate in form of calcium carbonate.

354. The property of the alkaline earth metals which increases with their atomic number?

(a) Ionisation energy
(b) Electronegativity
(c) Solubility of their hydroxides in water
(d) Solubility of their sulphates in water

Manipal-2016
NEET-2010
Karnataka-CET-2021
Kerala-CEE-29.08.2021

Ans. (c) : The alkaline earth metal contains the following element such as Be, Mg, Ca, Sr, Ba, Ra. In the group, when we move up to down the ionization potential, electronegativity decreases with increasing the atomic number but the solubility of their hydroxide increases in water.

355. Which among the following elements of group-2 exhibits anomalous properties?

(a) Be (b) Mg
(c) Ca (d) Ba

MHT CET-2018

Ans. (a) : Beryllium (Be) because of its exceptionally small atomic and ionic size, high ionisation enthalpy and non-availability of d-orbital in its valence shell represents anomalous behavior than rest of the members of group-2.

Some anomalous properties of Be –

- It forms bonds having appreciable covalent character.
- It forms amphoteric hydroxide while other elements form basic hydroxide.
- It forms coordination complexes .

356. Which of the following statements if false?

(a) Ca^{2+} ions are not important in maintaining the regular beating of the heart.
(b) Mg^{2+} ions are important in the green parts of the plants
(c) Mg^{2+} ions form a complex with ATP.
(d) Ca^{2+} ions are important in blood clotting.

NEET-I 2016

Ans. (a) : Ca^{2+} ions are not important in maintaining the regular beating of the heart.

- Calcium ions play on important role in muscle contraction that is why it is important for maintaining heartbeats.
- Ca^{2+} ion are required to trigger the contraction of muscles and to maintain the regular beating of the heart.

Option (b)

- Magnesium ions are centrally located in the chlorophyll structure, that is why magnesium is important in the green parts of plants and plays an important role in photosynthesis.

Option (c)

- Magnesium ions are associated with ATP to form a complex which together makes adenosine triphosphate stable.

Option (d)

- Calcium ions play an important role in the pathway of activation of protein factors responsible for blood clotting.

357. Which of the following metal ions play an important role in muscle contraction?

(a) K^+ (b) Na^+
(c) Mg^{2+} (d) Ca^{2+}

NEET-1994

Ans. (d) : Muscle contraction is regulated by Ca^{2+} ion, which will change thin filament into activated state. The binding of calcium to the troponin changes its shape so that the myosin binding sites on the actin (thin filaments) are exposed causing a muscle contraction.
Hence, calcium ion Ca^{2+} play an important role in muscles contraction.

358. Among the statements (I-IV), the correct ones are:

(I) Be has smaller atomic radius compared to Mg.
(II) Be has higher ionisation enthalpy than Al.
(III) Charge/radius ratio of Be is greater than that of Al.
(IV) Both Be and Al form mainly covalent compounds.

(a) (II), (III) and (IV) (b) (I), (II) and (IV)
(c) (I), (III) and (IV) (d) (I), (II) and (III)

[JEE Main-2020, 3 Sep Shift-II]

Ans. (b) : Charge / radius ratio of Be and Al is same because of diagonal relationship.

359. An alkaline earth metal 'M' readily forms water soluble sulphate and water insoluble hydroxide. Its oxide MO is very stable to heat and does not have rock-salt structure. M is

(a) Sr (b) Ca
(c) Be (d) Mg

[JEE Main-2020, 4 Sep Shift-II]

Ans. (c) : Water soluble sulphate and water insoluble hydroxide is 'Be'. BeO does not have rock-salt structure.

360. Among the sulphates of alkaline earth metals, the solubilities of $BeSO_4$ and $MgSO_4$ in water, respectively, are

(a) poor and poor (b) high and poor
(c) high and high (d) poor and high

[JEE Main-2020, 6 Sep Shift-I]

Ans. (c) : Due to high hydration energy of $BeSO_4$ and $MgSO_4$, their solubility in water will be high.
Order of solubility of sulphate of alkaline earth metals are–

$$\mathrm{BeSO_4 > MgSO_4 > CaSO_4 > SrSO_4 > BaSO_4}$$

@apna_pdf

361. The product obtained as a result of a reaction of nitrogen with CaC_2 is

(a) $CaCN_3$ (b) Ca_2CN
(c) $Ca(CN)_2$ (d) $CaCN$

NEET-I 2016

Ans. (c): A reaction of nitrogen with calcium carbide (CaC_2) is calcium cyanide [$Ca(CN)_2$].

$$CaC_2 + N_2 \xrightarrow{300°C-350°C} Ca(CN)_2$$

362. Which one of the following is present as an active ingredient in bleaching powder for bleaching action?

(a) $CaOCl_2$ (b) $Ca(OCl)_2$
(c) CaO_2Cl (d) $CaCl_2$

NEET-2011

Ans. (b) : $Ca(OCl)_2$ is present as an active ingredient in bleaching power for bleaching action.

• The hypochlorite ion- OCl^- is the active ingredient in bleach/bleaching powder.

363. Match List-I with List-II for the compositions of substances and select the correct answer using the code given :

	List - I (Substances)	**List - II (Composition)**
(A)	**Plaster of Paris**	**(i) $CaSO_4 . 2H_2O$**
(B)	**Epsomite**	**(ii) $CaSO_4 . 1/2H_2O$**
(C)	**Kieserite**	**(iii) $MgSO_4 . 7H_2O$**
(D)	**Gypsum**	**(iv) $MgSO_4 . H_2O$**
		(v) $CaSO_4$

(a) (A)-(iii), (B)-(iv), (C)-(i) (D)-(ii)
(b) (A)-(ii), (B)-(iii), (C)-(iv) (D)-(i)
(c) (A)-(i), (B)-(ii), (C)-(iii) (D)-(v)
(d) (A)-(iv), (B)-(iii), (C)-(iii) (D)-(i)

NEET-2011

Ans. (b) : Correctly matched.

• Plaster of Paris → $CaSO_4 . ½ H_2O$
• Epsomite → $MgSO_4 . 7H_2O$
• Kieserite → $MgSO_4 . H_2O$
• Gypsum → $CaSO_4 . 2H_2O$

364. The compound A on heating gives a colorless gas and a residue that is dissolved in water to obtain B. Excess of CO_2 is bubbled through aqueous solution of B, C is formed which is recovered in the solid form. Solid C on gentle heating gives back A. The compound is

(a) $CaCO_3$ (b) Na_2CO_3
(c) K_2CO_3 (d) $CaSO_4 . 2H_2O$

NEET-2010

Ans. (a) : This is possible only when the compound a is $CaCO_3$ and the reactions are as follows:

$$CaCO_3 \xrightarrow{\Delta} \underset{\text{(Colourless gas)}}{CO_2} + \underset{\text{(residue)}}{CaO}$$

$$CaO + H_2O \longrightarrow \underset{(B)}{Ca(OH)_2} \xrightarrow[\text{(excess)}]{CO_2} \underset{(C)}{Ca(HCO_3)_2} \xrightarrow{\Delta} CaCO_3$$

The compound is calcium carbonate ($CaCO_3$)

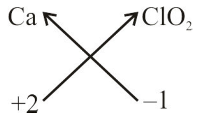
365. Which of the following represents calcium chlorite?

(a) $Ca(ClO_3)_2$ (b) $Ca(ClO_2)_2$
(c) $CaClO_2$ (d) $Ca(ClO_4)_2$

NEET-1996

Ans. (b) : The valency of calcium is 2 and a chlorite ion is ClO_2^- (–1).

We can use criss-cross method to write the chemical formula.



The Chemical formula of calcium chlorite is $Ca(ClO_2)_2$

366.Which of the following statement is false?

(a) Strontium decomposes water readily than beryllium
(b) Barium carbonate melts at a higher temperature than calcium carbonate.
(c) Barium hydroxides is more soluble in water than magnesium hydroxide.
(d) Beryllium hydroxide is more basic than barium hydroxide

NEET-1994

Ans. (d) : $Be(OH)_2$ is amphoteric, but the hydroxides of other alkaline earth metals are basic. The size of beryllium is very small and the hydroxide formed by it. So its hydroxide is less basic than barium hydroxide.

367. Magnesium reacts with an element (X) to form an ionic compound. If the ground state electronic configuration of (X) is $1s^2 2s^2 2p^3$, the simplest formula for this compound is

(a) Mg_2X_3 (b) MgX_2
(c) Mg_2X (d) Mg_3X_2

NEET-2018

Ans. (d) : Magnesium is an alkaline earth metal and forms Mg^{2+}ion.

Element (X) electronic configuration is $1s^2$, $2s^2$, $2p^3$.

The charges on cation and anion will be balanced when $3Mg^{2+}$ ions will combine with $2X^{-3}$ ions to form Mg_3X_2.

368. Compared with the alkaline earth metals, the alkali metals exhibit

(a) Smaller ionic rain
(b) Highest boiling points
(c) Greater hardness
(d) Lower ionization energies.

NEET-1990

Ans. (d) : Alkali metals have the lowest ionisation enthalpy in each period because alkali metals are largest in their respective periods and therefore the valency electrons are loosely held by the nucleus. Their atomic size is greater and hence, it is easy to pull out an electron from outer-most shell.

369. Which of the following atoms will have the smallest size?

(a) Mg (b) Na
(c) Be (d) Li

NEET-1989

Ans. (c) : The atomic size increases down the group and decreases in period from left to right.

Therefore, Li > Be and Na > Mg. Overall order Na > Mg > Li > Be. Thus, Be has smallest size.

370. The structures of beryllium chloride in solid state and vapour phase are

@apna_pdf

(a) Chain in both
(b) Chain and dimer, respectively
(c) Linear in both
(d) Diner and linear, respectively

NEET-2021

Ans. (b) : The structure of beryllium chloride in the solid state and vapour phase, respectively are chain and dimeric.

- $BeCl_2$ exist as $(BeCl_2)_n$ polymeric chain in solid form, while $BeCl_2$ exist as dimer $(BeCl_2)_2$ in vapour phase.

371. Among the following alkaline earth metal halides one which is covalent and soluble in organic solvents is

(a) Beryllium chloride
(b) Calcium chloride
(c) Strontium chloride
(d) Magnesium chloride

NEET-2021

Ans. (a) : Except for beryllium chloride, all other chloride of alkaline earth metals are ionic in nature. Due to high polarising power of Be^{2+} ion, all beryllium halides are predominantly covalent. They are soluble in organic solvents.

372. HCl was passed through a solution of $CaCl_2$, $MgCl_2$ and NaCl. Which of the following compound(s) crystallize(s)?

(a) Both $MgCl_2$ and $CaCl_2$
(b) Only NaCl
(c) Only $MgCl_2$
(d) NaCl, $MgCl_2$ and $CaCl_2$

NEET-2020

Ans. (b) : On the passing HCl through the mixture Cl^- ion concentration increases.

So, ionic product $[Na^+]$ $[Cl^-]$ becomes more than solubility product and NaCl will precipitate out.

Filtrate $\xrightarrow{\text{Ha gas passed}}$ Pure NaCl precipitation (common ion effect)

Calcium and magnesium chloride being more soluble than NaCl remain in the solution.

373. Which of the following is an amphoteric hydroxide?

(a) $Be(OH)_2$
(b) $Sr(OH)_2$
(c) $Ca(OH)_2$
(d) $Mg(OH)_2$

NEET-2019

Ans. (a) : $Be(OH)_2$ is amphoteric hydroxide, dissolving in both acids and alkalis.

$Be(OH)_2 + 2HCl \longrightarrow BeCl_2 + 2H_2O$ [Acid]

$Be(OH)2 + 2NaOH \longrightarrow Na_2[Be(OH)_4]$ [Base]

374. Among CaH_2, BeH_2, BaH_2, the order of ionic character is

(a) $BeH_2 < CaH_2 < BaH_2$
(b) $CaH_2 < BeH_2 < BaH_2$
(c) $BeH_2 < BaH_2 < CaH_2$
(d) $BeH_2 < BeH_2 < CaH_2$

NEET-2018

Ans. (a) : The order of ionic character is $BeH_2 < CaH_2 < BaH_2$

- For 2nd group hydrides, on moving down the group metallic character of metals increases. So ionic character of metal hydride increases.

375. On heating which of the following release CO_2 most easily?

(a) Na_2CO_3
(b) $MgCO_3$
(c) $CaCO_3$
(d) K_2CO_3

NEET-2015

Ans. (b) : On heating, $MgCO_3$, CO_2 released most easily. This is due to the small size of the resulting oxide ion.

$$MgCO_3 \xrightarrow{\Delta} MgO + CO_2$$

376. Solubility of the alkaline earth metal sulphates in water decreases in the sequence

(a) Sr > Ca > Mg > Ba
(b) Ba > Mg > Sr > Ca
(c) Mg > Ca > Sr > Ba
(d) Ca > Sr > Ba > Mg

NEET-2016

Ans. (c) : The solubility of the sulphates decreases as we go down the group of alkaline earth metals.
The decreasing order of sulphates is Mg > Ca > Sr > Ba.

377. Which of the following compounds has the lowest melting point?

(a) $CaCl_2$
(b) $CaBr_2$
(c) CaI_2
(d) CaF_2

NEET-2011

Ans. (c) : When the size of anion increases then covalent character also increases, so their melting points decreases. Melting point $CaF_2 > CaCl_2 > CaBr_2 > CaI_2$
Therefore, CaI_2 has the lowest melting point.

378. Which of the following alkaline earth metal sulphates has hydration enthalpy higher than its lattice enthalpy?

(a) $CaSO_4$
(b) $BeSO_4$
(c) $BaSO_4$
(d) $SrSO_4$

NEET-2010

Ans. (b) : Among alkaline earth metals, lattice enthalpy remain almost constant but hydration enthalpy decrease down the group. In case of large size anion such as SO_4^{2-} and the small changes in cation size does not alter the lattice energy, i.e. lattice energies are about the same. Thus $BasO_4$ has higher hydration energy as compared to lattice enthalpy.

379. Which one of the following compounds is a peroxide?

(a) KO_2
(b) BaO_2
(c) MnO_2
(d) NO_2

NEET-2010

Ans. (b) : In peroxides, the oxidation state of O is –1 and they give H_2O_2, with dilute acids, and have peroxide linkage.

In BaO_2, $+ 2 + (x \times 2) = 0$
$x = -1$

Thus, it is peroxide only it gives H_2O_2 when reacts with dilute acids and has peroxide linkage as Ba^{2+}[O-O].

380. Which of the following oxides is not expected to react with sodium hydroxide?

(a) CaO
(b) SiO_2
(c) BeO
(d) B_2O_3

NEET-2009

Ans. (a) : Generally acids react with bases and bases react with acids.

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Among give options BeO is an amphoteric oxide while B_2O_3 and SiO_2 are acidic oxides.
Thus all of them react with NaOH to form salts. CaO on the other hand is a basic oxide and hence with NaOH.

381. The correct order of increasing thermal stability of K_2CO_3, $MgCO_3$, $CaCO_3$ and $BeCO_3$ is

(a) $BeCO_3 < MgCO_3 < CaCO_3 < K_2CO_3$
(b) $MgCO_3 < BeCO_3 < CaCO_3 < K_2CO_3$
(c) $K_2CO_3 < MgCO_3 < CaCO_3 < BeCO_3$
(d) $BeCO_3 < MgCO_3 < K_2CO_3 < CaCO_3$

NEET-2007

Ans. (a) : The thermal stability of carbonate increases down the group and decreases as we move from left to right in a period, so the correct order is:

$$BeCO_3 < MgCO_3 < CaCO_3 < K_2CO_3$$

382. In which of the following the hydration energy is higher than the lattice energy?

(a) $MgSO_4$ (b) $BaSO_4$
(c) $SrSO_4$ (d) $CaSO_4$

NEET-2007

Ans. (a) : $MgSO_4$ has a higher hydration energy than lattice energy and is thus the most soluble out of the given alkaline earth metal sulphates.

383. The solubility in water of sulphate down the Be group is Be > Mg > Ca > Sr > Ba. This is due to

(a) Decreasing lattice energy
(b) High heat of salvation for smaller ions like Be^{2+}
(c) Increase in melting points
(d) Increasing molecular weight

NEET-1995

Ans. (b) : The solubility of an ionic compound depends upon two factor, lattice energy and hydration energy. The hydration energy decreases from Be^{2+} to Ba^{2+} due to decreases in charge density. This cause the decrease in the solubility's of the sulphate in this order.

In order words the solubility's decreases with increase in the ionic size. So we can say that the solubility in water of sulphate down the be group.

Be > Mg > Ca > Sr > Ba is due to the high heat solvation for smaller ions like Be^{2+}.

384. Crude sodium chloride obtained by crystallization of brine solution does not contain

(a) $MgSO_4$ (b) Na_2SO_4
(c) $MgCl_2$ (d) $CaSO_4$

NEET-Odisha 2019

Ans. (a) : Crude NaCl obtained by crystallization of brine solution contains.

Na_2SO_4, $CaCl_2$, $MgCl_2$, and $CaSO_4$.

Crude sodium chloride obtained by crystallization of brine solution does not contain $MgSO_4$.

385. Which of the following groups of ions makes the water hard?

(a) Sodium and bicarbonate
(b) Magnesium and chloride
(c) Potassium and sulphate
(d) Ammonium and chloride

NEET-1994

Ans. (b) : Hard water has high mineral content it is formed when water percolates through the deposits of chalk and limestone which are made up of magnesium and calcium carbonates. It does not lather with soap.

386. Which of the following metal evolves hydrogen on reacting with cold dilute HNO_3?

(a) Mg (b) Al
(c) Fe (d) Cu

NEET-1989

Ans. (a) : Magnesium metal reacts with dilute nitric acid to form magnesium nitrate and hydrogen gas.

$$Mg + HNO_3 \rightarrow Mg(NO_3)_2 + H_2(g)$$

387. Electronic configuration of calcium atom can be written be

(a) $[Ne]4p^2$ (b) $[Ar]4s^2$
(c) $[Ne]4s^2$ (d) $[Kr]4p^2$

NEET-1992

Ans. (b) : To write an electronic configuration of an atom, it is better if we remember the atomic number of noble gases and the orbital's follow the noble gas.

An atomic number of calcium = 20

The nearest noble configuration of calcium is $1s^2$ $2s^2$ $2p^6$ $3s^2$ $3p^6$ = 18 (Argon)

Hence, the electronic configuration of Ca = $[Ar]4s^2$

388. Which of the following compounds contains Mg ion?

(a) Haemoglobin (b) Vitamin B_{12}
(c) Ascorbic acid (d) Chlorophyll

Tripura JEE-2019

Ans. (d) : The chlorophyll molecule the central ion is magnesium and the large organic molecule is a porphyrin.

The porphyrin contains four nitrogen atoms that form bonds to magnesium in a square planer arrangement.

389. In aqueous solution, the most stable sulphate is

(a) $BeSO_4$ (b) $MgSO_4$
(c) $CaSO_4$ (d) $BaSO_4$

UP CPMT-2010

Ans. (d): Solubility of any salt is governed by two factors;

(i) Lattice energy, (ii) Hydration energy.

Among the sulphates of alkaline earth metals, the magnitude of lattice energy remains almost constant because of the large size of sulphates ion. The hydration energy, however, decreases from Be^{2+} to Ba^{2+}. Thus, the solubility of sulphates of alkaline earth metals decreases from Be^{2+} to Ba^{2+}. In other words, $BaSO_4$ is most stable in aqueous solution.

390. Element with atomic number 38. Belongs to

(a) II A group and 5th period
(b) II A group and 2nd period
(c) V A group and 2nd period
(d) III A group and 5th period

UP CPMT-2008

Ans. (a): The electronic configuration = 38

X (38) : $1s^2$, $2s^2$, $2p^6$, $3s^2$ $3p^6$, $4s^2$ $3d^{10}$ $4p^6$, $5s^2$

Or $1s^2$, $2s^2$, $2p^6$, $3s^2$, $3p^6$, $3d^{10}$,$4s^2$ $4p^6$, $5s^2$

Hence, it is belongs to II A group and 5th period. It is strontium (Sr).

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391. Blue vitriol is

(a) $MgSO_4 \cdot 5H_2O$ (b) $CuSO_4 \cdot 5H_2O$
(c) $CaSO_4 \cdot 5H_2O$ (d) $ZnSO_4 \cdot 5H_2O$

UP CPMT-2006

Ans. (b) : $CuSO_4 \cdot 5H_2O$ is blue vitriol. It is a blue crystalline substance soluble in water.

- The blue vitriol is also known as the Cu(II) sulphate pentahydrate or crystalline copper sulphate.

392. Bleaching action of $CaOCl_2$ is due to

(a) Nascent oxygen (b) Chlorine
(c) HClO (d) HCl

UPTU/UPSEE-2014, UP CPMT-2006

Ans. (a) :

$$2CaOCl_2 + H_2SO_4 \text{ (limited)} \rightarrow CaCl_2 + CaSO_4 + 2HClO$$

$$HClO \rightarrow HCl + [O]$$

On account of evalution of nascent oxygen. It acts as an oxidizing and bleaching agent.

393. Which has smallest size?

(a) Na^+ (b) Mg^{2+}
(c) Ne (d) O^{2-}

UP CPMT-2005

Ans. (b): Among isoelectronic species decreases with increase in nuclear charge.

	Mg^{2+}	Na^+	Ne	O^{2-}
No. of electron	10	10	10	10
Nuclear charge	+12	+11	+10	+8

$\therefore Mg^{2+} < Na^+ < Ne < O^{2-}$

$\therefore$ Mg^{2+} has smallest size.

394. Which alkaline earth metal compound is volatile?

(a) Mg_3N_2 (b) Ca_3N_2
(c) Be_3N_2 (d) None of the option

UPTU/UPSEE-2017

Ans. (c) : Be_3N_2 is volatile due to greater tendency of covalent character in Be and N atoms.

395. Alkaline earth's metals are denser than alkli metals, because metallic bonding in alkaline earth's metal is

(a) Stronger (b) Weaker
(c) Volatile (d) Not present

UPTU/UPSEE-2012

Ans. (a) : Alkaline earth's metals are denser than alkli metals, because metallic bonding in alkaline earth's metal is stronger.

396. You may have noticed that chicken-egg is very strong along its long axis so much so that it does not break even when pressed very hard. Which of the following is the main constituent of egg-shell?

(a) $CaSO_4.2H_2O$ (b) $CaSO_4.\frac{1}{2}H_2O$
(c) $CaSiO_3$ (d) $CaCO_3$

UPTU/UPSEE-2011

Ans. (d) : The chicken egg shell is 95-97% calcium carbonate crystals, which are stabilized by protein matrix.

Chicken egg is very strong along its long axis with $CaCO_3$ as main constituent.

397. The chemical which is used for plastering the broken bones is

(a) $(CaSO_4)_2\, H_2O$ (b) $MgSO_4 \cdot 7H_2O$
(c) $FeSO_4 \cdot 7H_2O$ (d) $CuSO_4 \cdot 5H_2O$

UPTU/UPSEE-2009

Ans. (a) : Plaster of Paris $(CaSO_4)_2\, H_2O$ is a chemical compound. It is used to joint fracture bones and keeping them immobilize. A compound of calcium is used for immobilizing the fractured bones of body.

398. Diacidic base is

(a) $CH_2(OH)_2$ (b) $Ca(OH)_2$
(c) $CH_3CH(OH)_2$ (d) All of these

UPTU/UPSEE-2009

Ans. (b) : A diacidic base is a base that produces two hydroxide ions when one of its molecules undergoes complete ionization.

Only $Ca(OH)_2$ has two hydroxide ions. Thus, $Ca(OH)_2$ is a diacidic base.

399. Plaster of Paris on making paste with little water sets to hard mass due to formation of

(a) $CaSO_4$ (b) $CaSO_4 \cdot 1/2H_2O$
(c) $CaSO_4 \cdot H_2O$ (d) $CaSO_4 \cdot 2H_2O$

UPTU/UPSEE-2008

Ans. (d) : Plaster of Paris (Calcium sulphate) is not water soluble. So, when the Plaster of Paris comes in contact with water it sets to a hard mass.

$$\underset{\text{(Plaster of Paris)}}{CaSO_4 \frac{1}{2}H_2O} + \frac{3}{2}H_2O \rightarrow \underset{\text{Gypsum (Hard mass)}}{CaSO_4.2H_2O}$$

400. Which one of the following processes is used for the manufacture of calcium?

(a) Reduction of CaO with carbon
(b) Reduction of CaO with hydrogen
(c) Electrolysis of a mixture of anhydrous $CaCl_2$ & KCl
(d) Electrolysis of molten $Ca(OH)_2$

WB-JEE-2008

Ans. (c) : Calcium is obtained by electrolysis of a fuse of $CaCl_2$ and KCl at nearly 700°C is an electrolytic cell made of graphite anode and iron cathode.

$$CaCl_2 \rightleftharpoons Ca^{2+} + 2Cl$$

At anode-

$$2Cl^- \rightarrow Cl_2 + 2e^-$$

At cathode-

$$Ca^{2+} + 2e^- \rightarrow Ca$$

401. Chlorine gas reacts with red hot calcium oxide to give

(a) Bleaching powder and dichlorine monoxide
(b) Bleaching powder and water
(c) Calcium chloride and chlorine dioxide
(d) Calcium chloride and oxygen

WB-JEE-2013

Ans. (d) $2CaO + 2Cl_2 \xrightarrow{\text{red hot}} 2CaCl_2 + O_2 \uparrow$.

Chlorine gas reacts with red hot calcium oxide to give Calcium Chloride and Oxygen gas.

402. The decreasing order of basic character of K_2O, BaO, CaO and MgO is

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(a) $K_2O > BaO > CaO > MgO$
(b) $K_2O > CaO > BaO > MgO$
(c) $MgO > BaO > CaO > K_2O$
(d) $MgO > CaO > BaO > K_2O$

WB-JEE-2015

Ans. (a) : On the basis of electropositivity of metal the order of basic character is-

$K_2O > BaO > CaO > MgO$

With increase in the charge of the metal cation or with decrease in the size of metal cation , the basic character of its oxide decreases.

This is due to increase in charge density.

403. In aqueous alkaline solution, two electrons reduction of HO_2^- gives

(a) HO^-
(b) H_2O
(c) O_2
(d) O_2^-

WB-JEE-2015

Ans. (a) : In aqueous alkaline solution, two electron reduction of HO_2^- gives HO^-.

$$H_2O_2 \rightleftharpoons H^+ + HO_2^-$$

We can write HO_2^- as H^+ anion. The two electron reduction of HO_2^- in an aqueous alkaline solution, we get the product HO^-. So, we can write the equation as,

$$HO_2^- + H_2O + 2e^- \rightarrow 3OH^-$$

404. Match the flame colours of the alkaline earth metal salts in the Bunsen burner.

A. Calcium	p. Brick red
B. Strontium	q. Apple green
C. Barium	r. Crimson

	A	B	C
(a)	p	r	q
(b)	r	p	q
(c)	q	r	p
(d)	p	q	r

WB-JEE-2015

Ans. (a)

(a).Calcium	-	Brickred
(b).Strontium	-	Crimson
(c).Barium	-	Applegreen

405. If radium and chlorine combine to form radium chloride, the compound would be

(a) Half as radioactive as radium
(b) Twice as radioactive
(c) As radioactive as radium
(d) Not radioactive

WB-JEE-2016

Ans. (c) : Radioactive is independent of the chemical environment of an ion or atom.

When radium and chlorine combine to form compound then the structure of nucleus does not changed.

Compound involves with unstable nuclei and that will become stable by emission of α, β, γ radiation.

Radium chloride will be as radioactive as radium itself.

406. Which of the following is least thermally stable?

(a) $MgCO_3$
(b) $CaCO_3$
(c) $SrCO_3$
(d) $BeCO_3$

WB-JEE-2018

Ans. (d) : Ionic character and thermal stability are directly proportional to each other.

$$\xrightarrow[\text{Ionic character}\uparrow\ \text{thermal stability}\uparrow]{BeCO_3\ \ MgCO_3\ \ CaCO_3\ \ SrCO_3}$$

The thermal stability order of carbonate of alkaline Earth metal will be –

$BeCO_3 < MgCO_3 < CaCO_3 < SrCO_3 < BaCO_3$

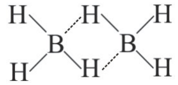
3. Boron Family

407. Which of the following statement is not correct about diborane?

(a) Both the Boron atoms are sp^2 hybridised
(b) There are two 3-centre-2-electron bonds.
(c) The four terminal B–H bonds are two centre two electron bonds.
(d) The four terminal Hydrogen atoms and the two Boron atoms lie in one plane.

NEET-17.07.2022

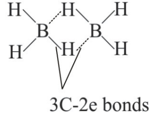
Ans. (b) : The structure of dibroane is



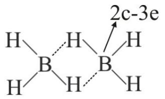
Structure of dibroane is dimeric structure atom are in different plane.

(ii) Both boron atom are sp^3 hybridired due to single covalent bond of (B – H)

(iii)



(iv)



In structure it is clearly visible there is four terminal - (B – H) bond are 2c - 2e bonds.

408. Which of the following hydrides is electron deficient ?

(a) CH_4
(b) B_2H_6
(c) NaH
(d) CaH_2

Karnataka CET-17.06.2022, Shift-II

Ans. (b) : In the molecule of B_2H_6 (diborane), there are 14 valence shell atomic orbitals that can be utilized for chemical bonding but there are only 12 valence electrons. Thus this molecule is electron deficient.

409. Given are two statements one is labelled as **Assertion A** and other is labelled as **Reason R.**

Assertion A : Magnesium can reduce Al_2O_3 at a temperature below 1350°, while above 1350°aluminium can reduce MgO.

Reason R : The melting and boiling points of magnesium are lower than those of aluminium.

In light of the above statements, choose most appropriate answer from the options given below:

(a) Both **A** and **R** are correct, and **R** is correct explanation of **A**
(b) Both **A** and **R** are correct, and **R** is NOT the correct explanation of **A**.

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(c) **A** is correct **R** is not correct.
(d) **A** is not correct, **R** is correct.

JEE Main-28.06.2022, Shift-I

Ans. (b) : Melting point for aluminium is 933.47K and melting point of magnesium is 923K
The melting point of magnesium are lower than those of aluminium but it is not the correct reason

410. Identify the correct statement for B_2H_6 from those given below:

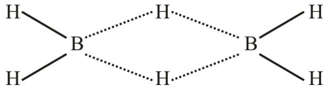
(A) In B_2H_6, all B-H bonds are equivalent.
(B) In B_2H_6, there are four 3-centre-2-electron bonds.
(C) B_2H_6 is a Lewis acid.
(D) B_2H_6 can be synthesized from both BF_3 and $NaBH_4$.
(E) B_2H_6 is a planar molecule.

Choose the most appropriate answer from the options given below:

(a) (A) and (E) only
(b) (B), (C) and (E) only
(c) (C) and (D) only
(d) (C) and (E) only

JEE Main-24.06.2022, Shift-I

Ans. (b) : B_2H_6 has two 3-centre-2-electron bonds and four 2-centre-2-electron bond hence, all B–H bonds are not equal.



Non planar bridge bond are different than terminal bond. So, it is an electron deficient compound as the octet of boron is incomplete hence, it act as Lewis acid
It can be synthesized from both BF_3 and $NaBH_4$

$$4BF_3 + 12NaH \xrightarrow{450K} 2B_2H_6 + 12NaF$$

$$4NaBH_4 + 2I_2 \longrightarrow 2B_2H_6 + 4NaI + H_2$$

So, it is a non-planar molecule.

411. Match List-I with List-II

List-I (Metal)		**List-II (Application)**	
a.	Cs	I.	High temperature thermometer
b.	Ga	II.	Water repellent sprays
c.	B	III.	Photoelectric cells
d.	Si	IV.	Bullet proof vest

Choose the most appropriate answer from the options given below:

(a) (a)-(III), (b)-(I), (c)-(IV), (d)-(II)
(b) (a)-(IV), (b)-(III), (c)-(II), (d)-(I)
(c) (a)-(II), (b)-(III), (c)-(IV), (d)-(I)
(d) (a)-(I), (b)-(IV), (c)-(II), (d)-(III)

JEE Main-29.06.2022, Shift-I

Ans. (a) : (a) Cesium (Cs) is used in photoelectric cell
(b) Generally Gallium (Ga) has high boiling point so, it is used in high temperature thermometer.
(c) Boron (B) liberate is a combination of high strength and high elastic modulus hence it is used in making bullet proof vest
(d) Silicon as silicones used for water proofing of fabrics.
Hence, option (A) is correct.

412. The process of converting hydrated alumina $Al(OH)_3$ into anhydrous alumina is called–

(a) Roasting
(b) Smelting
(c) Dressing
(d) Calcination

CG PET-22.05.2022

Ans. (d) : $Al_2O_3.2H_2O \xrightarrow[-2H_2O]{\Delta} Al_2O_3$
The process is known as calcination i.e. to heat a mineral below its melting point in absence of air in order to remove moisture, organic impurities and volatile impurities.

413. Which one of the following statements is not correct with respect to BF_3?

(a) It is an electron deficient compound
(b) It is a Lewis acid
(c) It is an ionic compound
(d) It forms adducts

AP EAMCET- 1995, 1996

Ans. (c) : BF_3 is a covalent compound and electron deficient. It behaves as Lewis acid.

$$NH_3 + BF_3 \rightleftharpoons NH_3 \rightarrow BF_3$$

It adduct to attain the stability.
BF_3 has boron bonded with three fluorine through covalent bond. It accept a pair of an electron to complete its octet. So, it is a Lewis acid.

414. Inorganic benzene contains

(a) C, H, Al
(b) C, H, B
(c) B, N, H
(d) C,N, H

AP EAMCET- 1999

Ans. (c) : Inorganic benzene is known as **borazole**. Borazine, also known as borazole is a polar inorganic compound with the chemical formula $B_3H_6N_3$. The molecular formula of borazole is $B_3N_3H_6$ and it contain's B, N and H. It is a colorless volatile liquid compound. In his cyclic compound, the three BH units and three NH units alternate.

415. Which of the following is not true?

(a) Aluminium liberates hydrogen on treating with a base
(b) Aluminium is used in the preparation of duralumin
(c) Aluminium is extracted by the electrolysis of alumina in presence of cryolite
(d) Aluminium is a strong oxidizing agent

AP EAMCET- 1999

Ans. (d) : Aluminium is a strong reducing agent not an strong oxidizing agent. Hence, statement is false.

- Hydrogen gas is liberated the action of aluminium with concentrated solution of sodium hydroxide. Hence, statement is true.
- Aluminium is used in the preparation of duralumin because duralumin is actually a metal, which is an alloy of aluminium, copper, magnesium and manganese. Hence, statement is true.
- In the electrolysis reaction of alumina, aluminium is extracted in the presence of cryolite. Hence, statement is true.

416. Which of the following reacts with BCl_3 to form diborane?

@apna_pdf

(a) NH_3 (b) $LiAlH_4$
(c) NaHg (d) $K_2Cr_2O_7$

AP EAMCET- 2000

Ans. (b) : $LiAlH_4$ reacts with BCl_3 to form diborane as represented as -

$$4BCl_3 + 3LiAlH_4 \rightarrow \underset{\text{(Diborane)}}{2B_2H_6} + 3LiCl + 3AlCl_3$$

417. The Chemical formula of feldspar is
(a) $KAlSi_3O_8$
(b) Na_3AlF_6
(c) $NaAlO_2$
(d) $K_2SO_4.Al_2(SO_4)_3.4Al(OH)_3$

AP EAMCET-2007

Ans. (a) : The chemical formula of feldspar is $KAlSi_3O_8$. Feldspars are a group of rock-forming aluminium tectosilicate minerals, containing sodium, calcium, potassium or barium. Feldspars make up about 60% of earth's crust and 41% of the earth's continental crust by weight.

418. Diethyl ether is prepared by passing ethyl alcohol vapours over a catalyst under high pressure and temperature. The catalyst is
(a) SiO_2 (b) CuO
(c) Al_2O_3 (d) Ag_2O

A.P.EAMCET/1996

Ans. (c) : Diethyl ether is prepared by passing ethyl alcohol vapours over a catalyst under high pressure and temperature. The catalyst is Al_2O_3.

$$CH_3CH_2OH + CH_3 - CH_2OH \xrightarrow[523K]{Al_2O_3} \underset{\substack{\text{Diethylether}\\ \text{or ethoxyethane}}}{CH_3CH_2OCH_2CH_3} + H_2O$$

419. Electrolytic reduction of Al_2O_3 to Al generally faces the difficulties like bad conductivity of Al_2O_3 and high fusion temperature. These difficulties are overcome buy the addition of
(a) Cryolite and CaF_2 to alumina
(b) Cryolite only to alumina
(c) CaF_2 only to alumina
(d) Cryolite and NaF to alumina

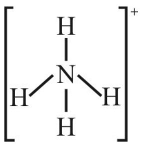
SCRA-2010

Ans. (a) : In the electrolysis of alumina it is mixed with cryolite (Na_3AlF_6) and Fluorspar (CaF_2) and Alumina become good electrical conductor.

420. Which one of the following statements is true for ammonium ion?
(a) All bonds are ionic
(b) All bonds are coordinate covalent
(c) H-atoms are situated at the corners of a square
(d) H-atoms are situated at the corners of tetrahedron

AP-EAMCET/1997

Ans. (d): The structure of ammonium ion-



In ammonium ion H-atoms are situated at the corners of tetrahedron.

421. Alkali metals are powerful reducing agents because_____
(a) They are metals
(b) They are monovalent
(c) Their ionic radii are large
(d) Their ionization energies are low

AP EAPCET 23-08-2021 Shift-I

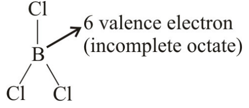
Ans. (d) : Alkali metals are powerful reducing agent because alkali metals have one valence electron which they lose to attain stability. Alkali metals have low ionization energies and easily lose an electron, therefore they act as reducing agent.

422. Boron compounds behave as Lewi's acid because of their______.
(a) Electron rich in nature
(b) Electron deficient in nature
(c) Ionization properties
(d) Proton donating nature

AP EAMCET- 2008

AP-EAMCET 25-08-2021 Shift - I

Ans. (b) : Boron halides behave as Lewis acids because of their electron deficient nature. It can accept a lone pair of electrons. Boron Compound-BCl_3



So it act as lewis acid.

423. Which element belongs to the family of elements, that also includes element Gallium?
(a) Carbon (b) Aluminum
(c) Iron (d) Arsenic

AP-EAMCET 25-08-2021 Shift - I

Ans. (b) : The elements of the 13th group element are boron (B), aluminium (Al), gallium (Ga), indium (In) and thallium (Tl). They all are metallic in nature except boron which is a metalloid.

424. A compound X, of boron reacts with NH_3 on beating to give another compound Y, which is called inorganic benzene. The compound X can be prepared by treating BF_3 with lithium aluminium hydride. The compounds X and Y are represented by the formulas.
(a) $B_2H_6, B_3N_3H_6$ (b) $B_2O_3, B_3N_3H_6$
(c) $BF_3, B_3N_3H_6$ (d) $B_3N_3H_6, B_2H_6$

AP EAMCET (Engg.) 17.09.2020, Shift-II

Ans. (a) : $$BF_3 \xrightarrow[-LiF,F_4]{LiAH_4} \underset{(X)}{B_2H_6} \xrightarrow[-H_2]{NH_3/\Delta} \underset{(Y)}{B_3N_3H_6}$$

(X) ⇒ B_2H_6 (Diborane)
(Y) ⇒ $B_3N_3H_6$ (Borazine or inorganic benzene)

425. Observe the following statements,
1. H_3BO_3 is used as antiseptic.
2. In B_2H_6, each boron is sp^2 hybridized.
3. Aqueous solution of borax is alkaline in nature.
The correct statements are
(a) 2 and 3 (b) 1, 2 and 3
(c) 1 and 3 (d) 1 and 2

AP EAMCET (Medical) - 2013

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Ans. (c) : 1. H_3BO_3 is used as an antiseptic and eye wash under the name 'boric lotion'.

2. Diborane, B_2H_6 contains two electrons each, three centered bonds. Each boron atom is in a link with four hydrogen atoms. This makes tetrahedral geometry. Hence, each boron atom is sp^3-hybridized. Thus, the statement is false.

3. The aqueous solution of borax is weakly alkaline in nature due to hydrolysis of $B_4O_7^{2-}$ ions.

426. The highest E^0 (in V) value for $M^+ \rightarrow M$ among the group 13 elements is-

(a) – 0.55 (b) 0.55
(c) 0.34 (d) 0.92

TS EAMCET 10.08.2021, Shift-I

Ans. (b) : For 13 group elements

$M^+ \rightarrow M \qquad E^o_{max} = 0.55ev.$

427. The metal that forms a self protecting film of oxide to prevent corrosion, is

(a) Cu (b) Al
(c) Pt (d) Au

EAMCET-1994

Ans. (b) : Aluminum forms a thin layer of Al_2O_3 (oxide) on its surface to prevent itself from corrosion.

$$2Al + 3O_2 \longrightarrow 2Al_2O_3$$

Moisture, $H_2O \longrightarrow H^+ + OH^-$

428. Which of the following reduction CANNOT be carried out with coke?

(a) $Fe_2O_3 \rightarrow Fe$ (b) $ZnO \rightarrow Zn$
(c) $Cu_2O \rightarrow Cu$ (d) $Al_2O_3 \rightarrow Al$

JEE Main 16.03.2021, Shift-II

Ans. (d) : Fe_2O_3, ZnO & Cu_2O can be reduce by carbon. Reduction of $Al_2O_3 \longrightarrow Al$ is carried out by electrolytic reduction of its fused salts.

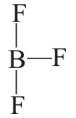
Reduction of $2Fe_2O_3\ (s) \rightarrow 4\ Fe\ (s) + 3O_2\ (g)$

429. BF_3 is used as a catalyst in several industrial processes due to its

(a) Strong reducing nature
(b) Weak reducing action
(c) Strong Lewis acid nature
(d) Weak Lewis acid character

AP EAMCET (Engg.) 17.09.2020 Shift-I

Ans. (c) : The lewis structure of BF_3 is



B has not been able to complete its octet (it has only 6 electrons around it). So, BF_3 is an electron deficient compound. All such electron deficient compounds are electron pair acceptors and so are Lewis acid.

BF_3 is acyclic because due to low is concept it concept a lone pair of electron.

430. Assertion (A) Boron has a smaller first ionisation enthalpy than beryllium.

Reason (R) The penetration of a 2s-electron to the nucleus is more than the 2p-electron hence, 2p-electron is more shielded by the inner core of electrons than 2s-electrons.

(a) Assertion and Reason both are correct statements but Reason is not correct explanation for Assertion.
(b) Assertion is correct statement but Reason is wrong statements.
(c) Assertion and Reason both are correct statements and Reason is correct explanation for Assertion.
(d) Assertion and Reason both are wrong statements.

AP EAMCET (Engg.) 17.09.2020 Shift-I

Ans. (c) : Assertion (A) Electronic configuration of boron (Z = 5) is [He] $2s^22p^1$. So in first ionisation (IE_1 or Δ_iH_1) removal will take place from unpaired p^1 -electrons which requires more energy.

Electronic configuration of Be (Z = 4) : (He) $2s^2$. So, the Assertion is a correct statement.

Reason (R) s-orbital is being symmetrical in shape (spherical), it shields nuclear force (nuclear charge) strongly. So, $2p^1$ electron of B is experiences lesser nuclear attractive force for ionisation. As a result

$$IE_1 \text{ or } \Delta_iH_1 : B < Be$$

So, the Reason is correct explanation for Assertion.

431. Which of the following compounds are formed, when boron trichloride is treated with water ?

(a) $H_3BO_3 + HCl$ (b) $B_2H_6 + HCl$
(c) $B_2O_3 + HCl$ (d) $HBO_3 + HCl$

AP EAMCET (Engg.) 18.09.2020, Shift-I

Ans. (a) : Boric acid and hydrochloric acid are formed when boron trichloride is treated with water.

$$\underset{\text{Boron trichloride}}{BCl_3} + 3H_2O \rightarrow \underset{\text{Boric acid}}{H_3BO_3} + 3HCl$$

432. Consider the following statements :

1. Zeolites are aluminosilicates.

2. Aluminium can occupy two adjacent sites in zeolites.

Which of the statements given above is/are correct ?

(a) 1 only (b) 2 only
(c) Both 1 and 2 (d) Neither 1 nor 2

SCRA - 2009

Ans. (a) : Zeolites are microspores, aluminosilicate minerals commonly used as commercial adsorbents and catalysts. Aluminium cannot occupy two adjacent in zeolites.

Zeolites are crystalline solids made up of silicon aluminium and O_2.

433. In borax bead test borax produces

(a) Metal metaborate (b) Metal oxide
(c) Metal orthoborate (d) Metal pyroborate

SCRA - 2009

Ans. (a) : In borax bead test, borax produces metal metaborate.

Borax bead test:

$Na_2B_4O_7 \longrightarrow 2\ NaBO_2 + B_2O_3$

$CuO + B_2O_3 \longrightarrow Cu\ (BO_2)_2$ (meta borate)

$CuO + NaBO_2 \longrightarrow NaCuBO_3$ (ortho borate)

434. The possible oxidation states of group 13 elements is/are

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(a) +3 (b) +1, +3
(c) +1 (d) +1, +2, +3

AP EAMCET (Engg.) 21.09.2020, Shift-II

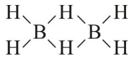
Ans. (b) : The general oxidation state exhibited by the group 13 elements in the group are +3 and +1 due to its general electronic configuration ns^2, np^2. As we go down the group of boron family, the tendency to form +1 ion increases. This is due to inert pair effect. Hence, the correct option is (b).

435. The bonding in diborane (B_2H_6) can be described by
(a) 4 two centre-two electron bonds and 2 three-centre-two electron bonds
(b) 3 two centre-two electron bonds and 3 three-centre-two electron bonds
(c) 2 two centre-two electron bonds and 4 three centre-two electron bonds
(d) 4 two centre-two electron bonds and 4 two centre-two electron bonds

TS EAMCET-2017

Ans. (a) : Diborane is the simplest boron hydride known. In the structure of diborane, the four hydrogen atoms and the two boron atoms lie in one plane. Above and below this plane, there are two bridging hydrogen atoms.

B_2H_6 (diborane)



Diborane has 4 two centre-two electron bonds and 2 three-centre-two electron bonds.

436. Dilute sodium hydroxide does not react with which of the following ?
(a) Ga (b) Al
(c) Ti (d) B

AP EAMCET (Engg.) 18.9.2020 Shift-I

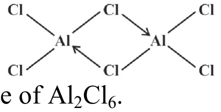
Ans. (d) : Boron does not react with dilute sodium hydroxide because it reacts with concentrated NaOH.

$$B + \underset{\text{Conc.}}{NaOH} + 3H_2O \rightarrow Na\left[B(OH)_4\right] + \frac{3}{2}H_2$$

437. Aluminium (III) chloride forms a dimer because aluminium _____
(a) Belong to boron family.
(b) Has a very high ionization enthalpy.
(c) Can have higher co-ordination number.
(d) Is next to Magnesium.

AP EAPCET 24.08.2021 Shift-II

Ans. (c) : $AlCl_3$ can form dimer and exists as Al_2Cl_6 aluminum has vacant. d-orbital accommodate electron from aluminium with the chlorine atom. $AlCl_3$ forms a dimer as there is unsaturation in coordination. $AlCl_3$ behaves as Lewis acid.



Structure of Al_2Cl_6.

438. AlF_3 is soluble in HF only in the presence of KF due to formation of—
(a) AlH_3 (b) $[AlH_6]^{3-}$
(c) $[AlF_6]^{3-}$ (d) $K[AlF_3H]$

AP EAPCET 20.08.2021 Shift-I

Ans. (c) : AlF_3 is soluble in HF due to the formation of $K_3[AlF_6]$.
Anhydrous HF is a covalent compound and is strongly H-bonded. So, it doesn't give F ions and hence AlF_3 doesn't dissolve in HF.

$AlF_3 + 3KF \xrightarrow{HF} K_3[AlF_6]$ or $3K^+ + [AlF_6]^{3-}$

439. What are the products formed when chlorine is passed through aqueous hypo solution?
(a) Na_2SO_3+HCl+S (b) Na_2SO_3+SO_3+HCl
(c) Na_2SO_4+HCl+S (d) Na_2SO_3+HCl+SO_2

AP EAMCET (Engg.) 2001

Ans. (c) : Hypo-solution is also called sodium thiosulphate solution $Na_2S_2O_3$
Products formed are sulphur, hydrochloric acid and sodium sulphate.

$Cl_2 + Na_2S_2O_3 + H_2O \longrightarrow Na_2SO_4 + HCl + S$

440. What is the molecular formula of borazole?
(a) B_2H_6 (b) $B_6N_6H_3$
(c) $B_3N_3H_6$ (d) $B_3N_3H_3$

AP EAMCET (Engg.) 2001

Ans. (c) : Borazine also known as Borazole –
$B_3N_3H_6$
(Inorganic benzene)

441. The stability of +1 oxidation state increases in the sequence ______
(a) Ga < In < Al < Tl (b) Al < Ga < In < Tl
(c) Tl < In < Ga < Al (d) In < Tl < Ga < Al

AP EAPCET 24.08.2021, Shift-I

Ans. (b) : The stability of +1 oxidation state increases in the 13 group of p-block element. The reason behind that due to the inert pair effect, as we move down the group then the order will be – Al < Ga < In < Tl.

442. H_3BO_3 or $B(OH)_3$ is considered as an acid because its molecule______
(a) Combines with proton form water molecule
(b) Accepts OH^- from water, releasing a proton
(c) Contains replaceable H^+ ion
(d) Can donate proton easily

AP EAPCET 20.08.2021 Shift-II

Ans. (b): Boric acid $B(OH)_3$ is an acid that acts as usual Barnsted – Lowry acids. It react with water according to

$B(OH)_3\,(aq) + 2H_2O\,(l) \rightleftharpoons B(OH)_4^-\,(aq) + H_3O^+(aq)$

So, $B(OH)_3$ accepts OH^- from water releasing a proton.

443. What is Z in the following reactions?

$$\mathbf{BCl_3 + H_2 \xrightarrow[450^0 C]{Cu\text{-}Al} X + HCl}$$

$$\mathbf{X \xrightarrow{methylation} Z}$$

(a) $(CH_3)BH_2$ (b) $(CH_3)_4B_2H_2$
(c) $(CH_3)_3B_2H_3$ (d) $(CH_3)_6B_2$

AP EAMCET (Engg.) 2012

Ans. (b) : $2BCl_3 + 6H_2 \xrightarrow[450°C]{Cu-Al} \underset{\underset{(X)}{\text{Diborane}}}{B_2H_6} + 6HCl$

$$\underset{(X)}{B_2H_6} + 4CH_3Cl \xrightarrow{\text{Methylation}} \underset{(Z)}{(CH_3)_4B_2H_2} + 4HCl$$

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444. Zeolites are shape selective structures because of

(a) High adsorption capacity
(b) Three dimensional network of atoms
(c) Presence of aluminosilicates
(d) Honey comb like structure.

COMEDK-2015,2014

Ans. (d) : The shape selectivity of zeolites is based on the interaction of reactant with the well-defined pore system because of honey comb like structure.

Shape selective catalyst-
(i) Depends on pore's size and structure.
(ii) Depends on size of reactant and product.

445. Which one of the following pairs of atomic numbers represents elements belonging to the same group?

(a) 13 and 31 (b) 11 and 20
(c) 14 and 33 (d) 12 and 30

COMEDK-2016

Ans. (a) : Atomic number of aluminium (Al)= 13 and that of gallium (Ga) =31 . Both element belongs to IIIA group.

446. Which of the following is not correct?

(a) Al reacts with NaOH and liberate H_2
(b) $AlCl_3$ is a Lewis acid
(c) Al is used in the manufacture of electrical cables
(d) NaOH is used during Hall's process of purification of bauxite

AP-EAMCET (Medical), 2006

Ans. (d) :
(a) Aluminum reacts with NaOH and liberate H_2

$2Al + 2NaOH + 2H_2O \xrightarrow{\Delta} 2NaAlO_2 + 3H_2$

Thus, statement is true.
(b) $AlCl_3$ is a Lewis acid because Al have vacant orbital. Statement is true.
(c) Al has high melting point due to which it is uses in electrical cables. Thus, statement is true.
(d) NaOH is used in the Bayer's process It is not used in the Hall's process. Hence, the statement is false.

447. Aluminium reacts with concentrate HCI and concentrated NaOH to liberate the gases ...... respectively:

(a) H_2 and O_2 (b) O_2 and H_2
(c) H_2 and H_2 (d) O_2 and O_2

AP-EAMCET (Medical), 2001

Ans. (c) : When aluminium reacts with concentrated HCl , H_2 gas is evolved and when Al reacts with NaOH, H_2 gas is also evolved.

$$2Al + 6HCl \rightarrow 2AlCl_3 + 3H_2$$
$$2Al + 6NaOH \rightarrow 2Na_3AlO_3 + 3H_2$$

448. Which one of the following elements is a non-metal?

(a) Boron (b) Indium
(c) Sodium (d) Magnesium

AP-EAMCET (Medical), 2002

Ans. (a) : Non metal is an element that doesn't have the characteristics of metal including, ability to conduct heat or electricity, luster or flexibility.
The non-metals are given as follows –
H, B, C, N, O, F, Cl, Br etc.
Thus, the given elements only boron is the non-metal.

449. Which pair of oxides is acidic in nature?

(a) B_2O_3,SiO_2 (b) B_2O_3, CaO
(c) N_2O, BaO (d) CaO, SiO_2

JEE Main 26.02.2021, Shift-II

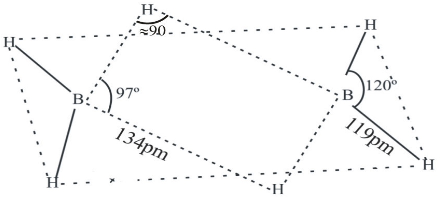
Ans. (a) : B_2O_3 and SiO_2 both are oxides of non-metal and hence are acidic in nature.
CaO, SiO_2= Basic Nature
N_2O = Neutral Oxide
B_2O_3,SiO_2 = Acidic nature

450. The correct statement about B_2H_6 is:

(a) All B-H-B angles are of 120º.
(b) Its fragment, BH_3, behaves as a Lewis base.
(c) Terminal B-H bonds have less p-character when compared to bridging bonds.
(d) The two B-H-B bonds are not of same length.

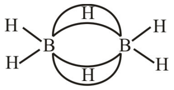
JEE Main 25-02-2021, Shift-I

Ans. (c) :



Structure of di-borane (B_2H_6)

The four terminal hydrogen atoms and two B atoms lie is one plane. Above and below this plane, there are two bridging hydrogen atoms. The four terminal B-H bonds are 2c – 2e⁻ bond while two bridging bonds are 3c –2e⁻ bond which is known as B–H–B bond.



The 3c – 2e⁻ bond are also referred as banana bonds.
Terminal bond angle is greater than that of bridge bond angle
Bond angle ∝ s- character

$$\text{Bond angle} \propto \frac{1}{p-\text{character}}$$

So, terminal B-H bond have less p-character when compared to bridge bonds.

451. The correct statements from below are

(I) H_3BO_3 is a liquid
(II) H_3BO_3 forms a layer structure
(III) In H_3BO_3, each BO_3 unit is joined by hydrogen bonds
(IV) H_3BO_3 is triacidic

(a) (I) and (II) (b) (II) and (III)
(c) (III) and (IV) (d) (II) and (IV)

TS-EAMCET 09.08.2021, Shift-I

Ans. (b) : H_3BO_3 (boric acid) is a colorless or white crystalline solid at room temperature.

- H_3BO_3 unit bonded together through hydrogen bonds to give a two- dimensional layered structure.

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- H_3PO_4 and citric acid are triacidic acids while H_3BO_3 is a mono basic acid.

So, option II and III is correct.

452. Match the following :

Column-1 **Reaction**	**Column-2** **Main product**
(A) $B_2H_6 + 2CO \longrightarrow$	**(I)** B_2O_2
(B) $B_2H_6 + 3O_2 \longrightarrow$	**(II)** $2BH_3{\cdot}CO$
(C) $B_2H_6 + 6H_2O \longrightarrow$	**(III)** $2H_3BO_3$
	(IV) $2BH_2(CO)$
	(V) $2HBO_2$

	A	B	C
(a)	IV	I	III
(b)	II	III	V
(c)	IV	III	I
(d)	II	I	III

TS EAMCET 05.08.2021, Shift-I

Ans. (d) :

Reaction	**Product**
$B_2H_6 + 2CO \longrightarrow$	$2BH_3{\cdot}CO$
$B_2H_6 + 3O_2 \longrightarrow$	B_2O_2
$B_2H_6 + 6H_2O \longrightarrow$	$2H_3BO_3$

453. A group 15 element, which is a metal and forms a hydride with strongest reducing power among group 15 hydrides. The element is:

(a) Bi (b) P

(c) As (d) Sb

JEE Main 16.03.2021, Shift-I

Ans. (a) : BiH_3 is the strongest reducing agent among the hydrides of 15 group elements as Bi- H bond dissociation energy is very less. All the elements of group 15 form hydride of the type EH_3 where E= N, P, As, Sb, Bi. When we move from top to bottom then reducing power increases in group 15. Hence, ammonia is a mild reducing agent while BiH_3 is the strongest reducing agent amongst all the hydrides.

454. Number of water molecules in Mohr's salt is

(a) 7 (b) 5

(c) 8 (d) 6

AIIMS-1994

Ans. (d): $(NH_4)_2\,Fe(SO_4)_2.6H_2O$ contains $6H_2O$

455. Which of the following is an alum?

(a) $FeSO_4(NH_4)_2SO_4.6H_2O$

(b) $NaAlO_2$

(c) $Na_2SO_4.Al_2(SO_4)_3.24H_2O$

(d) $KCl.\ MgCl_2\ .\ 6H_2O$

AIIMS-1994

Ans. (c): $Na_2SO_4.Al_2(SO_4)_3.24H_2O$

Sodium alum – $Na_2SO_4.Al_2(SO_4)_3.24H_2O$

456. Bauxite, an ore of aluminium is purified by

(a) Hall's process (b) Serpek's process

(c) Bayer's process (d) all of these

AIIMS-1996

Ans. (d): Aluminium ore is called bauxite.

Ores of Aluminium–

- Bauxite – $Al_2O_3{\cdot}2H_2O$
- Corundum – Al_2O_3
- Cryolite – Na_3AlF_6

Bauxite, an ore of aluminium, is purified by either Hall's process, Bayer's process, Serpek's process.

457. Assertion : Borax bead test is not suitable for Al (III).

Reason : Al_2O_3 is insoluble in water.

(a) If both Assertion and Reason are correct and the Reason is a correct explanation of the Assertion

(b) If both Assertion and Reason are correct but Reason is not a correct explanation of the Assertion

(c) If the Assertion is correct but Reason is incorrect

(d) If both the Assertion and Reason are incorrect

(e) If the Assertion is incorrect but the Reason is correct.

(AIIMS-2005)

Ans. (b): Borax bead test is not suitable for Al(III) because its oxidizing as well as reducing flame is colorless in both hot as well as cold. Alumina is insoluble in water as they exist in hydrated from like $Al_2O_3.\ 2H_2O$, $Al_2O_3.\ H_2O$ etc.

458. Thermite is a mixture of iron oxide and

(a) zinc powder (b) potassium metal

(c) sodium savings (d) aluminium powder

AIIMS-2002

Ans. (d): Thermite is the mixture of iron oxide Fe_2O_3 (rust) and aluminium powder.

$$Fe_2O_3 + 2Al \longrightarrow Al_2O_3 + 2Fe$$

459. Assertion: Atomic radius of gallium is higher than that of aluminium

Reason: The presence of additional d-electron offer poor screening effect for the outer electrons form increased nuclear charge.

(a) If both Assertion and Reason are correct and the Reason is the correct explanation of Assertion.

(b) If both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.

(c) If Assertion is correct but Reason is incorrect.

(d) If both the Assertion and Reason are incorrect.

(AIIMS-2017)

Ans. (c): When moving a group from top to bottom, no. of shell increases hence atomic radius increases.

The presence of additional d-electron offer poor screening effect for the outer electrons form decrease nuclear change.

460. Assertion: Colored cations can be identified by borax bead test.

Reason: Transparent bead ($NaBO_2+B_2O_3$) forms colored bead with colored cation.

(a) If both Assertion and Reason are correct and the Reason is the correct explanation of Assertion.

(b) If both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.

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(c) If Assertion is correct but Reason is incorrect.
(d) If both the Assertion and Reason are incorrect.

(AIIMS-2009)

Ans. (a): We use borax bead test to detect coloured ions. When the salt under analysis is placed on the borax bead and heated, the boric anhydride reacts with the salts forming a metaborate of characteristic colour and we can identify the given radical.

$$Na_2B_4O_7.10H_2O \xrightarrow{\text{Heat}} \underset{\substack{\text{Sodium}\\\text{meta borate}}}{2NaBO_2} + \underset{\text{Boric anhydride}}{B_2O_2} + 10H_2O$$

461. Assertion: $Al(OH)_3$ is insoluble in NH_4OH but soluble in NaOH.
Reason: NaOH is strong alkali.

(a) If both Assertion and Reason are correct and Reason is a correct explanation of the Assertion.
(b) If both Assertion and Reason are correct but Reason is not a correct explanation of the Assertion.
(c) If the Assertion is correct but Reason is incorrect.
(d) If both the Assertion and Reason are incorrect.
(e) If the Assertion is incorrect but the Reason is correct.

(AIIMS-1997)

Ans. (a): $Al(OH)_3$ is insoluble in NH_4OH but soluble in NaOH. NaOH is strong alkali. In presence of excess NaOH, $Al(OH)_3$ forms sodium meta aluminate which is soluble.

$$Al(OH)_3+NaOH \rightarrow \underset{\substack{\text{Sodium}\\\text{meta aluminate}}}{NaAlO_2}+2H_2O$$

462. Assertion: Boron is a metalloid.
Reason : Boron shows metallic nature.

(a) If both Assertion and Reason are correct and Reason is a correct explanation of the Assertion.
(b) If both Assertion and Reason are correct but Reason is not a correct explanation of the Assertion.
(c) If the Assertion is correct but Reason is incorrect.
(d) If both the Assertion and Reason are incorrect.
(e) If the Assertion is incorrect but the Reason is correct.

(AIIMS-1997)

Ans. (c): Metalloids possess metallic as well as non-metallic nature. Hence, Assertion is true and Reason is false.

463. A neutral molecule XF_3 has zero dipole moment. The element X is most likely

(a) chlorine
(b) boron
(c) nitrogen
(d) carbon

(AIIMS-2016)

Ans. (b): Boron trifluoride has zero dipole moment although it has three polar B-F bonds. Because BF_3 is sp^2 hybridized and trigonal planar, the resultant bond moment of any two B-F dipoles is equal in magnitude but opposite in direction to third B-F bond. So the vector sum of three bond dipole moment is zero.

ClF_3 is T-shaped, and CF_3 is pyramidal, all these molecules are unsymmetrical and have finite dipole moment.

Therefore, element X is boron.

464. The correct formula of borax is

(a) $Na_2[B_4O_4(OH)_3].9H_2O$
(b) $Na_2[B_4O_5(OH)_4].8H_2O$
(c) $Na_2[B_4O_6(OH)_5].7H_2O$
(d) $Na_2[B_4O_7(OH)_6].6H_2O$

(AIIMS-2016)

Ans. (b): Formula of borax is $Na_2[B_4O_5(OH)_4]. 8H_2O$. Its widely used as a household cleaner and booster for laundry detergent.

465. Which of the following oxides is strongly basic?

(a) B_2O_3
(b) Al_2O_3
(c) Ga_2O_3
(d) Tl_2O_3

(AIIMS-2015)

Ans. (d): On moving from top to bottom in a group, basic character of metal increases.

The correct sequence of increasing basic strength is $B_2O_3 < Al_2O_3 < Ga_2O_3 < Tl_2O_3$.

466. Chemically borax is

(a) Sodium metaborate
(b) Sodium orthoborate
(c) Sodium tetraborate
(d) Sodium tetraborate decahydrate

(AIIMS-2015)

Ans. (d): $Na_2B_4O_7.10H_2O$ = Sodium teraborate decahydrate.

467. BCl_3 does not exists as dimer but BH_3 exists as dimer (B_2H_6) because

(a) chlorine is more electronegative than hydrogen.
(b) there is $p\pi$-$p\pi$ back bonding in BCl_3 but BH_3 does not contain such multiple bonding.
(c) large sized chlorine atoms do not fit in between the small boron atoms where as small sized hydrogen atoms get fitted in between boron atoms.
(d) none of the above.

(AIIMS-2012)

Ans. (c): BCl_3 does not exists as dimer but BH_3 exists as dimer (B_2H_6) because large sized chlorine atoms do not fit in between the small boron atoms whereas small sized hydrogen atoms get fitted in between boron atoms.

468. Borax is used as cleansing agent because on dissolving in water it gives

(a) alkaline solution
(b) acidic solution
(c) bleaching solution
(d) colloidal solution

(AIIMS-2006)

Ans. (a): Borax is $Na_2B_4O_7.10H_2O$. It gives alkaline solution on dissolution in water as it is a salt of strong base and weak acid and because of this it acts as cleansing agent.

$Na_2B_4O_7 + 7H_2O \rightarrow 4H_3BO_3+2NaOH$.

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469. In diborane, the two H-B-H angles are nearly:

(a) $60^0, 120^0$ (b) $95^0, 120^0$
(c) $95^0, 150^0$ (d) $120^0, 180^0$

(AIIMS-2005)

Ans. (b): In diborane, the bonds between boran and the terminal hydrogen atoms are conventional two center-two electron ($2c–2e^-$) covalent Bonds. The two H–B–H angles are nearly 95^o and 120^o.

470. Which of the following is only acidic in nature?

(a) $Be(OH)_2$ (b) $Mg(OH)_2$
(c) $B(OH)_3$ (d) $Al(OH)_3$

(AIIMS-2004)

Ans. (c): $B(OH)_3$ is the hydroxide of non-metal which has acidic nature.

- All other except $B(OH)_3$ are metallic hydroxides have basic nature.

471. In lake test of Al^{3+} ion, there is a formation of colored floating. It is due to:

(a) adsorption of litmus by H_2O
(b) adsorption of litmus by $Al(OH)_3$
(c) adsorption of litmus by $Al(OH)_4^-$
(d) none of these

(AIIMS-2001)

Ans. (b): In lake test of Al^{3+} there is formation of coloured floating lake. It is due to the adsorption of litmus by $Al(OH)_3$.

472. Al_2O_3 on heating with carbon in an atmosphere of N_2 at high temperature produces:

(a) $Al + CO_2$ (b) $Al + CO_2 + NO$
(c) $Al_4C_3 + CO_2$ (d) $AlN + CO$

(AIIMS-1999)

Ans. (d):

$$Al_2O_3 + N_2 + 3C \longrightarrow 2AlN + 3CO$$

Group (IA) contains only metals called alkali metals and (III-A) also contains metals except boron, which is a metalloid. Group (VIII) contains transition elements which are metals. Group (VII A), contains only non-metals halogens (F, Cl, Br).

473. The most abundant metal in the earth crust is:

(a) Pb (b) Cu
(c) Al (d) Mg

(AIIMS-1998)

Ans. (c): The most abundant metals are 8.1% of aluminium 5.0% of iron and 3.6% of calcium followed closely by Na, K , Mg and Ti.

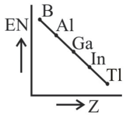
474. Which one of the following elements on doping with germanium, make it a p-type semiconductor?

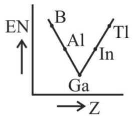
(a) Bi (b) Sb
(c) As (d) Ga

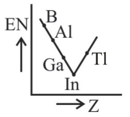
AP-EAMCET (Engg.) - 2014

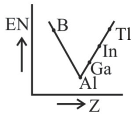
Ans. (d) : The group 14 element (germanium) is doped with group 13 element (gallium) to make p-type semiconductor.

475. Which one of the following correctly represents the variation of electronegativity (EN) with atomic number (Z) of group 13 elements?

(a)


(b)


(c)


(d)


AP-EAMCET (Engg.) - 2014

Ans. (d): Correct order of electronegativity of group 13 elements are as follows-

Element	EN (Pauling scale)
B	2.0
Al	1.5
Ga	1.6
In	1.7
TI	1.8

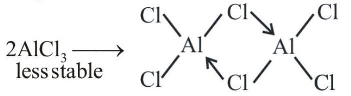
476. Assertion (A): $AlCl_3$ exists as a dimer through halogen bridged bonds.

Reason (R): $AlCl_3$ gets stability by accepting electrons from the bridged halogen.

(a) Both (A) and (R) are true and (R) is the correct explanation of (A)
(b) Both (A) and (R) true but (R) is not the correct explanation of (A)
(c) (A) is true, but (R) is false
(d) (A) is false, but (R) is true

AP-EAMCET – 2016

Ans. (a): $AlCl_3$ is a electron deficient species as Al possess only 6 electron in its outermost shell. It is exists as a dimer through halogen bridged bonds. Al_2Cl_6 forms from two $AlCl_3$ molecules. Since two Cl atom can act as a bridge to one pair to Al atom,



477. Which metal is protected by a layer of its own oxide?

(a) Al (b) Au
(c) Fe (d) Ag

AP- EAPCET- 07-09-2021, Shift-I

Ans. (a): Aluminium oxide layer serves as a protective barrier to the underlying aluminium itself and preventing chemical reactions with the metal, and hence A1 is protected from corrosion by a layer of its own oxide Al_2O_3.

478. What are X and Y respectively in the following reaction ?

$$\mathbf{B_2H_6 + 2KOH + 2X \rightarrow 2Y + 6H_2}$$

(a) K_2O, H_2O (b) H_2, H_2BO_3
(c) H_2, KBO_2 (d) B_2O_3, H_3BO_3

AP-EAMCET (Engg.)-2004

Ans. (c) : Diborane treated with strong alkali (KOH) giving the potassium metaborate and librating the hydrogen gas.

$$\underset{\text{Diborane}}{B_2H_6} + \underset{\text{Caustic potash}}{2KOH} + 2H_2O \longrightarrow \underset{\text{Potassium metaborate}}{2KBO_2} + \underset{\text{Hydrogen gas}}{6H_2\uparrow}$$

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479. Aluminium metal becomes passive in

(a) conc. HNO_3 (b) dil. H_2SO_4
(c) very dil. HNO_3 (d) conc. H_2SO_4

AP- EAMCET(Medical) -2010

Ans. (a): Conc. $HNO_3 + Al \longrightarrow Al_2O_3$

Al metal becomes passive because Al_2O_3 layer forms a protective coating on the surface of the metal.

480. Diborane reacts with ammonia under different conditions to give a variety of products. Which one among the following is not formed in these reactions?

(a) $B_2H_6.2NH_3$ (b) $B_{12}H_{12}$
(c) $B_3N_3H_6$ (d) $(BN)_n$

AP-EAMCET- (Engg.) - 2010

Ans. (b) : (a) Normally it forms complex with $2NH_3$

$B_2H_6 + 2NH_3 \to B_2H_6.2NH_3$

(b) Diborane does not react with ammonia to give $B_{12}H_{12}$

(c) When it reacts with NH_3 at moderate temperature.

$3B_2H_6 + 6NH_3 \to 2B_3N_3H_6 + 12H_2$

(d) When it reacts with NH_3 at high temperature.

$B_2H_6 + NH_3 \to (BN)_n$

Thus, $B_{12}H_{12}$ is not the product of reaction between dibrone and ammonia

481. Diborane reacts with HCl in the presence of $AlCl_3$ and liberates

(a) H_2 (b) Cl_2
(c) BCl_3 (d) Cl_2 and BCl_3

AP-EAMCET (Engg.) 2013

Ans. (a) : Diborane reacts with HCl in presence of $AlCl_3$ and liberates hydrogen:

$$\underset{\text{diborane}}{B_2H_6} + HCl \xrightarrow{AlCl_3} B_2H_5Cl + H_2\uparrow$$

482. Except B and Al, all other III group element exhibit + 1 oxidation state. This is because

(a) they are p-block elements
(b) their first ionization energy is less
(c) they have low melting point
(d) due to inert pair effect

AP - EAMCET (Medical) - 2007

Ans. (d): Except B and Al, all other III group elements exhibit +1 oxidation state. This is because of inert pair effect.

483. In cigarette lighters ___ is used.

(a) misch metal (b) Mg - alloy
(c) CeO_2 (d) pyrophoric alloy

SRMJEEE – 2010

Ans. (d) : In cigarette lighters, pyrophoric alloy is used to emit spark when struck. Disposable lighters is made of pyrophoric alloy called ferrocerium.

484. The intermediate product (X) formed in the following reaction is

$$B_2H_6 + 6NH_3 \to 3X \xrightarrow{\text{heat}} 2B_3N_3H_6 + 12H_2$$

(a) $[BH(NH_3)_3]^+ [BH_4]^-$
(b) $[BH_2(NH_3)_4]^+ [BH_4]^-$
(c) $[BH(NH_3)_4]^+ [BH_4]^-$
(d) $[BH_2(NH_3)_2]^+ [BH_4]^-$

AMU-2018

Ans. (d):

$$3B_2H_6 + 6NH_3 \longrightarrow 3\left[BH_2\left(NH_3\right)_2\right]^+\left[BH_4\right]^-$$

$$\xrightarrow{\text{Heat}} 2B_3N_3H_6 + 12H_2$$

B_2H_6 and NH_3 react in the ratio of 1 : 2 to form borazine ($B_3N_3H_6$) and the intermediate product

$x = \left[BH_2\left(NH_3\right)_2\right]^+ \cdot \left[BH_4\right]^-$.

485. DIBAL-H is

(a) $AlH(i\text{-}Bu)_2$ (b) $Al(OC_2H_5)_3$
(c) $Al[(CH_3)_2CHO]_3$ (d) $AlCl_3$

AMU-2015

Ans. (a) : DIBAL-H: Diisobutylaluminium hydride

$AlH\ (i\text{-}Bu)_2$

486. Which of the following statements is not correct for boric acid?

(a) It is soluble in hot water
(b) It acts as a tribasic acid
(c) It has a planar structure
(d) It acts as a monobasic acid

Assam CEE-2019

Ans. (b): Boric acid does not act as a tribasic acid. Boric acid $B(OH)_3$ or H_3BO_3 is a weak monobasic acid.

487. Which of the following oxides is most acidic?

(a) Al_2O_3 (b) SiO_2
(c) P_2O_5 (d) MgO

BCECE-2003

Ans. (c) : On moving from left to right in a periodic table the acidic nature of oxides increases while on moving top to bottom the acidic nature of oxides decreases, hence P_2O_5 is most acidic among all given acids.

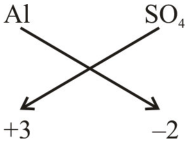
488. Value of x in potash alum, $K_2SO_4 . Al_x(SO_4)_3 . 24H_2O$ is–

(a) 4 (b) 1
(c) 2 (d) None of these

BCECE-2008

Ans. (c): Potash alum $K_2SO_4. Al_x (SO_4)_3. 24H_2O$.

It is a double salt



Therefore, $Al_2(SO_4)_3$ compound of Al^{3+} and SO_4^{2-} comparing x = 2.

489. Boric acid is polymeric due to

(a) Its acidic nature
(b) The presence of hydrogen bonds
(c) Its monobasic nature
(d) Its geometry

BCECE-2012

Ans. (b) : The presence of hydrogen bonds

Layer of boric acid is as a lattice and the units of boric acid are linked by hydrogen bonds. So we can say, Boric acid is polymeric due to the presence of hydrogen bonds.

@apna_pdf

490. What is Z in the following reactions?

$$\mathbf{BCl_3 + H_2 \xrightarrow[450^0 C]{Cu-Al} X + HCl}$$

$$\mathbf{X \xrightarrow{methylation} Z}$$

(a) $(CH_3)BH_2$ (b) $(CH_3)_4B_2H_2$
(c) $(CH_3)_3B_2H_3$ (d) $(CH_3)_6B_2$

BCECE-2014

Ans. (b) :

$$BCl_3 + H_2 \xrightarrow[450°C]{Cu-Al} \underset{\underset{X}{Diborane}}{B_2H_6} + HCl$$

$$\underset{X}{B_2H_6} + 4CH_3Cl \xrightarrow{methylation} \underset{Z}{(CH_3)_4B_2H_2}$$

491. The stability of the +1 oxidation state in Group 13 elements increases in the sequence

(a) $Al < Ga < In < Tl$ (b) $Tl < In < Ga < Al$
(c) $Tl < In < Al < Ga$ (d) $In < Tl < Ga < Al$

JEE Main-2019, 11 Jan Shift-II
BITSAT-2019
AMU–2006
NEET-2015, 2009

Ans. (a): The configuration of the outermost shell of group 13 element, is ns^2, np^1. Hence the expected oxidation states are +3 and +1. The stability of +1 oxidation state increases from aluminium to thallium and the stability of +3 oxidation state decreases form aluminium to thallium.

$B^+ < Al^+ < Ga^+ < In^+ < Tl^+$

492. Which of the following element has the highest ionization enthalpy?

(a) Boron (b) Aluminium
(c) Germanium (d) Thallium

BITSAT-2019
JEE Main 2019, 8 April shift-I

Ans. (a) : In the fifth group of periodic table as we go downward, ionization potential decreases, therefore boron has the highest ionization enthalpy among given options. The ionization enthalpy is directly proportional to the nuclear attraction and inversely proportional to the size of atom.

493. Diborane (B_2H_6) reacts independently with O_2 and H_2O to produce, respectively;

(a) B_2O_3 and H_3BO_3 (b) B_2O_3 and $[BH_4]^-$
(c) H_3BO_3 and B_2O_3 (d) HBO_2 and H_3BO_3

BITSAT-2021

Ans. (a) : B_2O_3 and H_3BO_3 the corresponding reactions are

$B_2H_6 + 3O_2 \longrightarrow B_2O_3 + 3H_2O$

$B_2H_6 + 6H_2O \longrightarrow 2B(OH)_3 + 6H_2$

494. Formula of diaspore is

(a) Al_2O_3 (b) $Al_2O_3\ H_2O$
(c) $Al_2O_3.2H_2O$ (d) $Al_2O_3.\ 3H_2O$

CG PET -2019

Ans. (b) : Diaspore is ore of alumiuium.
Formula of diaspore, $Al_2O_3 \cdot H_2O$

495. Aluminium is extracted by the electrolysis of

(a) alumina
(b) bauxite
(c) molten cryolite
(d) alumina mixed with molten cryolite

CG PET- 2013

Ans. (d) : Aluminium mixed with molten cryolite.

Aluminium is extracted by the electrolysis of purified Al_2O_3, and that is mixed with Na_3AlF_6 or CaF_2, which have low the melting point of the mixture, and it brings conductivity. Steel cathode and graphite anode are used. The graphite anode is useful here for reduction to metal.

$$Al_2O_3 + 3C \longrightarrow 4Al + 3CO_2.$$

This electrolysis process is known as Hall-Heroult process.

496. Cryolite is used in the electrolytic extration of aluminium

(a) to obtain more aluminium
(b) to decompose bauxite
(c) to protect anodes
(d) as a reducing agent

CG PET -2007

Ans. (b) : To decompose bauxite.

ionization of alumina: $2Al_2O_3 \longrightarrow 6O^{2-} + 4Al^{3+}$

Reaction at Cathode: $4Al^{3+} + 12e \longrightarrow 4Al$

Reaction at anode: $6O^{2-} \longrightarrow 3O_2 + 12e^-$

$$C + O_2 \longrightarrow CO_2.$$

497. The metal that does not give the borax bead test is

(a) Chromium (b) Nickel
(c) Lead (d) Manganese

CG PET -2005

Ans. (c) : The borax bead test is only for colored salts while Pb salts are white, hence they do not give borax bead test.

498. Corundum is

(a) SrO_2 (b) Al_2O_3
(c) $CaCl_2$ (d) Cu_2Cl_2

CG PET -2018

Ans. (b) : Corundum is the crystalline form of Aluminium oxide (Al_2O_3). It is the hardest known natural substance.

499. If we mix a pentavalent impurity in a crystal lattice of Ge, what type of semiconductor formation will occur?

(a) p- type (b) n- type
(c) Both (a) and (b) (d) None of these

CG PET- 2010

Ans. (b) : Pentavalent impurity atoms have five valance electrons hence they give one extra electron and form negative type or n-type semiconductor.

500. Zeiglar Natta catalyst is a mixture of _________.

(a) $TiCl_2\ \&\ (C_2H_5)_3Al$
(b) $TiCl_4\ \&\ (C_2H_5)_2Al$
(c) $TiCl_3\ \&\ (C_2H_5)_4Al$
(d) $(C_2H_5)_3Al\ \&\ TiCl_4$

GUJCET-2020

@apna_pdf

Ans. (d) : Zieglar–Natta catalyst $(C_2H_5)_3Al$ and $TiCl_4$ is the mixture of titanium tetra chloride and an alkyl aluminium derivative.

501. Among the halides of the elements of group 13, one which is most acidic is:

(a) BF_3 (b) $AlCl_3$

(c) BCl_3 (d) BBr_3

HP CET-2018

Ans. (d): BBr_3 is most acidic than other because it accepts electron most readily as it much more electron deficient than other.

502. The one that exist as dimer is:

(a) Aluminium iodide

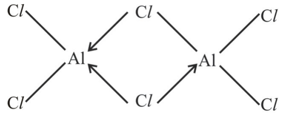
(b) Magnesium chloride

(c) Aluminium chloride

(d) Aluminium bromide

HP CET-2018

Ans. (c) $AlCl_3$ can form a dimer due to 3p → 3p overlap.



503. When metal 'M' is treated with NaOH, a white gelatinous precipitate 'X' is obtained, which is soluble in excess of NaOH. Compound 'X' when heated strongly gives an oxide which is used in chromatography as an adsorbent. The metal 'M' is

(a) Zn (b) Ca

(c) Al (d) Fe

(JEE Main 2018)

Ans. (c):

$$Al + NaOH \longrightarrow \underset{\text{Soluble}}{\left[Al(OH)_4\right]^-}$$

$$Al(OH)_3 + OH^- \longrightarrow \underset{\text{(White ppt)}}{Al(OH)_3}$$

$$2Al(OH)_3 \xrightarrow{heat} Al_2O_3 + 3H_2O$$

Al_2O_3 is used as an absorbent in column chromatography.

504. Boron can't form which one of the following anions?

(a) BF_6^{3-} (b) BH_4^-

(c) $B(OH)_4^-$ (d) BO_2^-

(AIEEE 2011)

Ans. (a) : Due to absence of vacant d-orbital in the outermost orbit, boron cannot form BF_6^{3-} ion.

505. Among the following, the maximum covalent character is shown by the compound.

(a) $SnCl_2$ (b) $AlCl_3$

(c) $MgCl_2$ (d) $FeCl_2$

(AIEEE 2011)

Ans. (b): Covalent character of an ionic compound is directly proportional to charge on ion, hence Al^{3+} possess maximum covalent character.

506. Which one of the following is the correct statement?

(a) Boric acid is a protonic acid

(b) Beryllium exhibits coordination number of six

(c) Chlorides of both beryllium and aluminium have bridged chloride structures in solid phase

(d) B_2H_6. $2NH_3$ is known as 'inorganic benzene'

(AIEEE 2007)

Ans. (c) : Chlorides of both beryllium and aluminium have bridged chloride structures in solid phase.

- Option (a) is wrong because Boric acid is a Lewis acid.
- Option (b) is wrong because, Beryllium exhibits co-ordination number of 4.
- Option (d) is also wrong because $B_3N_3H_6$ is known as inorganic benzene.

507. The type of hybridisation of boron in diborane is

(a) sp hybridisation (b) sp^2 hybridisation

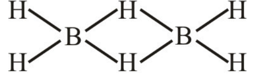
(c) sp^3 hybridisation (d) sp^3d^2 hybridisation

(AIEEE 2007), NEET-1999

AP EAMCET- 1992

Ans. (c) : Diborane (B_2H_6) has two electrons, each three centred bonds.

Each B atom is linked with four H-atom and posses tetrahedral geometry. Hence each Boran atom in diborane is sp^3 hybridised.



Diborane molecule

508. The structure of diborane (B_2H_6) contains

(a) four $2c–2e^-$ bonds and four $3c – 2e^-$ bonds

(b) two $2c–2e^-$ bonds and two $3c – 3e^-$ bonds

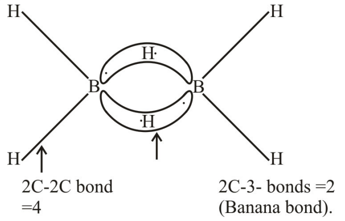
(c) two $2c–2e^-$ bonds and four $3c – 2e^-$ bonds

(d) four $2c–2e^-$ bonds and two $3c – 2e^-$ bonds

AMU-2011, UPTU/UPSEE-2007

(AIEEE 2005)

Ans. (d) : four $2C – 2C^-$ bonds and two $3C-2C^-$ bond.



509. Heating of an aqueous solution of aluminium chloride to dryness will give

(a) $Al(OH)Cl_2$ (b) Al_2O_3

(c) Al_2Cl_6 (d) $AlCl_3$

(AIEEE 2005)

Ans. (b) : Heating of an aqueous solution of aluminium chloride to dryness will give Al_2O_3.

$$AlCl_3 + 3H_2O \longrightarrow Al(OH)_3 + 3HCl$$

On strongly heating.

$$2Al(OH)_3 \longrightarrow Al_2O_3 + 3H_2O$$

@apna_pdf

510. Beryllium and aluminium exhibit many properties which are similar. But the two elements differ in

(a) exhibiting maximum covalency in compounds
(b) forming polymeric hydrides
(c) forming covalent halides
(d) exhibiting amphoteric nature in their oxides

(AIEEE 2004)

Ans. (a) : $BeCl_2$ and $AlCl_3$ have different covalent characters whereas they show many similar properties due diagonal relationship.
Hence, they differ in exhibiting maximum co-valancy in compounds.

511. Aluminium chloride exists as dimer, Al_2Cl_6 in solid state as well as in solution of non-polar solvents such as benzene. When dissolved in water, it gives

(a) $Al^{3+} + 3Cl^-$
(b) $[Al(H_2O)_6]^{3+} + 3Cl^-$
(c) $[Al(OH)_6]^{3-} + 3HCl$
(d) $Al_2O_3 + 6HCl$

(AIEEE 2004)

Ans. (b) : $AlCl_3$ is covalent but in water it becomes ionic due to large hydration energy of Al^{3+}.

$$AlCl_3 + 12H_2O \longrightarrow [Al(H_2O)_6]^{3+} + 12Cl^-$$

512. Alum is widely used to purify water since

(a) if forms complex with clay particles
(b) it coagulates the mud particles
(c) it exchanges Ca^{2+} ana Mg^{2+} ions present in hard water
(d) its sulphate ion is water purifier

(AIEEE 2002)

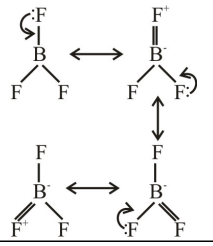
Ans. (b) : Mud is negatively charged colloidal particles hence it is coagulated with Al^{3+}. Ion exchange method is the best to purify water.

513. In which one of the following molecules strongest back donation of an electron pair from halide to boron is expected?

(a) BCl_3
(b) BF_3
(c) BBr_3
(d) BI_3

(JEE Main 2021, 27 Aug Shift-I)

Ans. (b) : Due to smaller size of F atom. BF_3 molecules has strongest back donation of an election pair.



514. Given below are the statements about diborane.

(A) Diborane is prepared by the oxidation of $NaBH_4$ and I_2.
(B) Each boron atom is in sp^2- hybridised state.
(C) Diborane has one bridged 3 centre-2-electron bond.
(D) Diborane is a planar molecule.

The option with correct statement(s) is

(a) (C) and (D) only
(b) (A) only
(c) (C) only
(d) (A) and (B) only

(JEE Main 2021, 22 July Shift-II)

Ans. (b) :

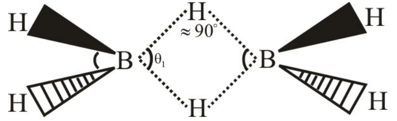
(A) $\underset{\text{Sodium borahydride}}{2NaBH_4} + I_2 \longrightarrow \underset{\text{diborane}}{B_2H_6} + 2NaI + H_2$
Hence (A) is true.
(B) each boron atom is in sp^3–hybridised state. hence (B) is wrong.
(c) Diborane has two bridged 3-centre-2- electron bond, hence (c) is wrong.
(D) Diborane is a tetrahedral molecule, hence (D) is wrong.

515. The correct statement about B_2H_6

(a) all B-H-B angles are of 120°
(b) the two B-H-B bonds are not of same length
(c) terminal B-H bonds have less p-character when compared to bridging bonds
(d) Its fragment, BH_3, behaves as a Lewis base

(JEE Main 2021, 25 Feb Shift-I)

Ans. (c) : Terminal B-H bonds have less p-character when companel to bridging bonds.



$\theta_2 > \theta_1$, B - H (terminal) having less p-character as compare to bridge bond.

517. The correct statements among I to III regarding group 13 element oxides are:

I. Boron trioxide is acidic.
II. Oxides of aluminium and gallium are amphoteric.
III. Oxides of indium and thallium are basic.

(a) I, II and III
(b) I and III only
(c) I and II only
(d) II and III only

(JEE Main 2019, 9 April Shift-II)

Ans. (a) : I, II and III.

B	Acidic oxides	On maxing top to
Al Ga	Amphoteric oxides	bottom in a group the basic character of oxides
In Th	Basic	increases

518. Aluminium is usually found in +3 oxidation state. In contrast, thallium exists in +1 and +3 oxidation states. This is due to

(a) lattice effect
(b) lanthanoid contraction
(c) inert pair effect
(d) diagonal relationship

(JEE Main 2019, 9 Jan Shift-I)

Ans. (c) : Due to the decrease in bond energies down a group, is called inert pair effect.

519. The electronegativity of aluminium is similar to

(a) lithium
(b) carbon
(c) beryllium
(d) boron

(JEE Main 2019, 10 Jan Shift-I)

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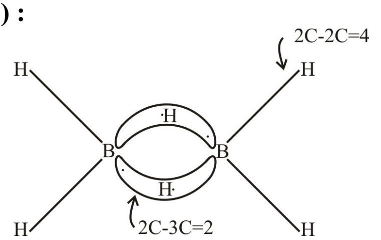
Ans. (c) : Al possess similar properties as Be due to diagonal relationship.

520. The number of 2-centre-2-electron and 3-centre -2-electron bonds in B_2H_6, respectively, are

(a) 4 and 2 (b) 2 and 4
(c) 2 and 2 (d) 2 and 1

(JEE Main 2019, 10 Jan Shift-II)

Ans. (a) :



521. The set in which compounds have different nature is

(a) $B(OH)_3$ and H_3PO_3
(b) $B(OH)_3$ and $A\ell(OH)_3$
(c) NaOH and $Ca(OH)_2$
(d) $Be(OH)_2$ and $A\ell(OH)_3$

JEE Main 03.08.2021 Shift-I

Ans. (b) : $B(OH)_3$ is acidic in nature where as $Al(OH)_3$ is amphoteric in nature.

522. The most stable oxidation state exhibited by Thallium is

(a) 0 (b) +1
(c) +2 (d) +3

J & K CET-(2012)

Ans. (b) : Due inert pair effect Thallium is most stable in oxidation state of + 1.

523. Boron is unable to form BF_6^{3-} because of

(a) High electro negativity of boron
(b) High electro negativity of fluorine
(c) Lack of d-orbital's in boron
(d) Less difference in electro negativity between B and F

J & K CET-(2012)

Ans. (c) : To form BF_6^{3-}, B should have d-orbital's, but Boron do not have d-orbital's hence do not form BF_6^{3-}.

524. What is the main product formed when iodine reacts with hypo?

(a) Na_2SO_4 (b) $Na_2S_4O_6$
(c) Na_2SO_3 (d) Na_2S

J & K CET-(2018)

Ans. (b) :

$$\underset{\text{Hypo}}{2Na_2S_2O_3} + F_2 \longrightarrow \underset{\text{Sodium tetrathianate}}{Na_2S_4O6} + 2NaI$$

525. Boron resembles carbon and silicon in many respects. However, one of the main differences of boron with carbon is that it

(a) has high ionization enthalpy
(b) has a low electronegativity
(c) has a small size
(d) form compounds which often behave as Lewis acids

J & K CET-(1997)

Ans. (d): B passes 3 electrons in outermost shell and has
6 electrons in compound state and has capacity to take lane pair of electron while carbon do not have.

526. The +1 oxidation state of thallium is more stable than its +3 oxidation state because of

(a) Its atomic size
(b) Its ionization potential
(c) Inert pair effect
(d) Diagonal relationship

J & K CET-(2013)

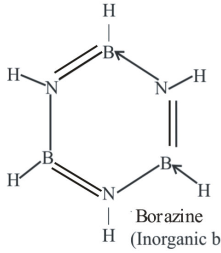
Ans. (c): Thallium (TI) shows +1 and +3 oxidation states because on moving down the group 13, the +1 state becomes more stable as compared to +3 due to inert pair effect.

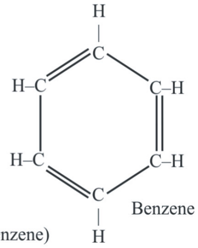
527. Inorganic benzene is

(a) $B_3H_3N_3$ (b) BH_3NH_3
(c) $B_3H_6N_3$ (d) $H_3B_3N_6$

Assam CEE-2020
AMU-2016, JCECE - 2010
UP CPMT-2010, JIPMER-2010

Ans. (c) : Borazine, known as inorganic benzene as its resemble in structure and properties, with benzene.


Borazine (Inorganic benzene)


Benzene

528. Arsenic sulphide is a negative sol. The reagent with least precipitating power is

(a) $AlCl_3$ (b) NaCl
(c) CaF_2 (d) Glucose

JCECE - 2011

Ans. (d) : Glucose carries no charge, thus has least precipitating power.
(Higher the charge of coagulating ion, higher is the precipitating power.)

529. Gallium arsenide is purified by

(a) Froth floatation process
(b) Van-Arkel method
(c) Zone refining method
(d) Electrolytic method

JCECE - 2011

Ans. (c) : Gallium arsenide is used as semiconductor and required in ultrapure form, so it is purified by zone refining method.

530. The hardest substance amongst the following is

(a) Be_2C (b) tritonium
(c) B_4C (d) graphite

JCECE - 2015

Ans. (c) : B_4C is the hardest substance along with diamond.

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531. When ortho boric acid (H_3BO_3) is heated, the residue is

(a) Boron (b) Metaboric acid
(c) Boric anhydride (d) Borax

JCECE - 2015

Ans. (c) : When ortho boric acid (H_3BO_3) is heated, the residue is boric anhydride-

$$2H_3BO_3 \xrightarrow{\Delta(\text{redhot})} \underset{\text{Boric anhydride}}{B_2O_3} + 3H_2O$$

532. The process of converting hydrated alumina into anhydrous alumina is called

(a) Roasting (b) Smelting
(c) Dressing (d) Calcination

JCECE - 2016

Ans. (d) : The process of converting hydrated alumina into anhydrous alumina is called calcination.
Calcination is the process in which the ore of the metal is heated to high temperature in the absence or limited supply of oxygen.

533. H_3BO_3 is a

(a) Monobasic and Lewis acid
(b) Monobasic and Bronsted acid
(c) Tribasic and Lewis acid
(d) Tribasic and Bronsted acid

JCECE - 2016

Ans. (a) : Boric acid (H_3BO_3) is also called as hydrogen borate or orthoboric acid. H_3BO_3 accepts OH^- ion and acts as a weak monobasic Lewis acid.

$$H_3BO_3 + H_2O \longrightarrow B(OH)_4^- + H^+$$

$$K_a = 10^{-9}$$

Since, value of K_a is very small hence, H_3BO_3 is a weak acid.

534. In III group precipitation, NH_4CI is added before adding NH_4OH to

(a) Decrease conc. of OH^- ion
(b) Prevent interference of PO_4^{3-} ion
(c) Increase conc. of Cl^- ion
(d) Increase conc. of OH^- ion

JIPMER-2009

Ans. (a) : NH_4Cl is strong electrolyte, it decomposes completely, which the NH_4OH is weak base it does not ionizes completely. Thus due to presence of common ion NH_4^+ in NH_4Cl, it suppresses the ionization of weak base NH_4OH in order decrease the OH^- concentration so that higher group cations will not get precipitated.

Common ion effect-

$$NH_4OH \rightleftharpoons NH_4^+ + OH^-$$

$$NH_4Cl \rightleftharpoons NH_4^+ + Cl^-$$

535. Which of the following is the electron deficient molecule?

(a) B_2H_6 (b) C_2H_6
(c) PH_3 (d) SiH_4

JIPMER-2007

Ans. (a) : Diborane, B_2H_6 is an electron deficiant species, it contains less number of electron than required for bonding.
In diborane, 14 electrons are required to form 7 bonds however only 12 electrons are present.

536. Which of the following is correct statement?

(a) Aluminium dissolves in dilute mineral acids but is made passive by concentrated nitric acid.
(b) Aluminium vessel can be used as storage of NaOH.
(c) Aluminium chloride does not dissociate in water.
(d) AlF_3 is soluble in anhydrous HF.

JIPMER-2018

Ans. (a) : Aluminium dissolves in dilute mineral acids but is made passive by connected nitric acid.
Aluminium does not react with concentrated nitric acid. A layer of aluminium oxide is formed when aluminium reacts with the nitric acid because nitric acid is an oxidizing agent. Due to the layer of the aluminium oxide nitric acid cannot react with inner aluminium metal.

$$2Al + 6HCl \longrightarrow 2AlCl_3 + 3H_2$$

$$2Al + 3[O] \xrightarrow{HNO_3} Al_2O_3$$

$$2Al + 2NaOH + 2H_2O \longrightarrow 2NaAlO_2 + 3H_2$$

537. A Lewis acid 'X' reacts with $LiAlH_4$ in ether medium to give a highly toxic gas. This gas when heated with NH_3 gives a compound commonly known as inorganic benzene. The gas is

(a) B_2O_3 (b) B_2H_6
(c) $B_3N_3H_6$ (d) BF_3

Karnataka-CET-2020

Ans. (b) : Let's, Lewis acid 'X' = BCl_3

$$4BCl_3 + LiAlH_4 \longrightarrow \underset{\text{toxic gas}}{2B_2H_6} + 3AlCl_3 + 3LiCl$$

$$3B_2H_6 + 6NH_3 \longrightarrow 3\left[BH_2(NH_3)_2\right]^4\left[BH_4\right]^- \xrightarrow{\Delta} \underset{\text{inorganic benzene}}{2B_3N_3H_6} + 12H_2$$

538. Which of the following metallic oxide exhibit amphoteric nature?

(a) CaO (b) Al_2O_3
(c) Na_2O (d) BaO

Karnataka-CET-2017

Ans. (b) : Oxides of Al and Ga are amphoteric in nature.
Hence, Al_2O_3 exhibit in amphoteric nature.

539. The complex formed when Al_2O_3 is leached from bauxite using conc. NaOH solution is,

(a) $Na[Al(OH)_4]$ (b) $NaAl_2O_4$
(c) $Na_2[Al(OH)_3]$ (d) Na_2AlO_2

Karnataka-CET-2016

Ans. (a) : When bauxite is leached by NaOH it gives $Na[Al(OH)_4]$, dissolve in NaOH.

$$Al_2O_3 + 2NaOH + 3H_2O \longrightarrow \underset{\text{Bauxite}}{2Na\left[Al(OH)_4\right]}$$

540. Which of the following cations will have minimum flocculation value for arsenic sulphide sol?

(a) Na^+ (b) Mg^{2+}
(c) Ca^{2+} (d) Al^{3+}

Karnataka-CET-2013

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Ans. (d) : According to Hardy Schulze law, Flocculation values will be minimum for the ion having higher coagulation power of an ion.

541. Boric acid is used in carom boards for smooth gliding of pawns because.

(a) H_3BO_3 molecules are loosely chemically bonded and hence soft
(b) Its low density makes it fluffy
(c) It can be powdered to a very small grain size
(d) It is chemically inert with the plywood
(e) H-bonding in H_3BO_3 gives it layered structure

Kerala-CEE-2006

Ans. (a): H-bonding in H_3BO_3 gives it layered structure. Because of this layered structure, the pawns can easily slip over the surface of boric acid.

542. Each B–H–B bridge in B_2H_6 is formed by the sharing of:

(a) 2 electrons
(b) 4 electrons
(c) 1 electron
(d) 3 electrons
(e) 8 electrons

Kerala-CEE-2004

Ans. (a): In B_2H_6, B–H–B bridge is formed by the sharing of 2 electron.

543. Be and Al exhibit diagonal relationship. Which of the following statements about them is/are not true?

I. Both react with HCL to liberate H_2
II. They are made passive by HNO_3
III. Their carbides given acetylene on treatment with water
IV. Their oxides are amphoteric

(a) III and IV
(b) I and III
(c) I only
(d) II and III
(e) III only

Kerala-CEE-2011

Ans. (e) : The carbides of both Be and Al liberate methane with water.

$$Be_2C + 2H_2O \longrightarrow 2BeO + CH_4$$

$$Al_4C_3 + 6H_2O \longrightarrow 2Al_2O_3 + 3CH_4$$

544. The correct formula of borax is

(a) $Na_2\,[B_4O_4(OH)_3].\,9H_2O$
(b) $Na_2\,[B_4O_5(OH)_4].\,8H_2O$
(c) $Na_2\,[B_4O_6(OH)_5].\,7H_2O$
(d) $Na_2\,[B_4O_7(OH)_6].\,6H_2O$
(e) $Na_2\,[B_4O_8(OH)_7].\,5H_2O$

Kerala-CEE-2013

Ans. (b): $Na_2\left[B_4O_5(OH)_4\right]\cdot 8H_2O$ - Borax formula

545. Oxyacids of phosphorus and the starting materials for their preparation are given below.

Oxyacid – Materials for preparation

(A) H_3PO_2 –	**(i) Red P + alkali**
(B) H_3PO_3 –	**(ii) P_4O_{10} + H_2O**
(C) H_3PO_4 –	**(iii) P_2O_3 + H_2O**
(D) $H_4P_2O_6$ –	**(iv) White P + alkali**

Choose the correct answer from the codes given below

(a) (A) – (iv); (B) – (iiii); (C) – (ii); (D) – (i)
(b) (A) – (i); (B) – (iii); (C) – (ii); (D) – (iv)
(c) (A) – (iv); (B) – (iii); (C) – (i); (D) – (ii)
(d) (A) – (ii); (B) – (iii); (C) – (i); (D) – (iv)
(e) (A) – (iiii); (B) – (i); (C) – (ii); (D) – (iv)

Kerala-CEE-2013

Ans. (a) :

	Material for preparation	Oxyacid
(i)	White P + Alkali	$\longrightarrow H_3PO_2$
(ii)	$P_2O_3 + 3H_2O$	$\longrightarrow 2H_3PO_3$
(iii)	$P_4O_{10} + 6H_2O$	$\longrightarrow 4H_3PO_4$
(iv)	Red P + Alkali	$\longrightarrow H_4P_2O_6$.

Hence, option (a) is the correct answer.

546. Choose the correct statements about diborane

(I) It is prepared by the oxidation of sodium borohydride with iodine.
(II) It undergoes cleavage reactions with Lewis bases to give borane adducts.
(III) It is produced on an industrial scale by a reaction of BF_3 with $LiAlH_4$.
(IV) It is readily hydrolysed by water to give borazine.
(V) It burns is oxygen and gives boron trioxide.

(a) I, II, III
(b) I, II, V
(c) I, II, IV
(d) II, III, IV
(e) I, III, V

Kerala-CEE-2020

Ans. (b) : (i) Diborane is prepared in the laboratory by oxidation of $NaBH_4$ with iodine in diglyme as solvent.

On industrial scale, diborane is obtained by the reaction of BF_3 with NaH.

Diborane readily hydrolysed by water to give boric acid. Diborane burns in oxygen to give Borontrioxide and water.

$$2NaBH_4 + I_2 \rightarrow \underset{\text{Diborane}}{B_2H_6} + 2NaI + H_2$$

547. Which of the following anions is present in the chain structure of silicates?

(a) $(Si_2O_5^{2-})_n$
(b) $(Si_2O_3^{2-})_n$
(c) $Si_2O_4^{4-}$
(d) $Si_2O_7^{6-}$

Manipal-2016

Ans. (b) :

Single chain $(SiO_3^{2-})_n$ Si : O → 1 : 3.
Double chain $(Si_4O_{11}^{6-})_n$ Si : O → 4 : 11
Silicate sheet $(Si_2O_5^{2-})_n$

Thus, anions present in chain structure of the silicate is $\left(SiO_3^{2-}\right)_n$

548. The diagonal relationship in Be and Al is due to

(a) Similar ionization enthalpy
(b) Similar metallic character
(c) Similar ionic size and charge/radius ratio
(d) Similar electronegativity

MHT CET-03.05.2019, SHIFT-I

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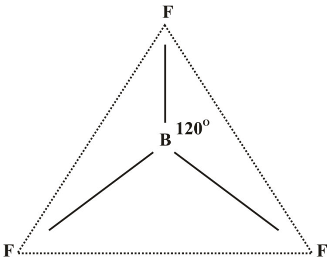
Ans. (c) : Be and Al have a diagonal relationship because their ionic sizes and charge/radius ratios are similar.

549. BF_3 is planar and electron deficient compound. Hybridization and number of electrons around the central atom, respectively are

(a) sp^2 and 8 (b) sp^3 and 4
(c) sp^3 and 6 (d) sp^2 and 6

NEET-2021

Ans. (d) :



- Hybridization = sp^2
- Number of electrons = 6
- Shape is trigonal planar

550. The correct order of atomic radii in group 13 element is

(a) B < Al < In < Ga < Tl
(b) B < Al < Ga < In < Tl
(c) B < Ga < Al < Tl < In
(d) B < Ga < Al < In < Tl

NEET-2018

Ans. (d): On moving down the group, the atomic radii increases. However, due to poor shielding of nuclear charges by 3d-elctrons $r_{Ga} < r_{Al}$. The electrons in outermost shell of Ga experience more force of attraction towards nucleus then Al which decreases atomic radius, as Ga has 10-d electrons which do not screen the nuclear charge in an effective manner. The order of atomic radii in group 13 element is-

B < Ga < Al < In < Tl

551. AlF_3 is soluble in HF only in presence of KI. It is the to the formation of

(a) $K_3[AlF_3H_3]$ (b) $K_3[AlF_6]$
(c) AlH_3 (d) $K[AlF_3H]$

NEET-II 2016

Ans. (b) : AlF_3 is insoluble in anhydrous HF because the F^- ions are not available in hydrogen bonded HF but it becomes soluble in presence of little amount of KF due to formation of soluble complex.

$$AlF_3 + 3KF \longrightarrow K_3\left[AlF_6\right].$$

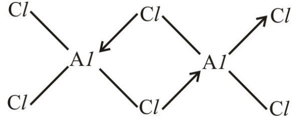
Hence, option (b) is the right answer.

552. Aluminium (III) chloride forms a dimer because aluminium

(a) Belongs to 3rd group
(b) Can have higher coordination number
(c) Cannot form a trimer
(d) Has high ionization energy

NEET-1995

Ans. (b): $AlCl_3$ forms a dimer as there is unsaturation in coordination. Also it enables Al atoms to complete their octets. Higher coordination can be achieved by Al due to its incomplete p-subshell.



553. Which one of the following elements is unable to form MF_6^{3-} ion?

(a) Ga (b) Al
(c) B (d) In

NEET-2018

Ans. (c): Boron does not have any vacant d-orbitals in its valence shell, so it cannot expand its covalency beyond 4. i.e. Boron cannot form the ion like MF_6^{3-} i.e. BF_6^{3-}.

554. The tendency of BF_3, BCl_3 and BBr_3 to behave as Lewis acid decreases in the sequence

(a) $BCl_3 > BF_3 > BBr_3$ (b) $BBr_3 > BCl_3 > BF_3$
(c) $BBr_3 > BF_3 > BCl_3$ (d) $BF_3 > BCl_3 > BBr_3$

NEET-2010

Ans. (b): Lewis acid has tendency to accept lone pair electron. In BF_3, boron has a vacant. 2p-orbital and each fluorine has fully filled unutilized 2p-orbitals. Fluorine transfers two electrons to vacant 2p-orbitals of boron, thus forming pπ– pπ bond.

The tendency to back donate decreases from F to 2 as energy level deference between B and halogen atom increases from F to I. So order of Lewis acid is-

$BBr_3 > BCl_3 > BF_3$

555. The relative Lewis acid character of boron trihalides is in the order

(a) $BI_3 > BBr_3 > BF_3 > BCl_3$
(b) $BI_3 > BBr_3 > BCl_3 > BF_3$
(c) $BF_3 > BCl_3 > BBr_3 > BI_3$
(d) $BCl_3 > BF_3 > BI_3 > BBr_3$

AMU-2019
JCECE-2015
J & K CET-2012
AMU-2005
Kerala CEE-2005

Ans. (b) : Boron halides are lewis acids. The order of acidic strength $BBr_3 > BF_3$, Less acidic nature of BF_3 is II-back bonding.

Thus, The Lewis acidity increases in the order

$BF_3 < BCl_3 < BBr_3 < BI_3$

556. Boric acid is an acid because its molecule

(a) Contains replaceable H^+ ion
(b) Gives up a proton
(c) Accepts OH^- from water releasing proton
(d) Combines with proton from water, molecules

NEET-II 2016
UP CPMT-2012

Ans. (c) : Accepts OH^- from water releasing a proton

$$H_3BO_3 + H_2O \rightleftharpoons [B(OH)_4]^- + H^+$$

when it reacts with water, boric acid accepts hydroxide to release a proton from water.

@apna_pdf

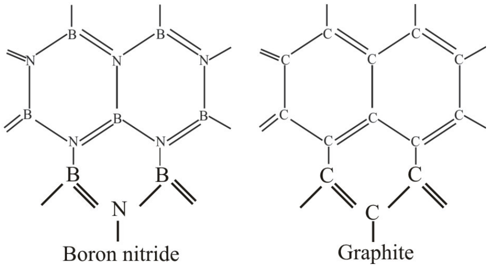
557. Which of the following structure is similar to graphite?

(a) B_4C (b) B_2H_6

(c) BN (d) B

NEET-2013

Ans. (c) : Boron Nitride (BN) has similar structure to graphite. Boron nitride sometimes also referred to as inorganic graphite.



558. Which of the following statements about H_3BO_3 is not correct?

(a) It has a layer structure in which planar BO_3 units are joined by hydrogen bonds

(b) It does not act as proton donor but acts as a Lewis acid by accepting hydroxyl ion

(c) It is a strong tribasic acid

(d) It is prepared by acidifying an aqueous solution of borax

NEET-1994

Ans. (c) : It is a strong tribasic acid.
H_3BO_3 is a weak monobasic acid.

559. Zeolite which is used for softening of hard water is

(a) hydrated sodium aluminium silicate

(b) Sodium calcium silicate

(c) sodium borosilicate

(d) calcium magnesium silicate

AMU–2003

Ans. (a) : Zeolite: $Na_2O.Al_2O_3.2SiO_2.xH_2O$
A zeolite is a hydrated sodium aluminium silicate which is used for softening of hard water through ion exchange.

560. Which of the following does not exhibit inert pair effect?

(a) Al (b) TI

(c) Pb (d) Bi

UP CPMT-2014

Ans. (a) : Inert pair effect is only exhibited by higher members of p–block elements. Thus, Al does not exhibit this effect.

561. Which of the following species does not exist?

(a) BF_3 (b) $B(OH)_6^{3-}$

(c) Al_2Cl_6 (d) $AlCl_3$

UP CPMT-2014

Ans. (b): $B(OH)_6^{3-}$ B because of the absence of d–orbitals, cannot extend its covalency beyond 4 and hence, $B(OH)_6^{3-}$ does not exist.

562. Which of these is least likely to act as a Lewis base?

(a) NH_3 (b) BH_3

(c) R– O –H (d) R_2O

UP CPMT-2014

Ans. (b) : BH_3, being electron deficient, have a tendency of gaining, not losing electrons, so it behaves like a Lewis acid that's why it is a least likely to act as a Lewis base.

563. Ammonal used in bombs is a mixture of

(a) Al + KNO_3 (b) Al + Al_2O_3 + B_2O_3

(c) Al + $Al(NO_3)_3$ (d) Al_2O_3 + C

UP CPMT-2011

Ans. (c) : Mixture of Al powder and $Al(NO_3)_3$, know as ammonal, it is used in explosive bombs.

564. The process of converting hydrated alumina into anhydrous alumina is called

(a) Roasting (b) Smelting

(c) Dressing (d) Calcination

UP CPMT-2009

Ans. (d): Concentrated hydroxide ores (hydrated alumina) are converted into their oxide (anhydrous alumina) by a process, called calcination, in which the concentrated ore is heated in a limited supply of air.

565. In solid CO_2, small molecules are held together by

(a) Electrical attraction

(b) Covalent bond forces

(c) Strong electrostatic attraction

(d) Vander Waal's forces.

AMU–2003

Ans. (d) : Vander Waals's forces.
The force of attraction between the molecules of CO_2 in solid state is Vander Waal's force of attraction.

566. Electron deficient molecule is

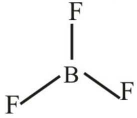
(a) CCl_4 (b) PCl_5

(c) BF_3 (d) SF_6

UP CPMT-2005

Ans. (c): Boron contains six electrons in its valence shell so, it is capable to accommodate one pair of electrons. Hence it acts as Lewis acid. As we know Lewis acid has tendency to accept a pair of electron.

BF_3



Boron (central atom) has 6 electrons in valence shell, 3 from boron and one each from three fluorine atoms.
∵ Boron in BF_3 has less than 8 electrons.
So, BF_3 is a electron deficient molecule.

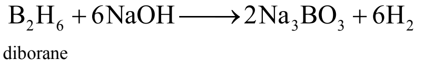
567. Fusion of boron with NaOH produces

(a) $B_2O_3 + H_2$ (b) $NaBO_2 + H_2$

(c) $Na_2B_4O_7 + H_2$ (d) $Na_3BO_3 + H_2$

UP CPMT-2001

Ans. (d): All the boron are decomposed by aqueous NaOH. Each B–B or B–H bond in a molecule of boron liberates one molecule of H_2.



$$\underset{\text{diborane}}{B_2H_6} + 6NaOH \longrightarrow 2Na_3BO_3 + 6H_2$$

@apna_pdf

568. Borax bead test of Cr (chromium) is:

(a) Green (b) Blue

(c) Violet (d) Brown

UPTU/UPSEE-2005

Ans. (a) : Borax bead test of Cr form Cr^{3+} (Dark green bead). In borax bead text, metal oxide reacts with a glass bead to form metaborates.

$$\underset{\text{}}{Cr_2O_3 + B_2O_3 \xrightarrow{\Delta} \underset{\text{Green colour}}{Cr(BO_2)_3}}$$

569. Inorganic graphite is

(a) B_2H_6 (b) BN

(c) BF_3 (d) $B_2N_3H_6$

UPTU/UPSEE-2017

BITSAT-2010

Ans. (b) : BN has similar structure to graphite, hence called inorganic graphite because it structure is like graphite with alternating boron and nitrogen atoms replacing the carbon atoms in the hexagonal structure.

570. When borax is heated strongly, it gives

(a) $BaBO_2$ (b) B_2O_3

(c) $B_3N_3H_6$ (d) $Na_2B_4O_7$

UPTU/UPSEE-2010

Ans.(b):

$$Na_2B_4O_7.10H_2O \xrightarrow[-10H_2O]{\text{heat}} Na_2B_4O_7 \xrightarrow{\text{heat}} 2NaBO_2 + B_2O_3$$

$NaBO_2 + B_2O_3$ is formed on heating borax.

571. The magnetic nature of boron molecule is same as the magnetic nature of

(a) nitrogen molecule

(b) carbon molecule

(c) unipositive nitrogen molecule

(d) oxide ion

UPTU/UPSEE-2010

Ans. (c): Unipositive nitrogen molecule.

Boron molecule and unipositive nitrogen molecule both are paramagnetic in nature.

572. $B(OH)_3$ is a

(a) Triacid base (b) Tribasic acid

(c) Monoacid base (d) Monobasic acid

Assam CEE-2014

Ans. (d) : $B(OH)_3$ is weak mono basic acid and lewis acid. It takes OH^- ion from water and leaves H^+ ion.

$$B(OH)_3 + H_2O \rightleftharpoons [B(OH)_4]^- + H^+$$

573. The correct statement about B_2H_6 is/are:

(a) All B atoms are sp^3 hybridised

(b) It is paramagnetic

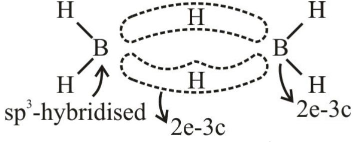
(c) It contains 3C – 4e bonding

(d) There are two types of H present

WB-JEE-30.04.2022

Ans. (a, d) : All B atoms are hybridised sp^3.

There are two types of H-bonds are presents.



3. H_b....B....H_b....bond angle is 130°

4. All H in B_2H_6 in the same plane.

574. Which of the following metals has the largest abundance in the earth's crust?

(a) Aluminium (b) Calcium

(c) magenesium (d) sodium

WB-JEE-2010

Ans. (a): Aluminium metal has the largest abundance in the earth crust.

Aluminium	82000 ppm	(8.3%)
Calcium	50000 ppm	(4.15%)
Magnesium	23,300 ppm	(2.33%)
Sodium	23600 ppm	(2.36%)

575. Which of the following contains P-O-P bond?

(a) Hypophosphorous acid

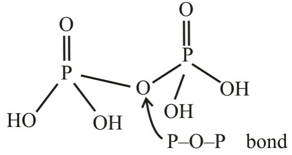
(b) Phosphorous acid

(c) Pyrophosphoric acid

(d) Orthophosphoric acid

WB-JEE-2010

Ans. (c): Pyrophosphoric acid



P–O–P contains in pyro phosphoric acid

576. In borax the number of B —O—B links and B—OH bonds present are, respectively

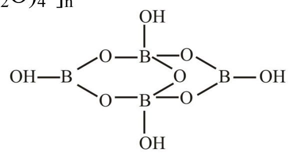
(a) five and four (b) four and five

(c) three and four (d) five and five

WB-JEE-2013

Ans. (a) : Five and four.

Borax : $[Na(H_2O)_4^+]_n$



Number of B–OH Bonds = 4

Number of B–O–B bonds = 5

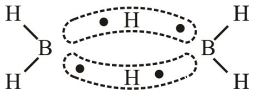
577. In diborane, the number of electrons that accounts for bonding in the bridges is

(a) six (b) two

(c) eight (d) four

WB-JEE-2013

Ans. (d) :



Four electrons accounts for bonding in the bridges.

B–H–B→3C–2e⁻

bond = $2e^-$

B–H–B = $2\times2e^- = 4e^-$

578. Which of the following oxides is the most acidic?

(a) BeO (b) MgO

(c) Al_2O_3 (d) Cl_2O_7

AMU-2013

Ans. (d) : Oxides of chlorine are acidic

The acidic nature increases as % of oxygen incenses.

Thus, Cl_2O_7 is the most acidic oxide. .

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579. The reducing power of Al, Ga, In and Tl follows the sequence

(a) Al > Ga > In > Tl (b) Tl > In > Ga >Al
(c) Al > In > Ga > Tl (d) In > Ga > Al > Tl

AMU-2007

Ans. (b): Tl > In > Ga > Al.
- Reducing power increases down the group and decreases along the period.

4. Carbon Family

580. Match List-I with List – II

List – I (Si-Compounds)		**List - II (Si-Polymeric/other Products)**	
(A)	**$(CH_3)_4Si$**	**(I)**	**Chain Silicon**
(B)	**$(CH_3)Si(OH)_3$**	**(II)**	**Dimeric Silicon**
(C)	**$(CH_3)_2Si(OH)_2$**	**(III)**	**Silane**
(D)	**$(CH_3)_3Si(OH)$**	**(IV)**	**2D Silicon**

Choose the correct answer from the option Given below:

(a) (A)-(III), (B)-(II), (C)-(I), (D)-(IV)
(b) (A)-(IV), (B)-(I), (C)-(II), (D)-(III)
(c) (A)-(II), (B)-(I), (C)-(IV), (D)-(III)
(d) (A)-(III), (B)-(IV), (C)-(I), (D)-(II)

JEE Main-27.06.2022, Shift-I

Ans. (d) :
$Si(CH_3)_4 \rightarrow$ Silane
$Si(CH_3)(OH)_3 \rightarrow$ 2D Silicon
$Si\ (CH_3)_2(OH)_2 \rightarrow$ Chain silicon
$Si\ (CH_3)_3OH \rightarrow$ Dimeric silicones

581. Which of the following elements is considered as a metalloid?

(a) Sc (b) Pb
(c) Bi (d) Te

JEE Main-26.06.2022, Shift-II

Ans. (d) : Scandium (Sc), Lead (Pb) and Bismuth are metal Tellurium (Te) is metalloid.

582. Which one of the following statements is not correct?

(a) Application of lime makes the soil acidic
(b) High acidity in soil is typical of humid climate
(c) Increasing soil acidity results in declining soil fertility
(d) Arid climate is characterized by alkaline soil

NDA (II)-2015

Ans : (a) Application of lime don't make soil acidic because lime is a strong base.

583. Which one of the following elments is used in pencil-lead?

(a) zinc (b) Lead
(c) Carbon (Graphite) (d) Tin

NDA (I)-2017

Ans : (c) Graphite is a allotropes of carbon which is used in pencil lead. Graphite molecules are made up of layered layers of flat clusters of carbon atoms.

584. Glass is a

(a) liquid
(b) colloid
(c) non-crystalline amorphous solid
(d) crystalline solid

NDA (I)-2017

Ans : (c) Glass is an non-crystalline amorphous solid material that exhibits a glass transition, which is the reversible transition in amorphous materials from hard and relatively brittle state into a molten or rubber-like state.

585. Consider the following reaction:

$$CH_4 + 2O_2 \longrightarrow CO_2 + 2H_2O$$

Which of the following about the reaction given above is/are correct?
1. Carbon is oxidized.
2. Hydrogen is oxidized.
3. Hydrogen is reduced.
4. Carbon is reduced.
Select the correct answer using the code given below.

(a) 1 only (b) 1 and 2 only
(c) 2 and 3 only (d) 2 and 4 only

NDA (II)-2017

Ans. (b) : $CH_4 + 2O_2 \rightarrow CO_2 + H_2O$ is the combustion of methane.
In the combustion of methane, carbon loses hydrogen and gains oxygen, so it is being oxidized. Oxygen gains hydrogen (and carbon), so it is being reduced. Hydrogen gains oxygen (and loses carbon), so it is being oxidized.

586. Molecules of which of the following has cage like structure?
1. Diamond
2. Graphite
3. Fullerenes
Select the correct answer using the code given below:

(a) 1, 2, and 3/1 (b) 2 and 3 only
(c) 2 only (d) 3 only

NDA (I)-2017

Ans : (d) Fullerenes has cage like structure. Fullerenes are molecules composed entirely of carbon with spherical (buckyballs), ellipsoid, tubular or a combination shape.

587. How is carbon black obtained?

(a) By heating wood at high temperature in absence of air
(b) By heating coal at high temperature in absence of air
(c) By burning hydrocarbons in a limited supply of air
(d) By heating coal at high temperature in presence of air

NDA (I)-2018

Ans. (c) : Carbon black is obtained from burning hydrocarbons in a limited supply of air

$$CH_4 + \underset{\text{(limited supply)}}{O_2} \rightarrow \underset{\text{Carbon Black}}{C} + 2H_2O$$

588. Which one of the following properties is NOT true for graphite?

@apna_pdf

(a) Hybridisation of each carbon atom is *sp^3*
(b) Hybridisation of each carbon atom is *sp^2*
(c) Electrons are delocalized over the whole sheet of atoms
(d) Each layer is composed of hexagonal rings

NDA (I)-2018

Ans. (a) : In Graphite, the hybridization of each carbon atom is not sp^3. A graphite crystal consist of layers of carbon atoms or sheets of carbon atoms. Every carbon atom in a graphite is layered joined to the other three carbon atoms by strong covalent bonds to form flat hexagonal rings.

589. Which one of the following is the purest form of Carbon?
(a) Charcoal
(b) Coke
(c) Fullerene
(d) Carbon black

NDA (I)-2018

Ans. (c) Fullerene is the purest form of carbon. Fullerene have smooth structure without having changing bonds. The pure solid form of pure or mixed fullerenes is called fullerite.

590. The Poisonous nature of Carbon monoxide (CO) is due to its
(a) insolubility in water
(b) ability to form a complex with haemoglobin
(c) ability to reduce some metal oxides
(d) property of having one sigma bond

NDA (I)-2018

Ans. (b) : The poisonous nature of Carbon Monoxide (CO) is due to its ability to reduce some metal oxide. Carbon monoxide gas is poisonous because it combines with haemoglobin in the blood of human body.

591. Which one of the following statements is not correct?
(a) All carbons in diamond are linked by carbon-carbon single bond
(b) Graphite is layered structure in which layers are held together by weak van der Waals forces
(c) Graphite layers are formed by hexagonal rings of carbon atoms
(d) Graphite layers are held together by carbon-carbon single bond

NDA (II)-2018

Ans. (d) : Graphite is layered structure in which layers are hold together by van der Waals force and not by carbon-carbon single bond.

592. Which one of the following is called 'syngas'?
(a) $C(s) + H_2O(g)$
(b) $CO(g) + H_2O(g)$
(c) $CO(g) + H_2(g)$
(d) $NO_2(g) + H_2(g)$

NDA (II)-2018

Ans. (c) : Syngas is a mixture of carbon monoxide and dihydrogen. Since the mixture of the two gases is used for the synthesis of methanol, it is called syngas.
Hence, $CO(g)+H_2(g)$ is called syngas.

593. Which one of the following is termed as 'Dry ice'?
(a) Ice present in ice-cream
(b) Solid water at Antarctica
(c) Solid state of carbon dioxide
(d) Solid water of ionosphere

NDA (II)-2019

Ans : (c) Solid Carbon dioxide (CO_2) is also called dry ice because on decreasing pressure it converts directly into solid state without coming in liquid state.

594. SiO_2 is soluble in;
(a) H_2SO_4
(b) HNO_3
(c) HF
(d) HCl

AP-EAMCET (Med.)-1999

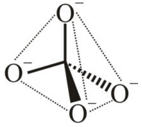
Ans. (c) : Silica (SiO_2) is soluble in HF due to the formation of H_2SiF_6 the two steps reaction shown below-

$$SiO_2+4HF \rightarrow SiF_4+2H_2O$$
$$SiF_4+2HF \rightarrow H_2SiF_6$$

595. Which one of the following is not correct in respect of ortho -silicates?
(a) They are not formed by discrete SiO_4^{4-} unit
(b) The unit SiO_4^{4-} makes a cyclic frame work.
(c) There is no double bond between Si and O atoms
(d) They are used as gem-stone

SCRA 2012

Ans. (c) : Ortho silicates are the simplest silicates which contain discrete SiO_4^{4-} tetrahedral units. The basic structure of ortho silicate unit is shown below. No double bond between Si-O is present.



596. The process of slow cooling of glass is called
(a) Annealing
(b) Hardening
(c) Tempering
(d) None of these

AP EAMCET- 1991

Ans. (a) : The process of slow cooling of glass is called **annealing**. The process of annealing glass relieves internal stresses, which could otherwise leave it susceptible to cracking or shattering in response to minor mechanical or thermal shock. The annealing temperature range is 454-482°C.

597. The reagent that has action on glass is
(a) Aqua regia
(b) Hydrofluoric acid
(c) Oleum
(d) Fuming HNO_3

AP EAMCET- 1991

Ans. (b) : The reagent that has action on glass is hydrofluoric acid. Glass is supercooled liquid. It is soluble in HF due to formation of H_2SiF_6.
$6HF + SiO_2 \rightarrow H_2SiF_6 + 2H_2O$

598. The melting point of diamond is very high since the type of bonding in it is
(a) Two dimensional network
(b) Metallic
(c) Covalent coordinate
(d) Three dimensional giant network

AP EAMCET- 1993

Ans. (d) : Diamond is a three dimensional gaint network due to which its melting point is extremely high. Diamond are made of carbon so they form as carbon atoms under a high temperature and pressure.

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599. Glass is soluble in a solution of
(a) Hydrochloric acid (b) Hydrofluoric acid
(c) Sulphuric acid (d) Nitric acid

AP EAMCET- 1993

Ans. (b) : Glass is soluble in a solution of HF. This property is made use in the process of etching.

$$4HF + SiO_2 \rightarrow SiF_4 + 2H_2O$$

SiO_2 present in glass reacts with HF to form SiF_4. Therefore glass is soluble in HF.

600. Ordinary glass is a combination of the following
(a) SiO_2, Na_2SiO_3, $CaSiO_3$
(b) SiO_2,Na_2CO_3,$CaCO_3$
(c) Na_2CO_3,K_2CO_3,SiO_2
(d) SiO_2, $PbCO_3$, $CaSiO_3$

AP EAMCET- 1995

Ans. (a) : The ordinary glass is a composition of SiO_2, Na_2SiO_3 and $CaSiO_3$. Ordinary glass is used for making bottles, windows, pans, ordinary glass tubes, glass sheets etc.

601. The glass which contains PbO mainly is
(a) Soda glass (b) Flint glass
(c) Pyrex glass (d) Borosil

AP EAMCET- 1995

Ans. (b) : The glass which contains PbO is mainly is flint glass. The molecular formula of flint glass is $K_2O.PbO. 6SiO_2$

602. The inert form of carbon is
(a) Diamond (b) Graphite
(c) Coal (d) Charcoal

AP EAMCET- 1995

Ans. (a) : The inert form of carbon is diamond because they do not react with acids or bases.
Diamond and Graphite are the inert allotropic form of carbon.

603. Silica is soluble in
(a) HCl (b) HNO_3
(c) H_2SO_4 (d) HF

AP EAMCET- 1998
Haryana PMT-2009

Ans. (d) : Silica is soluble in HF due to formation of H_2SiF_6 according to the two steps reaction shown.

$$SiO_2 + 4HF \rightarrow SiF_4 + 2H_2O$$
$$SiF_4 + 2HF \rightarrow H_2SiF_6$$

604. Carbogen is
(a) Pure form of carbon
(b) $COCl_2$
(c) Mixture of CO and CO_2
(d) Mixture of O_2 and CO_2

AP EAMCET- 1998

Ans. (d) : Carbogen is a mixture of 90% O_2 an 10% CO_2. It's also called Meduna's mixture after its inventer Ladislas Meduna.

605. During Serpeck's process, silica is eliminated as
(a) Si (solid) (b) SiO_2(vapour)
(c) SiO_2(solid) (d) Si (vapour)

AP EAMCET- 2000

Ans. (d) : In Serpeck's Process is used for the purification of bauxite ore containing silica (SiO_2) as the main impurity. Therefore, Serpeck's process silica is eliminated as Si (vapor).

$$SiO_2 + 2C \xrightarrow{1800^0C} Si + 2CO$$

606. Which of the following is not correct?
(a) SiO_2 is used as acid flux.
(b) The distance between the layers in graphite is $3.35X10^{-8}$cm
(c) SiO_2 reacts with Na_2CO_3 and Liberates CO
(d) The hybridization of C in graphite is sp^2

AP EAMCET- 2005

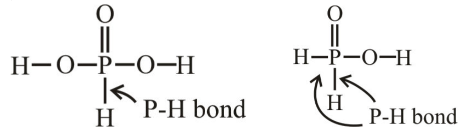
Ans. (c) : Silica (SiO_2) reacts with sodium carbonate to form the sodium meta silicate and carbon dioxide gas liberate. Hence, the statement c is false.

$$SiO_2 + Na_2CO_3 \rightarrow \underset{\text{Sodium silicate}}{Na_2SiO_3} + CO_2\uparrow$$

607. Which pair of oxyacids of phosphorus contains 'P — H' bonds?
(a) H_3PO_4, H_3PO_3 (b) $H_3PO_5, H_4P_2O_7$
(c) H_3PO_3, H_3PO_2 (d) H_3PO_2, HPO_3

AP EAMCET (Engg.)-2009

Ans. (c): H_3PO_3, H_3PO_2



608. Which of the following species do not exist ?
(a) $[SiF_6]^{2-}$ (b) $[SiCl_6]^{2-}$
(c) $[GeCl_6]^{2-}$ (d) $[SiF_5]$-

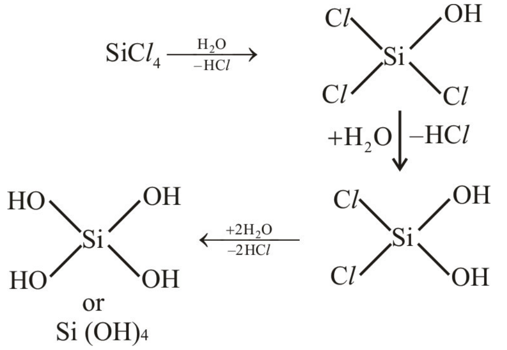
AP EAPCET 24.08.2021 Shift-II

Ans. (b): $[SiF_6]^{2-}$ has F atoms are 2p orbital and smaller size and interaction of F lone pair electron with d-orbitals of silicon are stronger in F. $[SiCl_6]^{2-}$ has Cl atoms are 3p orbital and larger size so interaction of Cl lone pair electron with d-orbitals of silicon are not stronger so do not exist.

609. What would be the product of following reaction $SiCl_4 \xrightarrow{\text{excess of } H_2O}$? (Major Product)
(a) $SiCl_3(OH)$ (b) $Si(OH)_4$
(c) $SiCl_3(OH)_2$ (d) $SiCl_4$(no reaction)

AP EAPCET 20.08.2021 Shift-I

Ans. (b):



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610. Identify (P) and (Q) in the following reaction:

$$\mathbf{CH_3Cl + Si \xrightarrow[570K]{Cu-powder} (P) \xrightarrow{H_2O} (Q) \longrightarrow}$$

Straight chain polymer

(a) P: $(CH_3)_3\,SiCl$ Q: $(CH_3)_3SiOH$
(b) P: $(CH_3)_2\,SiCl_2$ Q: $(CH_3)_2Si(OH)_2$
(c) P: $(CH_3)_2SiCl_2$ Q: $(CH_3)_2Si(OH)Cl$
(d) P: $(CH_3)_2SiCl_2$ Q: $(CH_3)_2\,SiO$

AP EAPCET 19-08-2021 Shift-I

Ans. (b): Mechanics

$$\begin{tikzcd} CH_3Cl+Si \arrow[r, "Cu-powder", "570K"'] & (P) \arrow[r, "H_2"] & (Q) \arrow[d] \\ & & \text{Straight chain polymer} \end{tikzcd}$$

$$2CH_3Cl+Si \xrightarrow[570K]{Cu-powder} \underset{(P)}{(CH_3)_2SiCl_2} \xrightarrow{H_2O} \underset{(Q)}{(CH_3)_2Si(OH)_2} + 2HCl$$

In the second process dimethyl dichlorane react with water to produce dimethyl dihydroxysilane and hydrogen chloride this is called the hydrolysis of dimethyldichloro

611. The catenation tendency of C, Si and Ge is in the order Ge < Si < C. The bond energies (in kJ mol^{-1}) of C–C, Si–Si and Ge–Ge bonds, respectively are

(a) 348, 180, 167	(b) 180, 167, 348
(c) 148, 167, 380	(d) 148, 180, 367

AP EAMCET (Engg.) 2001

Ans. (a): C–C, Si – Si and Ge – Ge are 348, 180 and 167 kJ/mol respectively.

612. What would be the products for the following reactions respectively? (water molecules would be the expected biproduct)

(i) $SiO_2 + 2NaOH \rightarrow ?$
(ii) $SiO_2 + 4HF \rightarrow ?$

Options

(a) SiONa & SiOF	(b) Na_2SiO_3 & SiF_4
(c) Na_3SiO_4 & $SiOF_2$	(d) $Na_2Si_2O_7$ & Si_2OF_2

AP EAPCET-6 Sep. 2021, Shift-II

Ans. (b): SiO_2 reacts with hot and concentrated sodium hydroxide (NaOH) to form sodium silicate and water.

SiO_2 + 2Conc.NaOH → Na_2SiO_3+H_2O

Hydrofluoric acid (HF) reacts with silicon dioxide (SiO_2) to produce silicon tetra fluoride (SiF_4) and water.

$SiO_2 + 4HF \rightarrow SiF_4 + 2H_2O$

613. Among the following oxides, which one is weakly basic and yet a powerful oxidant ?

(a) CO_2	(b) SnO_2
(c) SiO_2	(d) PbO_2

AP EAMCET (Engg.) 17.09.2020 Shift-I

Ans. (d) : For the dioxides of group - 14 elements (CO_2, SiO_2, GeO_2 and PbO_2 is most basic in nature. Again, in oxidation state Pb in + 4 which is less PbO_2 stable than its + 2 state because of inert pair effect.

So Pb^{4+} of PbO_2 has a tendency to be reduced into more stable Pb^{2+} (PbO) showing strong oxidising nature of PbO_2.

614. The acidic character of the group-15 elements in the increasing order is _____

(a) $As_2O_3 < P_2O_3 < Bi_2O_3 < Sb_2O_3$
(b) $As_2O_3 < P_2O_3 < Sb_2O_3 < Bi_2O_3$
(c) $Bi_2O_3 < Sb_2O_3 < As_2O_3 < P_2O_3$
(d) $Sb_2O_3 < As_2O_3 < P_2O_3 < Bi_2O_3$

AP EAPCET 24.08.2021, Shift-I

Ans. (c) : The acidic character of the oxides decreases down the group because the electro negativity is the property of the element to attract electron pairs. The correct order of acidic character is $Bi_2O_3 < Sb_2O_3 < As_2O_3 < P_2O_3$.

615. Identify the incorrect statement about SiO_2 (silica) from the following:

(a) It is highly reactive due to low Si – O bond enthalpy
(b) It is a covalent three-dimensional network solid
(c) Quartz the crystalline form of silica, is used as a piezoelectric material
(d) An amorphous form of silica is used in filtration plants

AP EAPCET 24.08.2021, Shift-I

Ans. (a): (1) Silicon dioxide is not very reactive compound due to the polarity of molecule is zero. So, the first statement is false.

(2) The silicon atom in SiO_2 shows tetrahedral co-ordination, with four oxygen atoms surrounding a central Si atom. Hence, the second statement is true.

(3) The third statement is also true because the crystal quartz is used as pieozoelectric material.

(4) This statement is true because amorphous form of SiO_2 is used in filtration plants.

616. The element with maximum bond-energy_____.

(a) C	(b) Pb
(c) Ge	(d) Si

AP EAPCET 20.08.2021 Shift-II

Ans. (a): Bond energy is defined as measure of bond strength of a chemical bond. On going from top to bottom on group, bond energy decrease due to bond strength decrease.

So, carbon has maximum bond energy.

617. Which one of the following elements reduces NaOH to Na ?

(a) Si	(b) Pb
(c) C	(d) Sn

AP EAMCET (Engg.) 2012

Ans. (c) : NaOH when heated with coke, gets reduced to Na.

$$6NaOH + 2C \xrightarrow{\Delta} 2Na + 2Na_2CO_3 + 3H_2\uparrow$$

Here C behaves as reducing agent.

618. Which one of the following elements, when present as an impurity in silicon makes it a p-type semiconductor?

(a) As	(b) P
(c) In	(d) Sb

AP EAMCET (Engg.) 2012

@apna_pdf

Ans. (c) : Semiconductors like germanium or silicon depend with any of the trivalent atoms like boron, indium or gallium are called p-type semiconductors. The impurity atom is surrounded by four silicon atoms.

Valency of As, P and Sb is +5 and of In is +3. Thus, 'In' is the impurity which when added to Si gives p-type semi-conductor.

619. Which one of the following elements reacts with steam?

(a) C (b) Ge

(c) Si (d) Sn

AP EAMCET (Engg.) -2014

Ans. (d) : C, Si, Ge do not react with water (steam) while Sn reacts with steam to form SnO_2 and H_2.

$Sn(s) + 2H_2O(g) \rightarrow SnO_2(g) + 2H_2\ (g)$

620. $H_2S_2O_7$ has a commercial name as

(a) oil of vitriol (b) hypo

(c) oil of sulphur (d) oleum.

COMEDK-2019

Ans. (d) : In practice, when a pressure of 2 bar and a temperature of 720 K operated, the SO_3 gas from the catalytic converter is absorbed in concentrated H_2SO_4 to produce oleum ($H_2S_2O_7$). Sulfuric acid, sulfuric also spelled sulfuric (H_2SO_4) also called oil of vitriol or hydrogen sulfate, dense, colorless oily, corrosive liquid.

621. Which of the following is not hydrolysed easily?

(a) CCl_4 (b) $SiCl_4$

(c) $GeCl_4$ (d) $SnCl_4$

COMEDK-2016

Ans. (a) : CCl_4 is not hydrolyzed because of two reasons-

1. Carbon does not have d-orbitals because it is found in 2nd period i.e. second shell so as the 3d-orbitals are not available and so it can not expand its co-ordination no. above 4.

Since, in carbon tetrachloride (CCl_4) all the valencies are satisfied, so it can not add any water molecule by any mean so the reaction becomes

$CCl_4 + H_2O \rightarrow$ No reaction.

2. Due, to smaller size of C-atom it is shielded by the larger Cl-atoms it is shielded by the larger Cl-atoms so attach of water is not possible for hydrolysis.

622. Carbogen is

(a) pure form of carbon

(b) $COCl_2$

(c) mixture of CO and CO_2

(d) mixture of O_2 and CO_2.

COMEDK 2019

Ans. (d) : Carbogen is a mixture of 95% (O_2) and 5% (CO_2).

623. The chemical formula of zeolite is:

(a) $K_2Al_2Si_2O_8.xH_2O$ (b) $CaAl_2Si_2O_8$

(c) $Na_2Al_2Si_2O_8.xH_2O$ (d) $Na_2[Na_4\ (PO_3)_6]$

AP-EAMCET (Medical), 2003

Ans. (c) : The chemical formula of Zeolite is $Na_2Al_2Si_2O_8.xH_2O$. It is used in the softening of hard water.

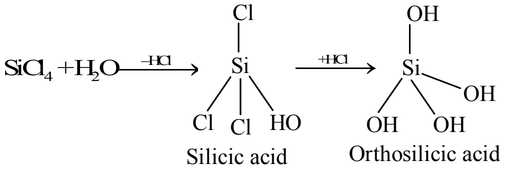
624. Hydrolysis of $SiCl_4$ gives compound X and HCl. On heating to 1000°C, X loses water and forms Y. Indentify X and Y, respectively

(a) SiO_2 and Si (b) H_4SiO_4 and SiO_2

(c) SiO_2 and SiC (d) H_4SiO_4 and SiC

AP-EAMCET (Medical), 2008

Ans. (b) : The hydrolysis of $SiCl_4$ gives compounds silicic acid and HCl.



Orthosilicic acid (H_4SiO_4), on heating at high temperature, loses two water molecules and gives silica (SiO_2).

$$\underset{\text{Orthosilicic acid}}{H_4SiO_4} \xrightarrow[-2H_2O]{1000^\circ} \underset{\text{Silica}}{SiO_2}$$

625. Which one of the following is used to remove silicon dioxide in Serpeck's process of purification of bauxite?

(a) CaO (b) Na_2CO_3

(c) Coke (d) Nickel

AP-EAMCET (Medical), 2001

Ans. (c) : Silicon dioxide (SiO_2) is removed by coke in Serpeck's process. In Serpeck's process is used when silica is present in considerable amounts in bauxite ore. The ore is mixed with coke and heated at 1800°C in the presence of nitrogen. Silica is reduced to silicon which volatilizes off at this temperature.

$$SiO_2 + 2C \longrightarrow Si(\uparrow) + 2CO(\uparrow)$$

626. Which of the following is a correct set for SiO_2?

(a) Linear, acidic (b) Linear, basic

(c) Tetrahedral, acidic (d) Angular, basic

AP-EAMCET (Medical), 2002

Ans. (c) : SiO2 is a covalent, 3-D network solid. Each Si atom is covalently bonded in a tetrahedral manner to four oxygen atoms. Each oxygen atom in turn covalently bonded to another silicon atoms. Each corner is shared with another tetrahedron.

627. How many O-atoms are shared per SiO_4 tetrahedral in silicate anion of beryl mineral?

(a) 4 (b) 3

(c) 2 (d) 1

GUJCET-2007

Ans. (c) : Beryl is cyclic silicate with $[Si_6O_{18}]^{12-}$ anion. There are two oxygen atoms are shared per SiO_4 tetrahedral in silicate anion of beryl mineral. The cyclic structure of $Si_6O_{18}^{12-}$. So the number of O- atoms shared per SiO_4 tetrahedral in silicate anion of beryl mineral are 2.

The chemical formula of beryl mineral $Be_3Al_2Si_6O_{18}$.

628. Calgon is used for water treatment. Which of the following statement is NOT true about Calgon?

(a) Calgon contains the 2nd most abundant element by weight in the Earth's crust.

@apna_pdf

(b) It is polymeric compound and is water soluble.
(c) It is also known as Graham's salt.
(d) It does not remove Ca^{2+} ion by precipitation.

JEE Main 26.02.2021,Shift-II

Ans. (a) : Calgon contains the 2nd most abundant element by weight in the Earth's crust.

- 2nd most abundant element is 'Si' and it is not present in calgon.
- $Na_6P_6O_{18}$ = (Graham's salt) (Sodium hexa meta phosphate)
- It exist in polymeric form as $(NaPO_3)_6$ and water soluble compound.
- It removes Ca^{2+} in soluble ion but not by precipitation.

Hence, all the statements are correct.

629. The 'dry ice' is ....

(a) dry CO_2 gas
(b) solid CO_2
(c) dry SO_2 gas
(d) Solid NH_3

AP EAMCET (Engg.) 18.09.2020, Shift-I

Ans. (b): Dry ice is solid CO_2 which is a molecular crystal.

630. Consider the following statements about glass :

1. Glass is a solid solution and its composition may vary.
2. For making silica glass very high temperature is required. This can be reduced by adding oxides to the melt.
3. Normal domestic glass for windows is calcium alkali silicate.
4. Al_2O_3 is added to glass to give ruby red colour to it.

Which of the statements given above are correct?

(a) 1, 2 and 4
(b) 2, 3 and 4
(c) 1, 2 and 3
(d) 1, 3 and 4

SCRA - 2009

Ans. (b): Glass is actually neither a liquid-super cooled or otherwise-nor a solid. It is an amorphous solid. A state somewhere between those two states of matters exists.

Rest of the 3 points which are given is correct.

631. Assertion: $SiCl_4$ gets easily hydrolysed, while CCl_4 does not.

Reason: Carbon cannot extend its covalency due to the absence of d-orbitals but Si can extend its covalency.

(a) If both Assertion and Reason are correct and Reason is the correct explanation of Assertion.
(b) If both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.
(c) If Assertion is correct but Reason is incorrect.
(d) If both the Assertion and Reason are incorrect.

AIIMS 25 May 2019 (Evening)

Ans. (a): Both Assertion and Reason are correct and Reason is the correct explanation of Assertion.

- $SiCl_4$ can accept lone pair given by H_2O molecule due to presence of d-orbitals whereas CCl_4 has no d-orbitals hence it do not hydrolised.
- CCl4 does not undergo hydrolysis by water because the carbon atom is small and is shielded by larger chlorine atoms. Carbon does not have 3d atomic orbitals that water can use to form co-ordinate bonds. In SiCl4, the silicon atom is larger than the carbon atom and also has available 3d atomic orbitals for bonding.

632. Which of the following is a formula of methanides?

(i) Be_2C
(ii) CaC_2
(iii) Mg_2C_3
(iv) SiC

(a) only (i), (iv)
(b) only (i), (ii)
(c) only (iii), (iv)
(d) only (ii), (iv)

AIIMS 25 May 2019 (Morning)

Ans. (a): Methanides are the metal carbides in which carbon atom acts as anion :

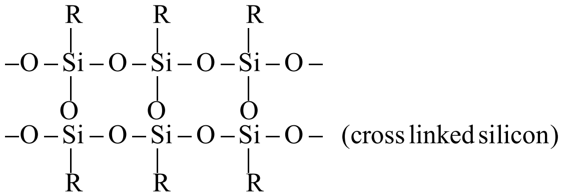
633. Which of the following shows bond in silicon?

(a) Si-C-Si-C-Si
(b) Si-Si-Si-Si
(c) -Si-O-Si-O-Si-
(d) Si-C-Si-O-Si.

AIIMS-1994

Ans. (c): – Si – O – Si – O – Si –

Silicon:


R
R
R
–O – Si – O – Si – O – Si – O –
O
O
O
–O – Si – O – Si – O – Si – O –
R
R
R
(cross linked silicon)

634. Silicon is an important constituent of

(a) alloys
(b) rocks
(c) vegetables
(d) animals

AIIMS-1996

Ans. (b): Silicon is the important constituent of rock in form of silica (SiO_2).

635. In processing of steel which of the following allotropes of carbon is used?

(a) Carbon black
(b) Charcoal
(c) Coke
(d) Graphones

AIIMS 26 May 2019 (Morning)

Ans. (c): Coke is an allotrope of carbon used for the processing of steel.

636. Assertion: Silicones are hydrophobic in nature.

Reason: Si – O – Si linkages are moisture sensitive.

(a) If both Assertion and Reason are correct and the Reason is the correct explanation of Assertion.
(b) If both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.
(c) If Assertion is correct but Reason is incorrect.
(d) If both the Assertion and Reason are incorrect.

[AIIMS-2006, 2015]

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Ans. (c)

- Silicons are insoluble in water and does not react with it. So they are hydrophobic in nature.
- The crystal structure of silica has Si—O—Si linkage and it is extremely stable and considerable energy is required to break the silicon oxygen bonds in it. So silicons are hard and have high melting point and it is moisture resistant. Hence, reason is false.

637. **Assertion:** Pb_3O_4 react with HNO_3 and form PbO_2

Reason: Lead is stable in +4 oxidation state.

(a) If both Assertion and Reason are correct and the Reason is the correct explanation of Assertion.
(b) If both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.
(c) If Assertion is correct but Reason is incorrect.
(d) If both the Assertion and Reason are incorrect.

(AIIMS-26 May, 2018-Evening)

Ans. (c): Assertion is correct but Reason is incorrect.

- $Pb_3O_4 + HNO_3 \rightarrow PbO_2\,(Solid) + Pb\,(NO_3)_2 + H_2O$

but Pb^{2+} is more stable due to inert pair effect.

638. **Assertion:** Pb^{4+} compounds are stronger oxidizing agents than Sn^{4+} compounds.

Reason: The higher oxidation states for the group 14 elements are more stable for the heavier members of the group due to 'inert pair effect'.

(a) If both Assertion and Reason are correct and the Reason is the correct explanation of Assertion.
(b) If both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.
(c) If Assertion is correct but Reason is incorrect.
(d) If both the Assertion and Reason are incorrect.

(AIIMS-2014, 2016)

Ans. (c): Assertion is correct but Reason is incorrect.

- Pb^{4+} is less stable than Pb^{2+} hence it has tendency to reduce hence it is a good oxidising agent than Sn^{4+}.
- p-block, on moving top to bottom, the stability of lower oxidation state increases due to inert pair effect. Pb^{4+} is less stable than Sn^{4+}, making it a better oxidizing agent.
- The oxidation state +2 is more stable on moving down the group 14 element (for heavier atom) from top to bottom. Hence, reason is false.

639. **Assertion:** PbI_4 is a stable compound.

Reason: Iodide stabilizes higher oxidation state.

(a) If both Assertion and Reason are correct and Reason is a correct explanation of the Assertion.
(b) If both Assertion and Reason are correct but Reason is not a correct explanation of the Assertion.
(c) If the Assertion is correct but Reason is incorrect.
(d) If both the Assertion and Reason are incorrect.
(e) If the Assertion is incorrect but the Reason is correct.

(AIIMS-2003)

Ans. (d): If assertion and Reason both are incorrect. PbI_4 is not a stable compound because Pb shows (II) oxidation state more frequently than Pb (IV) due to inert pair effect. Iodide cannot stabilize higher oxidation states. Thus, assertion is true but reason is false.

640. **Assertion:** SiF_6^{2-} is known but $SiCl_6^{2-}$ is not

Reason: Size of fluorine is small and its lone pair of electrons interacts with d-orbitals of Si strongly.

(a) If both Assertion and Reason are correct and Reason is a correct explanation of the Assertion.
(b) If both Assertion and Reason are correct but Reason is not a correct explanation of the Assertion.
(c) If the Assertion is correct but Reason is incorrect.
(d) If both the Assertion and Reason are incorrect.
(e) If the Assertion is incorrect but the Reason is correct.

(AIIMS-2005)

Ans. (a): SiF_6^{2-} is known because F has small size therefore can be easily arranged around silicon to form SiF_6^{2-}. The ion is quite stable unlike $SiCl_6^{2-}$ in which size of Cl atom is large which destabilize it and create steric hindrance to each other therefore cannot be arranged around silicon in excess.

641. **Why is graphite used as a dry lubricant in machinery**

(a) Each carbon atom undergoes sp^3 hybridization
(b) Graphite has layered structure and cleaves easily between the layers and therefore it is very soft and slippery
(c) Graphite is a non-conductor of electricity
(d) Graphite has two sigma bonds and two pi bonds

SCRA-2015

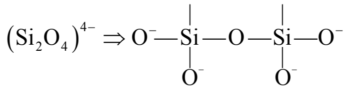
Ans. (b): Graphite used as a dry lubricant in machinery because graphite has hexagonal ring layered structure and it cleaves easily between the layers and therefore it is very soft and slippery.

642. **Name the kind of silicate formed, when two silicate units $(SiO_4)^{4-}$ share one oxygen atom.**

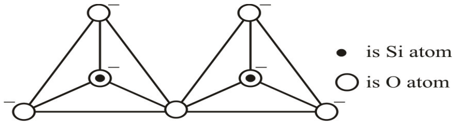
(a) Chain silicate (b) Cycle (ring) silicate
(c) Pyrosilicate (d) Sheet silicate

AP EAMCET (Engg.) 17.09.2020, Shift-II

Ans. (c) : In pyrosilicate $(Si_2O_7)^{4-}$, two silicate units $(SiO_4)^{4-}$ share one oxygen atom.



$$(Si_2O_4)^{4-} \Rightarrow O^-—\overset{\overset{O^-}{|}}{\underset{\underset{O^-}{|}}{Si}}—O—\overset{\overset{O}{|}}{\underset{\underset{O^-}{|}}{Si}}—O^-$$



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643. **Assertion:** NH_3 is absorbed more readily over activated charcoal than CO_2.

Reason: NH_3 is non-polar.

(a) If both Assertion and Reason are correct and Reason is a correct explanation of the Assertion.
(b) If both Assertion and Reason are correct but Reason is not a correct explanation of the Assertion.
(c) If the Assertion is correct but Reason is incorrect.
(d) If both the Assertion and Reason are incorrect.
(e) If the Assertion is incorrect but the Reason is correct.

(AIIMS-2000)

Ans. (c): If Assertion is correct but reason is incorrect.

- NH_3 absorbs more readily over activated charcol than CO_2 because of its polar nature. It is correct reason because NH_3 has polar nature.

644. **Assertion:** Stannous chloride gives grey precipitate with mercuric chloride, but stannic chloride does not do so.

Reason: Stannous chloride is a powerful oxidising agent which oxidises mercuric chloride to metallic mercury.

(a) If both Assertion and Reason are correct and Reason is a correct explanation of the Assertion.
(b) If both Assertion and Reason are correct but Reason is not a correct explanation of the Assertion.
(c) If the Assertion is correct but Reason is incorrect.
(d) If both the Assertion and Reason are incorrect.
(e) If the Assertion is incorrect but the Reason is correct.

(AIIMS-2002)

Ans. (c): If assertion is true but reason is false.

- Sn^{4+} is more stable than Sn^{2+}. So, Sn^{2+} is oxidised to Sn^{4+} by losing 2e when it reacts with mercuric chloride i.e. $SnCl_2$ is reducing agent.

$SnCl_2$ (Stannous chloride) on reaction with mercuric chloride ($HgCl_2$), oxidizes to $SnCl_4$ (Stannic chloride)

$$SnCl_2 + 2HgCl_2 \rightarrow SnCl_4 + \underset{\text{(Greyish)}}{Hg_2Cl_2}$$

So, in this reaction, stannous chloride is acting as reducing agent that, reduces Hg(II) to Hg(I) then to Hg(0)

$$SnCl_2 + Hg_2Cl_2 \rightarrow 2Hg + SnCl_4.$$

645. **Which compound do not react with dilute HCl at high temperature?**

(a) $SnSO_4$
(b) $PbSO_4$
(c) BiOCl
(d) $CdSO_4$

(AIIMS-27 May, 2018-Morning)

Ans. (b): $PbSO_4$ does not react with dilute HCl even at high temperature. $PbSO_4$ belongs to group-I so, it is insoluble in HCl.

646. **Ge(II) compounds are powerful reducing agents whereas Pb(IV) compounds are strong oxidants. It can be due to**

(a) Pb is more electropositive than Ge
(b) Ionization potential of lead is less than that of Ge
(c) Ionic radii of Pb^{2+} and Pb^{4+} are larger than those of Ge^{2+} and Ge^{4+}
(d) More pronounced inert pair effect in lead than in Ge

(AIIMS-2012)

Ans. (d): Ge^{4+} is more stable than Ge^{2+} as a result of which Ge^{2+} has a tendency to be oxidized to Ge^{4+} so, Ge^{2+} compounds act as powerful reducing agents. But Pb^{2+} is more stable than Pb^{4+} because of pronounced inert pair effect as a result of which Pb^{4+} has a tendency to get reduced to Pb^{2+} so, Pb^{4+} compounds act as strong oxidizing agents (i.e. oxidants).

647. **Carbon cannot be used to produce magnesium by chemical reduction of MgO because:**

(a) carbon is not a powerful reducing agent.
(b) magnesium reacts with carbon to from carbides.
(c) carbon does not react with magnesium.
(d) carbon is a non-metal.

(AIIMS-2014)

Ans. (b): Magnesium reacts with carbon to form carbides.

Carbon cannot be used to produce magnesium by chemical reduction of MgO because magnesium reaction with carbon from carbides.

$$2Mg + 3C \xrightarrow{2000^{o}C} Mg_2C_3$$

648. **Carborundum is obtained when silica is heated at high temperature with**

(a) carbon
(b) carbon monoxide
(c) carbon dioxide
(d) calcium carbonate

(AIIMS-2014)

Ans. (a): Silica on heating with carbon at high temperature gives carborundum (SiC).

$$\underset{\text{Silica}}{SiO_2} + \underset{\text{Carbon}}{3C} \xrightarrow{\Delta} \underset{\text{Carborundum}}{SiC} + 2CO$$

649. **Which of the following product is formed when SiF_4 reacts with water?**

(a) SiF_3
(b) H_4SiO_4
(c) H_2SO_4
(d) H_2SiF_4

(AIIMS-2010)

Ans. (b): SiF_4(like $SiCl_4$) get hydrolised to form H_4SiO_4(Silicic acid)

$$SiF_4 + 4H_2O \longrightarrow \underset{\text{Ortho Silicic acid}}{Si(OH)_4 \text{ or } H_4SiO_4} + 4HF\ .$$

650. **The chemical formula of' tear gas" is**

(a) $COCl_2$
(b) CO_2
(c) Cl_2
(d) CCl_3NO_2

(AIIMS-2008)

Ans. (d): Tear gas is also called lachrymator gas. It is not a gas but an aerosol. The actual formula of tear gas is $C_{10}H_5ClN_2$(2-chlorobenzalomalononitirle).

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651. The energy gaps (E_g) between valence band and conduction band, for diamond, silicon and germanium are in the order:

(a) E_g (diamond) > E_g (silicon) > E_g (germanium)
(b) E_g (diamond) < E_g (silicon) < E_g (germanium)
(c) E_g (diamond) = E_g (silicon) = E_g (germanium)
(d) E_g (diamond) > E_g (germanium) > E_g (silicon)

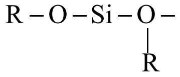
(AIIMS-2006)

Ans. (a): E_g (diamond) > E_g (silicon) > E_g (germanium) because diamond is on insulator and non-metallic character decrease down the group.

- Ionization energy is the energy required to pull away an electron. So if the atomic radius is small the electron "feels" stronger to pull from the positive nucleus. Thus, that electron is harder to pull off. Therefore it decreases with an increase in atomic radii.

652. The repeating unit in silicone is

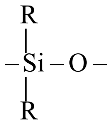
(a) SiO_2 (b) R_2SiO

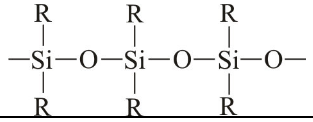
(c) 
$R-O-\underset{R}{\underset{|}{Si}}-O-$

(d) $–R_2–Si–O–O–R$

(AIIMS-2007)

Ans. (b):


$-\underset{R}{\underset{|}{\overset{R}{\overset{|}{Si}}}}-O-$

Silicone is : 
$-\underset{R}{\underset{|}{\overset{R}{\overset{|}{Si}}}}-O-\underset{R}{\underset{|}{\overset{R}{\overset{|}{Si}}}}-O-\underset{R}{\underset{|}{\overset{R}{\overset{|}{Si}}}}-O-$

653. The liquefied metal expanding on solidification is:

(a) Ga (b) Al
(c) Zn (d) Cl

(AIIMS-2004)

Ans. (a): Gallium is soft, silvery metal. Its melting point is 30°C. This metal expanded by 3.1% when it solidifies and hence it should not be stored in glass or metal containers.

654. The electrical conductivity of semiconductors:

(a) decreases with temperature
(b) increases with temperature
(c) remains constant on heating
(d) none of the above

(AIIMS-2001)

Ans. (b): On increasing the temperature of semiconductor the electron get free from covalent bond hence conductivity increases.

655. Producer gas is a mixture of:

(a) $CO + H_2$ (b) $H_2 + CH_4$
(c) $CO + N_2$ (d) $CO + H_2O$

(AIIMS-1998, 2000)

Ans. (c): Producer gas is a mixture of carbon monoxide and nitrogen ($CO + N_2$). It is produced by passing air mixed with little steam over a red hot coke bed maintained at a temperature of about 1100°C. Its calorific value is very low. Among all gaseous fuels, producer gas is the cheapest.

656. Solid CO_2 is known as dry ice:

(a) It melts at 0^0C
(b) Its B.P. is more than 199^0C
(c) It evaporates at -78^0C without melting
(d) None of the above

(AIIMS-2000)

Ans. (c): Dry ice is frequently used as a substitute for refrigeration for groceries and medical supplies due to its exceptionally low temperature of –78°C. Dry ice is made by compressing and cooling gaseous CO_2 under high pressure, resulting in liquid CO_2. Dry ice is often used as an alternative to refrigeration for foodstuffs and medical supplies.

657. Water glass is:

(a) Na_2SiO_3 (b) Mg_2Si
(c) $SiCl_4$ (d) $Ca(H_2PO_4)_2$

(AIIMS-2001)
BCECE-2007

Ans. (a): Water glass, also called sodium silicate or soluble glass, a compound containing sodium oxide (Na_2O) and silica (silicon dioxide, SiO_2) that forms a glassy solid with the very useful property of being soluble in water.

658. Water gas is produced by:

(a) Passing steam over red hot coke
(b) Passing steam and air over red hot coke
(c) burning coke in excess of air
(d) burning coke in limited supply of air

(AIIMS-2001)

Ans. (a): Water gas is produced by passing steam over a bed of red hot coke at 1000- 1400°C

$$\underset{\text{Coke}}{C} + H_2O \longrightarrow \underset{\text{water gas}}{CO + H_2}\ ;\ \Delta H = +28 \text{ kcal}$$

659. Bell metal is an alloy of:

(a) Sn and Pb (b) Cu and Pb
(c) Sn and Cu (d) In, Sn and Cu

(AIIMS-1999)

Ans. (c): Bell metal is an alloy of Tin and Copper in 1 : 4 ratio.

660. The approximate percentage of silica in cement is:

(a) 5 - 10% (b) 15 - 20%
(c) 20 - 25% (d) 25 - 30%

(AIIMS-1998)

Ans. (c): Cement consists of lime mixed with silica and alumina. The approximate percentage of silica in cement is 20-25% or 17 to 25%.

661. The incorrect statement among the following is/are ____

(a) NCl_5 does not exist while PCl_5 does
(b) Pb prefers to form tetravalent compounds
(c) The three C - O bonds are equal in the CO_3^{2-} ion
(d) Both O_2^+ and NO are paramagnetic

AP EAPCET 19-08-2021, Shift-II

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Ans. (b) :
- (a) NCl_5 does not exist because there are no d-orbital in second energy level. Whereas the PCl_5 exist due to presence of d-orbitals. This is correct.
- (b) Pb prefers to form bivalent compounds due to inert pair effect. Hence it is incorrect.
- (c) The three C – O bond are equal in CO_3^{2-} ion so the statement is true.
- (d) Both O_2^+ and NO are paramagnetic because both contains unpaired electrons. Hence this statement is true.

662. Assertion (A) : The colour of old lead paintings can be restored by washing them with a dilute solution of H_2O_2.
Reason (R) : Hydrogen peroxide reduces PbS to Pb.
(a) Both A and R are true and R is a correct explanation for A
(b) Both A and R are true but R is not a correct explanation for A
(c) A is true. R is false
(d) A is false. R is true

AP EAPCET 19-08-2021, Shift-II

Ans. (c): When the old lead painting are kept in the atmosphere for a long period, the traces of H_2S gas present in the atmosphere converts lead oxide (PbO) in to lead sulphide (PbS) which is black in colour. It can be restored by keeping then in H_2O_2 solution for sometime as a result of which lead sulphide is oxidized to lead sulphate.

$$PbO + H_2S \longrightarrow \underset{\text{(Black)}}{PbS} + H_2O$$

The H_2O_2 reduces the PbS to $PbSO_4$, Which is white.

$$\underset{\text{(Black)}}{PbS} + 4H_2O_2 \rightarrow \underset{\text{(White)}}{PbSO_4} + 4H_2O$$

The Hydrogen peroxide reduces the PbS to $PbSO_4$. Hence the second statement will be false.

663. $SiCl_4$ on hydrolysis forms 'X' and HCl. Compound 'X' loses water at 1000°C and gives 'Y'. Compounds 'X' and 'Y' respectively are
(a) H_2SiCl_6, SiO_2
(b) H_4SiCl_4, Si
(c) SiO_2, Si
(d) H_4SiO_4, SiO_2

VITEEE- 2009

Ans. (d) : $SiCl_4 + 4H_2O \longrightarrow H_4SiO_4 + 4HCl$

$$H_4SiO_4 \xrightarrow[1000^\circ C]{\Delta} SiO_2 + 2H_2O$$

664. Which one of the following elements reacts with steam?
(a) C
(b) Ge
(c) Si
(d) Sn

AP-EAMCET (Engg.) - 2014

Ans. (d) : Among the given element, only Sn reacts with water to form SnO_2 and H_2.

$$Sn(s) + 2H_2O(g) \xrightarrow{\Delta} SnO_2(g) + 2H_2(g)$$

665. Which one of the following is a correct set?
(a) Diamond, sp^2
(b) Graphite, sp^3
(c) Diamond, sp
(d) Graphite, sp^2

AP-EAMCET- (Engg.)-2011

Ans. (d): Graphite is an allotrope of carbon and two dimensional sheet like structure. The adjacent layers of sheet are held together by Van der Waal's forces. In graphite each carbon atom is present in sp^2 hybridised state.

666. Chemically zeolites are _______
(a) Calcium silicates
(b) Sodium silicates
(c) Hydrates aluminosilicates
(d) Magnesium silicates

AP- EAPCET- 07-09-2021, Shift-I

Ans. (c):
Chemically Zeolite ($Na_2Al_2Si_2O_8.xH_2O$) are hydrated aluminosilicates with three dimensional network of silicates in which one silicon atom replaced by aluminum atom giving Al– O – Si framwork.

667. Silica (SiO_2) reacts with Mg to form a magnesium compound X. X reacts with dilute HCl and forms Y. Y is :
(a) MgO
(b) $MgCl_2$
(c) MgSiO
(d) $SiCl_4$

AP-EAMCET (Engg.)-2004

Ans. (b): Silica (SiO_2) reacts with Mg to form a magnesium compound i.e. magnesium oxide (MgO). Magnesium oxide reacts with dilute HCl and forms the magnesium chloride.

$$\underset{\text{Silica}}{SiO_2} + \underset{\text{Magnesium}}{2Mg} \longrightarrow \underset{\substack{\text{Magnesium}\\ \text{oxide}\\ \text{(X)}}}{2MgO} + \underset{\text{Silicon}}{Si}$$

$$\underset{\substack{\text{Magnesium}\\ \text{oxide}}}{MgO} + 2HCl \longrightarrow \underset{\substack{\text{Magnesium}\\ \text{chloride}\\ \text{(Y)}}}{MgCl_2} + H_2O$$

668. Assertion (A) : GeF_4 and $SiCl_4$ act as Lewis bases.
Reason (R) : Ge and Si have d-orbital's to accept electrons.
The correct answer is
(a) Both (A) and (R) are correct, (R) is not the correct explanation of (A)
(b) (A) is correct but (R) is not correct
(c) (A) is not correct but (R) is correct
(d) Both (A) and (R) are correct, (R) is the correct explanation of (A)

AP EAMCET (Medical) - 2013

Ans. (c) : GeF_4 and $SiCl_4$ act as Lewis acid because the tetra halides of Si, Ge, Sn and Pb form hexahalo complexes like $[SiF_6]^{2-}$, $[GeF_6]^{2-}$, $[SiCl_6]^{2-}$, $[SnCl_6]^{2-}$, $[PbCl_6]^{2-}$, with the corresponding halide ions by increasing their co-ordination number from 4 to 6 due to the availability of d-orbital's.

669. How many corners of SiO_4 units are shared in the formation of three dimensional silicates?
(a) 3
(b) 2
(c) 4
(d) 1

AP-EAMCET (Engg.) 2013

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Ans. (c) : Four oxygen atoms of each tetrahedral (SiO_4) are shared with other tetrahedral, three dimensional network structure is obtained in silicates.

670. $SiCl_4 \xrightarrow{H_2O} X \xrightarrow{1000°C} Y$

In the above reaction, X and Y respectively are

(a) SiO_2 and Si (b) H_4SiO_4 and SiO_2

(c) H_2SiCl_6 and SiO_2 (d) H_4SiO_4 and Si

AP - EAMCET (Medical) - 2007

Ans. (b) : Silicon tetrachloride reacts with water to formed the silicic acid and further heated at 1000°C to give the silicondioxide (SiO_2).

$$\underset{\text{Silicon tetrachloride}}{SiCl_4} \xrightarrow{H_2O} \underset{\substack{\text{Silicic acid}\\(X)}}{H_4SiO_4} \xrightarrow{1000°C} \underset{\substack{\text{Silicon dioxide}\\(Y)}}{SiO_2}$$

671. SiO_2 is reacted with sodium carbonate. What is the gas liberated?

(a) CO (b) O_2

(c) CO_2 (d) O_3

AP-EAMCET (Engg.)-2005

Ans. (c) : Silica is reacted with sodium carbonate (Na_2CO_3), sodium silicate is formed. This reaction is the basic reaction in the manufacture of glass.

$$SiO_2 + Na_2CO_3 \longrightarrow Na_2SiO_3 + CO_2(\uparrow)$$

Hence, carbondioxide (CO_2) gas is released.

672. Silica is attacked by

(a) conc. HNO_3 (b) conc. H_2SO_4

(c) aqua regia (d) hydrofluoric acid.

AMU-2013

Ans. (d) : HF (Hydrofluoric acid).

$$\underset{\text{Silica}}{SiO_2} + 4HF \xrightarrow[-2H_2O]{} SiF_4 \xrightarrow{+2HF} H_2SiF_6$$

673. Which of the following has least tendency to undergo catenation ?

(a) C (b) Si

(c) Ge (d) Sn

AMU-2010

Ans. (d) : The linking of identical atoms with each other to form long chains is called catenation. All the elements of group 14 have the property to catenate. This property decreases from carbon to lead. Carbon has the maximum property to catenate. The decrease of this property is associated with M-M bond energy which decreases from carbon to lead.

674. Which of the following dihalides will be most stable?

(a) SiX_2 (b) GeX_2

(c) SnX_2 (d) PbX_2

AMU-2006

Ans. (d) : The stability of the dihalides increases in going from Ge to Pb due to inert pair effect.

675. Lassaigne's test is not used for the detection of

(a) carbon (b) halogen

(c) nitrogen (d) sulphur

AMU-2005

Ans. (a) : For the detection of halogens, nitrogen and sulphure lassaigne's test is used.

676. Which of the following elements has the lowest melting point ?

(a) Sn (b) Pb

(c) Si (d) Ge

TS EAMCET-2017

Ans. (a) : On decreasing down the group of carbon family melting point decreases generally.

$$\underset{4373}{C} > \underset{1693}{Si} > \underset{1218}{Ge} > \underset{600}{Pb} > \underset{505K}{Sn}$$

677. Which gas is used in aerated water?

(a) CO_2 (b) SO_2

(c) CO (d) Water vapours

BCECE-2006

Ans. (a): Any water artificially impregnated with a large amount of gas (CO_2) is aerated water. This gas is either artificially injected under pressure or occurring due to natural geological processes.

678. Carbon can reduce ferric oxide to iron at a temperature above 983K because

(a) carbon monoxide formed is thermodynamically less stable than ferric oxide

(b) carbon has a higher affinity towards oxidation than iron

(c) free energy change for the formation of carbon dioxide is less negative than that for ferric oxide

(d) iron has a higher affinity towards oxygen than carbon

BCECE-2014

Ans. (b): Carbon has a higher affinity towards oxidation than iron.

Above 983K, free energy change for the formation of CO_2 is more negative than that of ferric oxide. Thus above this temperature, carbon has a higher affinity towards oxidation than iron.

679. Which of the following statement are correct?

(a) CO_2 and SiO_2 both are gases

(b) CO_2 is gas and SiO_2 is liquid

(c) CO_2 is a gas but SiO_2 is a solid

(d) Carbon and Si both form oxides of similar reactions

BCECE-2015

Ans. (c) : SiO_2 is a giant molecular structure but CO_2 is simple molecular structure due to this reason CO_2 is a gas but SiO_2 is a solid.

680. For making good quality mirrors, plates of float glass are used. These are obtained by floating molten glass over a liquid metal which does not solidify before glass. The metal used can be

(a) Tin (b) Sodium

(c) Magnesium (d) Mercury

BITSAT-2009

Ans. (d): Among the given metals, mercury has lowest melting point, which means the lowest freezing point. So, mercury is used.

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681. Ordinary glass is:

(a) Sodium silicate
(b) Calcium silicate
(c) Sodium and calcium silicate
(d) Mixed salt of Na and Ca

BITSAT-2015

Ans. (c) : Ordinary glass which is also known as soda glass or soft glass is a mixture of sodium silicate (Na_2SiO_3), calcium silicate ($CaSiO_3$) and silica (SiO_2).

682. Identify the incorrect statement:

(a) In $(Si_3O_9)^{6-}$, tetrahedral SiO_4 units share two oxygen atoms
(b) Trialkylchlorosilane on hydrolysis gives R_3SiOH
(c) $SiCl_4$ undergoes hydrolysis to give H_4SiO_4
(d) $(Si_3O_9)^{6-}$ has cyclic structure

BITSAT-2020

Ans. (b) : Trialkylchlorosilane on hydrolysis gives R_3SiOH,

$$R_3SiCl \xrightarrow{H_2O} R_3Si\boxed{OH + H-O}SiR_3 \longrightarrow R_3SiO-O-Si-R_3$$

683. Doping of silicon with boron leads to

(a) n- type semiconductor
(b) p- type semiconductor
(c) superconductor
(d) insulator

CG PET- 2011

Ans. (b) : Doping of divalent impurity to semiconductor leads to formation of p-type semiconductor.

684. Number of carbon atoms in kerosene is

(a) C_{17-20}
(b) C_{12-16}
(c) C_{20-25}
(d) C_{25-30}

Manipal-2020, CG PET- 2015
UPTU/UPSEE-2005

Ans. (b): Kerosene is a mixture of hydrocarbons. The chemical composition depends on its source of isolation usually, it consists of about 10 different hydrocarbons, each containing 11 to 16 carbon atoms per molecule.

685. Which method is used to get very pure germanium used in semiconductor?

(a) Electrolysis
(b) Vapour-phase refining
(c) Liquation
(d) Zone-refining

GUJCET-2015, 2016

Ans. (d): Zone refining is used to obtain metal of very high purity. It is based on principle that an impure molten metal on gradual cooling will deposit its crystals of pure metal, while the impurities will be left in the remaining part of the molten metal. Germanium metal can be purified by this method.

686. The correct statement among the following is

(a) $(SiH_3)_3N$ is planar and less basic than $(CH_3)_3N$
(b) $(SiH_3)_3N$ is pyramidal and more basic than $(CH_3)_3N$.
(c) $(SiH_3)_3N$ is pyramidal and less basic than $(CH_3)_3N$.
(d) $(SiH_3)_3N$ is planar and more basic than $(CH_3)_3N$

(JEE Main 2019, 12 April Shift-I)

Ans. (a): $(SiH_3)_3N$ is planar and less basic than $(CH_3)_3N$. In $(SiH_3)_3N$ the lone pairs of nitrogen is delocalized to the empty orbitals of the silicon due to which it is planar and less basic when compared with $(CH_3)_3N$.

687. The one that is extensively used as a piezoelectric material is

(a) quartz
(b) tridymite
(c) amorphous silica
(d) mica

(JEE Main 2019, 9 Jan Shift-I)

Ans. (a) : Quartz is used as piezoelectric material. It produces electricity when any mechanical stress in forms of pressure applied on it. Thus it is also used in watches and oscillators.

688. Correct statements among (I) to (IV) regarding silicones are:

I. They are polymers with hydrophobic character.
II. They are biocompatible.
III. In general, they have high thermal stability and low dielectric strength.
IV. Usually, they are resistant to oxidation and sued as greases.

(a) I and II only
(b) I, II, III only
(c) I II, III and IV
(d) I, II and IV only

(JEE Main 2019, 9 Jan Shift-I)

Ans. (d) : Silicones are the polymer of silicon-containing [–(R)$_3$Si–O–]n linkage.

(i) It is a polymer with hydrophobic character thus used in making water resistant seals.

(ii) They are biocompatible silicon rubber have good mechanical properties, are low cost and are nontoxic and non-irritant materials because of these desirable characteristics it considered as biocompatible.

(iii) They have high thermal stability and low dielectric strength which is not correct.

(iv) They are also resistant to oxidation because of their wax-like texture. They are also used in greases.

689. The element that shows greater ability to form pπ - pπ multiple

(a) Ge
(b) Si
(c) Sn
(d) C

(JEE Main 2019, 12 Jan Shift-II)

Ans. (d): Carbon (C) atom has 2p orbital's able to form strongest pπ– pπ bonds due to its size. The pπ- pπ bond is formed when the collision occurs sideways and not head on.

690. The element that does not show catenation is

(a) Ge
(b) Sn
(c) Si
(d) Pb

(JEE Main 2019, 12 Jan Shift-II)

Ans. (d): Catenation is not shown by Pb. Down the group metallic character increases and Pb is a metal and catenation is the property of non-metal.

691. Which of the following exists as covalent crystals in the solid state?

(a) Iodine
(b) Silicon
(c) Sulphur
(d) Phosphorus

(JEE Main 2013)

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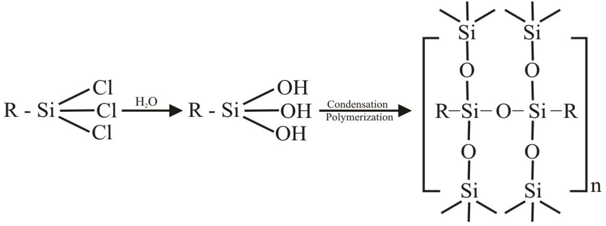
Ans. (b) Silicon (Si) : Covalent solid.
Sulphur (S_8) : Molecular solid
Phosphorous (P_4): Molecular solid
Iodine (I_2): Molecular solid.
Hence, option (b) is correct.

692. Among the following substituted silanes the one which will give rise to cross linked silicone polymer on hydrolysis is

(a) R_4Si (b) $R\,SiCl_3$
(c) R_2SiCl_2 (d) R_3SiCl

(AIEEE 2007)

Ans. (b) : On hydrolysis of $RSiCl_3$ will give $RSi(OH)_3$ which will polymerise to cross-linked silicon polymer



693. The stability of dihalides of Si, Ge, Sn and Pb increases steadily in the sequence

(a) $GeX_2 < SiX_2 < SnX_2 < PbX_2$
(b) $SiX_2 < GeX_2 < PbX_2 < SnX_2$
(c) $SiX_2 < GeX_2 < SnX_2 < PbX_2$
(d) $PbX_2 < SnX_2 < GeX_2 < SiX_2$

(AIEEE 2007)

Ans. (c) : $SiX_2 < GeX_2 < SnX_2 < PbX_2$.
On moving down the group (IV) the +2 oxidation state is more stable due to inert pair effect.

694. Which of the following oxides is amphoteric in character?

(a) SnO_2 (b) SiO_2
(c) CO_2 (d) CaO

(AIEEE 2005)

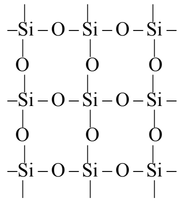
Ans. (a): SnO_2 reacts both acid and base hence it is an amphoteric oxide.

695. In silicon dioxide

(a) Three are double bonds between silicon and oxygen atoms
(b) Silicon atom is bonded to two oxygen atoms
(c) Each silicon atom is surrounded by two oxygen atoms and each oxygen atom is bonded to two silicon atoms
(d) Each silicon atom is surrounded by four oxygen atoms and each oxygen atom is bonded to two silicon atoms

(AIEEE 2005)

Ans. (d): In silicon dioxide (SiO_2) each silicon atom is surrounded by four oxygen atoms and each oxygen atom is bonded to two silicon atoms.



696. The soldiers of Napolean army while at Alps during freezing winter suffered a serious problem as regards to the tin buttons of their uniforms. White metallic tin buttons got converted to grey powder. This transformation is related to

(a) A change in the crystalline structure of tin
(b) An interaction with nitrogen of the air at very low temperature
(c) A change in the partial pressure of oxygen in the air
(d) An interaction with water vapour contained in the humid air

(AIEEE 2004)

Ans. (a): Grey tin is very brittle and easily crumbles down to a powder in very cold climates.

Grey tin $\rightleftharpoons$ White tin
(Cubic) (Tetragonal).

The change of white tin to grey tin is accompanied by an increase in the volume. This is called a tin disease or tin plague.. As temperature, decreases, white tin (β form) changes to grey tin (α form)

$\beta\text{-Sn} \longrightarrow \alpha\text{–Sn}$ at 132ºC.

α–Sn has much less density than β-Sn. It changes the crystalline structure.

697. Glass is a

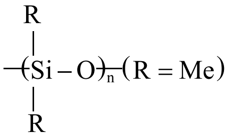
(a) Microcrystalline solid
(b) Super cooled liquid
(c) Gel
(d) Polymeric mixture

(AIEEE 2003)

Ans. (b) : Glass is a super cooled liquid because it has an amorphous structure. Amorphous solid have tendency to flow so called a super coolled liquid.

698. The basic structural unit of feldspar, zeolites, mica and asbestos is

(a) $(SiO_3)^{2-}$ (b) SiO_2
(c) $(SiO_4)^{4-}$ (d)



$-(\overset{R}{\underset{R}{Si}}-O)_n-(R = Me)$

(JEE Main 2019, 12 April Shift-I)

Ans. (c) : Basic unit of zeolite, mica, asbestos and feldspar is $(SiO_4)^{4-}$

699. The amorphous form of silica is

(a) Tridymite (b) Kieselguhr
(c) Cristobalite (d) Quartz

(JEE Main 2019, 9 April Shift-II)

Ans. (b) : Quartz, tridymite and cristobalite are all crystalline form of silica however kiesalguhr is an amorphous (crypto-crystalline) form of silica.

700. The correct order of catenation is

(a) $C > Sn > Si \approx Ge$ (b) $Si > Sn > C > Ge$
(c) $C > Si > Ge \approx Sn$ (d) $Ge > Sn > Si > C$

(JEE Main 2019, 10 April Shift-I)

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Ans. (c) : C > Si > Ge ≈ Sn
Catenation properties of non-metal decreases on moving down the group.

701. Which of the following is used for making optical instruments?

(a) SiO_2 (b) Si
(c) SIH_4 (d) SiC

AP EAMCET- 2006

Ans. (a): SiO_2 is used for making optical instrument.

- Use of silicon element to the making the semiconductor devices.
- SiH_4 is used in the production of amorphous silicon.
- Silicon carbide (SiC) elements are used today in the melting of glass and non-ferrous metal etc.

702. An oxide of an element is a gas and dissolves in water to give an acidic solution. The element belongs to

(a) II group (b) IV group
(c) VIII group (d) zero group

AP EAMCET- 2007

Ans. (b) : An oxide of an element is a gas and dissolved in water to give an acidic solution. The element belong to IV group.

$$\underset{\text{element}}{C} + O_2 \rightarrow \underset{\text{oxide}}{CO_2} \xrightarrow{H_2O} \underset{\text{acidic solution}}{H_2CO_3}$$

703. Identify B in the following reaction

$$H_4SiO_4 \xrightarrow[-H_2O]{1000^0C} A \xrightarrow[A]{\text{Carbon}} B + CO$$

(a) corundum (b) quartz
(c) silica (d) carborundum

AP EAMCET-2008

Ans. (d) : Orthosilicic acid (H_4SiO_4), on heating at high temperature, loses two water molecules and gives silica (SiO_2) which on reduction with carbon gives carborundum (SiC) and CO.

$$H_4SiO_4 \xrightarrow[-2H_2O]{1000°C} SiO_2 \xrightarrow[\Delta]{C} \underset{\substack{\text{Carborundum} \\ \text{'B'}}}{SiC} + CO$$

704. Which of the following substances consists of only one element

(a) Marble (b) Sand
(c) Diamond (d) Glass

MPPET- 2009

Ans. (c) : Diamond is an allotrope of carbon.
Diamond is a substance consists of only one element.
It is a hard, beautiful crystalline substance.

- Glass is mainly composed of silica and sodium carbonate.
- Marble is mainly composed of calcium carbonate.
- Sand is composed of silica dioxide.

705. Which of the following statements is correct ?

(a) Silicon doped with boron is an n-type semiconductor
(b) Silicon doped with arsenic is a p-type semiconductor
(c) Metals are good conductors of electricity
(d) Electrical conductivity of semiconductors decreases with increasing temperature

AP EAMCET Engg. -2007

Ans. (c): Metals are good conductor of electricity due to the presence of free electrons. Silicon doped with boron is an p-type semi conductor.

- Silicon doped with arsenic is a n-type semi conductor.
- Electrical conductivity of semi conductors increases with increase in temperature.

706. Carbon and germanium belong to the 14th group. The maximum co-ordination number of carbon is less than germanium, because of _____

(a) Larger size of germanium
(b) Electronegativity difference
(c) Availability of low-lying d-orbitals in germanium
(d) Electrical conductivity

AP EAPCET 23-08-2021 Shift-I

Ans. (c) : Carbon (C) and Germanium (Ge) belong to the 14th group. Carbon is in 2nd period and no d-orbital include. Germanium (Ge) is in 4th period and will have d-orbital. So, the maximum coordination number of carbon is less than germanium because of availability of low-lying d-orbitals in germanium.

707. An inorganic compound (A) made of two most occurring elements in the earth's crust and used in building construction when made to react with carbon, forms a poisonous gas(B) which is most stable diatomic molecule. Compound (A) and (B) are

(a) SiO_2 , CO_2 (b) SiO_2 , CO
(c) SiO_2 , N_2 (d) CaO , CO_2

AP-EAMCET-25-08-2021 Shift-I

Ans. (b) : When silica react with carbon forms the poisoneous gas CO. The reaction is as given below-

$$\underset{\text{'A'}}{SiO_2} + 2C \rightarrow Si + \underset{\substack{\text{'B'} \\ \text{(poisoneous gas} \\ \text{most stable)}}}{2CO}$$

708. Among the following options the element with the highest density and lowest boiling point is

(a) C (b) Sn
(c) Pb (d) Ge

TS-EAMCET (Engg.), 07.08.2021 Shift-II

Ans. (c) :

Element	Density(g/*l*)	Boiling point(°C)
C	2.26	4827
Sn	7.31	2602
Pb	11.35	1749
Ge	5.323	2833

Hence, lead (Pb) has highest value of density and lowest value of boiling point.

@apna_pdf

5. Allotropes of Carbon

709. Choose the correct statement:

(a) Both diamond and graphite are used as dry libricants

(b) Diamond and graphite have two dimensional network

(c) Diamond is covalent and graphite is ionic

(d) Diamond is sp^3 hybridised and graphite is sp^2 hybridized.

NEET-17.07.2022

Ans. (d) : The allotrope of carbon is diamond and graphite. In diamond each carbon is bonded with four other carbon atom. So, hybridisation of carbon atom is sp^3. In graphite each carbon is bonded with three other carbon atom. So, hybridisation of carbon atom is sp^2.

710. Which one of the following compounds of Group-14 elements is not known?

(a) $[GeCl_6]^{2-}$ (b) $[Sn(OH)_6]^{2-}$

(c) $[SiCl_6]^{2-}$ (d) $[SiF_6]^{2-}$

(JEE Main 2021, 25 July Shift-I)

Ans. (c) Due to inter-electron repulsions between chlorine atoms the compound $(SiCl_6)^{2-}$ is not known.

711. The incorrect statement regarding the structure of C_{60} is

(a) The six-membered rings are fused to both six and five-membered rings

(b) Each carbon atom forms three sigma bonds

(c) The five-membered rings are fused only to six-membered rings

(d) It contains 12 six-membered rings and 24 five-membered rings

(JEE Main 2021, 16 March Shift-II)

Ans. (d) : It contains 12 six-membered rings and 24 five-membered rings.

The C_{60} actually contains 12 five-membered rings and 20 six membered rings.

712. Water does not produce CO on reacting with

(a) CH_4 (b) C

(c) CO_2 (d) C_3H_8

(JEE Main 2021, 25 Feb Shift-II)

Ans. (c) : $CO_2 + H_2O \rightarrow H_2CO_3$

$C + H_2O(\text{Steam}) \rightarrow CO + H_2$

$CH_4 + H_2O \rightarrow CO + 3H_2$

$C_3H_8 + H_2O \rightarrow 3CO + H_2$

Thus, CO_2 does not produce CO, but it produces carbonic acid.

713. 'X' melts at low temperature and is a bad conductor of electricity in both liquid and solid state. X is

(a) carbon tetrachloride (b) silicon carbide

(c) mercury (d) zinc sulphide

(JEE Main 2020, 9 Jan Shift-II)

Ans. (a) : The melting point of carbon tetrachloride is –22.92°C

The dipole moment of carbon is zero hence it is a non-polar compounds. As there is no charge separation in the molecule, therefore this compound is a very bad conductor of electricity in solid as well as in liquid state.

Carbon tetrachloride, a colourless, dense, highly toxic, volatile, nonflammable liquid possessing a characteristic odour and belonging to the family of organic halogen compound, used principally in the manufacture of dichlorodifluromethane (a refrigerant and propellant).

714. Which one of the following statements about diamond and graphite is not correct?

(a) Diamond has a tetrahedral structure, whereas graphite has a hexagonal planar structure.

(b) Both physical and chemical properties of diamond and graphite are different.

(c) Graphite is soft but diamond is hard.

(d) Graphite is a good conductor of electricity while diamond is not.

NDA (II)-2019

Ans : (b) Since they both made of carbon their chemical properties are similar. But the most physical properties like hardness, conductivity of heat/electricity etc. are different. Graphite has a layered structure while diamond has a crystalline structure.

715. The hydride that is not electron deficient is

(a) AlH_3 (b) B_2H_6

(c) SiH_4 (d) GaH_3

(JEE Main 2019, 11 Jan Shift-II)

Ans. (c) : To know about electron deficient we have to determine the octet or duplet of each atom in the molecule. If the octet and duplet of each of the atoms in the molecule is complete them it is not electron deficient.

Silicon has 4 electrons in its valence shells and requires 4 electrons to complete its octet and here it forms a bond with 4 hydrogen SiH_4 is an electron precise molecule not electron deficient.

716. The difference in activity

$Me_3CCH_2COOH > Me_3SiCH_2COOH$

Can be attributed to the fact that

(a) Silicon is more electropositive than carbon and therefore has an electron donating inductive effect

(b) Silicon is a non-metal

(c) carbon is more electropositive than silicon and has an electron donating inductive effect

(d) carbon is a non-metal.

J & K CET-(2001)

Ans. (a) : Silicon is more electropositive than carbon and therefore has an electron donating inductive effect Me_3CCH_2COOH is more acidic than Me_3SiCH_2COOH.

717. The electronic configuration of chalcogens is

(a) $ns^2\ np^2$ (b) $ns^2\ np^3$

(c) $ns^2\ np^4$ (d) $ns^2\ np^1$

J & K CET-(2000)

Ans. (c) : The chalcogens are the elements that belongs to group 16 of the modern periodic table (or the oxygen family). The chalcogens consists of 5 elements-oxygen, sulphur, selenium, tellurium and polonium. The general electronic configuration of the chalcogens can be written as '$ns^2\ np^4$', when 'n' denotes the value of the principal quantum number corresponding to the valence shell of the element.

@apna_pdf

718. Which of the following is used for making optical instruments?

(a) SiO_2 (b) Si
(c) SiH_4 (d) SiC

JCECE - 2009

Ans. (a):
Silica is an important ingredient which is widely used for making optical instruments. A clear, strong glass is produced when pure silica is fused at a high temperature. Thus, amorphous silicon dioxide (SiO_2) is used in making optical instruments.

719. Among the following substituted silanes the one which will give rise to cross linked silicone polymer on hydrolysis is

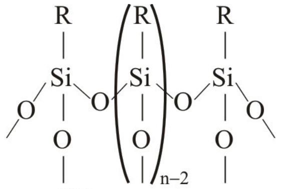
(a) R_3SiCl (b) R_3SiCl_2
(c) R_4Si (d) $RSiCl_3$

JCECE - 2017

Ans. (d): Preparation of silicone takes place as

$$RSiCl_3 + 3H_2O \longrightarrow RSi(OH)_3 + 3HCl$$

$$nRSi(OH)_3 \xrightarrow{(n-1)H_2O}$$



Silicone

720. The catenation tendency of C, Si and Ge is in the order Ge < Si < C. The bond energies [in kJ mol^{-1}]of C–C, Si–Si and Ge–Ge bonds, respectively are

(a) 348, 167, 180 (b) 348, 180, 167
(c) 167, 180, 348 (d) 180, 167, 348

JIPMER-2015

Ans. (b) : 348, 180, 167
The catenation tendency is depends on bonds energies, more will be the catenation tendency more will be the bond energy. Carbon has highest bond energy hence highest catenation tendency.

$$C-C > Si-Si > Ge-Ge$$
$$348 > 180 > 167 \text{ kJ/mol}$$

721. Which of the following sets has Lewis acid behaviour for all the components?

(a) BF_3 (b) BF_3, SiF_4, PF_5
(c) SiF_4, PF_5 (d) BF_3, PF_5
(e) (a) and (b)

Kerala-CEE-2019

Ans. (e) : BF_3, SiF_4, PF_5 sets has Lewis acid behavior for all the components. In Lewis concept many acids do not have proton. These species are electron deficient that readity react with base by accepting its Ione-pair of electron.

$$\underset{\substack{\text{Lewis acid}\\\text{(electron accepter)}}}{A^+} + \underset{\substack{\text{Lewis acid}\\\text{(electron donor)}}}{B^-} \longrightarrow \underset{\substack{\text{Co-ordinate}\\\text{covalent bond}}}{A-B}$$

722. The energy gap is much more in silicon than in germanium because

(a) It has less number of electrons
(b) It has high atomic mass number
(c) Its crystal has much stronger bonds called ionic bonds
(d) It valence electrons are more tightly bound to their parent nuclii
(e) Its valence electrons are more loosely bound to their parent nuclii

Kerala-CEE-2019

Ans. (d) : Its valence electrons are more tightly bound to their parent the electrons in the silicon atoms are more tightly bound to the nucleus than the electrons of the germanium atom due to its small size. Hence, the bond gap of silicon is more than that of germanium.

723. Which one of the following element is represented as Eka-Silicion in Mendeleev's periodic table?

(a) Gallium (b) Germanium
(c) Aluminium (d) Tin
(e) Arsenic

Kerala-CEE-2020

Ans. (b) : The element Eka-Silicon in Mendeleev's periodic table is known as Germanium.
Germanium (Ge) is a chemical element places between silicon and tin in Group of the periodic table.

- Germanium has a diamond-like structure and its properties are very similar to the physical and chemical properties of silicon.

724. The number of six membered and five membered rings in Buckminster Fullerene respectively is

(a) 20, 12 (b) 12, 20
(c) 14, 18 (d) 14, 11

Kerala-CEE-29.08.2021
Karnataka CET-2021

Ans. (a) : Buckminster fullerene is an allotrope of carbon. It has a shape of soccer ball. It is made up of twenty hexagons and twelve pentagons and has an age like fuse with six ring structure of C_{60}.

725. More than four bonds are made by how many elements in carbon family?

(a) 1 (b) 2
(c) 3 (d) 4
(e) 5

Kerala-CEE-2018

Ans. (e) In carbon family except carbon all other forms more than four bonds due to presence of d-orbitals. Si, Ge, Sn, Pb, Fl.
C- does not form more than four bonds due to absence of d-orbitals.

726. A molecule of stachyose contains how many carbon atoms?

(a) 6 (b) 12
(c) 18 (d) 24

MHT CET-2017

Ans. (d) : Stachyose has 24 carbon atoms having chemical formula $C_{24}H_{42}O_{21}$.

727. What is the chief constituent of pyrex glass?

(a) B_2O_3 (b) SiO_2
(c) Al_2O_3 (d) Na_2O

MHT CET-2017

@apna_pdf

Ans. (b) Pyrex glass is obtained by fusing together 60 to 80% SiO_2, 10 to 25% B_2O_3 and remaining Al_2O_3.
Pyrex is a very important material for a many number of applications that require heat and chemical resistance.
SiO_2 is the chief constituent of Pyrex glass.

728. What is the hybridisation of carbon atoms in fullerene?

(a) sp^3 (b) sp
(c) sp^2 (d) dsp^3

JIPMER-2018, MHT CET-2017

Ans. (c) : sp^2 - hybridisation
In fullerene, Carbon atom is sp^2-hybridised like to graphite.

729. The common basic structural unit in silicates and silica is

(a) $Si_2O_6^{4-}$ (b) SiO_3^{2-}
(c) SiO_4^{4-} (d) $Si_2O_7^{6-}$

MHT CET-2011

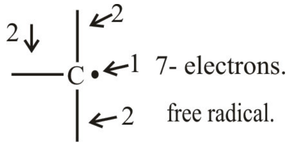
Ans. (c) : The common basic structural unit in silicates and silica is SiO_4^{4-}.
Silica (SiO_2) and silicates contain a common structural unit $(SiO_4)^{4-}$ in which each Si is surrounded tetrahedrally by four oxygen atoms.

730. The central carbon atom of a free radical contains

(a) 6 electrons (b) 7 electrons
(c) 8 electrons (d) 10 electrons

MHT CET-2011

Ans. (b) : Free radicals are obtained by homalytic bond fission hence central carbon atom of free radical contains 7 electrons.



731. Which of the following does not contain silicon?

(a) Kaoline (b) Agate
(c) Ruby (d) Quartz

MHT CET-2007

Ans. (c) :

Kaoline	$Al_2Si_2O_5(OH)_4$
Agate	SiO_2
Ruby	Al_2O_3
Quartz	SiO_2

732. Monosilane on coming in contact with air burns with a luminous flame producing vortex rings. These rings are of

(a) SiO_2 (b) SiO
(c) Si (d) H_2SiO_3

MHT CET-2007

Ans. (a) Monosilane (eg. SiH_4) on coming in contact with air burns with luminous flame producing vortex ring. These rings are of silica.

$$\underset{\text{Monosilone}}{SiH_4} + 3O_2 \rightarrow \underset{\text{Vortex ring.}}{SiO_2} + 2H_2O$$

733. Identify the correct statements from the following:

(A) $CO_{2(g)}$ is used as refrigerant for ice-cream and frozen food.

(B) The structure of C_{60} contains twelve six carbon rings and twenty five carbon rings.

(C) ZSM-5, a type of zeolite, is used to convert alcohols into gasoline

(D) CO is colourless and odourless gas

(a) (A), (B) and (C) only (b) (A) and (C) only
(c) (B) and (C) only (d) (C) and (D) only

NEET-2020

Ans. (d)
(a) $CO_2(g)$ used as refrigerant for ice-cream and frozen food because of its sublimation properties. (Wrong).
(b) The structure of C_{60} contains twelve five-carbon rings and twenty six carbon rings. (Wrong)
(c) ZSM-5 a type of Zeolite, is use to convert alcohol in to gasoline. (Correct)
(d) CO is a colorless and odorless gas. (Correct).
∴ hence statements (c) and (d) are correct.

734. Which of the following compounds is used in cosmetic surgery?

(a) Silica (b) Silicates
(c) Silicones (d) Zeolites

Odisha NEET-2019

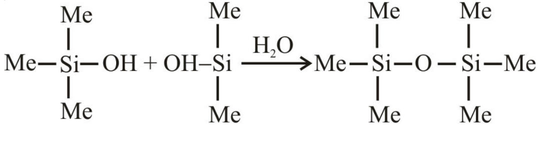
Ans. (c) : Silicones are used in cosmetic surgery to increase water resistance.
Silicones persist indefinitely as substitutes for bone, cartilage and soft tissue of all shapes and sizes.

735. Which of these is not a monomer for a high molecular mass silicone polymer?

(a) Me_3SiCl (b) $PhSiCl_3$
(c) $MeSiCl_3$ (d) Me_2SiCl_2

NEET-2013

Ans. (a) : Me_3SiCl is not a monomer for a high molecular mass. Silicon polymer because it generate Me_3SiOH when subjected to hydrolysis which contains only one reaction site



$$Me_3Si{-}OH + OH{-}SiMe_3 \xrightarrow{H_2O} Me_3Si{-}O{-}SiMe_3$$

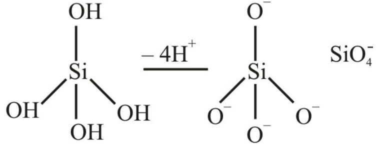
Final product

736. The basic structural unit of silicates is

(a) SiO_3^{2-} (b) SiO_4^{2-}
(c) SiO^- (d) SiO_4^{4-}

NEET-2013

Ans. (d) : In a silicate is any member of a family of anions consisting of silicon and oxygen usually with the general formula (SiO^{4-}_4). It is a tetrahedral unit, Si atom is Sp^3-hybridized and forms four covalent bonds with oxygen atoms.



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737. Which statement is wrong?

(a) Beryl is an example of cyclic silicate.

(b) Mg_2SiO_4 is orthosilicate

(c) Basic structural unit in silicates is the SiO_4 tetrahedron

(d) Feldspars are not aluminosilicates

NEET-Karnataka-2013

Ans. (d) : Magnesium orthos silicate is a chemical compound with the formula Mg_2SiO_4. It is the ortho silicate salt of magnesium. It exists a forsterite in nature.

- Silicate mineral structures is the silicon oxygen tetrahedron (SiO^{4-}_4). It consist of a central silicon atom surrounded by four oxygen atoms in the shape of a tetrahedron.
- Feldspars is a common tectosilicate aluminosilicate mineral made of potassim, sodium and calcium cations surrounded by a negatively charged network of silicon, aluminium and oxygen atoms.

738. Carbon cannot reduce Fe_2O_3 to Fe at a temperature below 983 K because

(a) free energy change for the formation of CO is more negative than that of Fe_2O_3

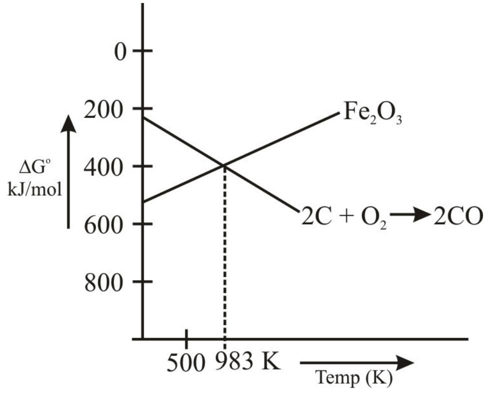
(b) CO is thermodynamically more stable than Fe_2O_3

(c) carbon has higher affinity towards oxygen than iron

(d) iron has higher affinity towards oxygen than carbon

Karnataka-CET-2011

Ans. (d) : carbon connot reduce Fe_2O_3 to Fe at a temperature below 983K because iron has higher affinity towards oxygen than carbon.



Below 983 K, conversion of iron to ferric oxide is more favourable.

739. The Straight chain polymer is formed by

(a) hydrolysis of CH_3SiCl_3 followed by condensation polymerisation

(b) hydrolysis of $(CH_3)_4Si$ by addition polymerisation

(c) hydrolysis of $(CH_3)_2SiCl_2$ followed by condensation polymerisation

(d) hydrolysis of $(CH_3)_3SiCl$ followed by condensation polymerisation

NEET-2009

Ans. (c) : hydrolysis of $(CH_3)_2SiCl_2$ followed by condensation polymerization.

The condensation polymerision of dimethyl dihydroxy silane leads to straight chain polymerisarion.

$(CH_3)_2SiCl_2 \xrightarrow{H_2O} (CH_3)_2Si(OH)_2 \rightarrow [(CH_3)_2SiO]_n$

740. Which of the following anions is present in the chain structure of silicates?

(a) $(Si_2O_5^{2-})_n$ (b) $(SiO_3^{2-})_n$

(c) SiO_4^{4-} (d) $Si_2O_7^{6-}$

NEET-2007

Ans. (b) : Silicate minerals containing chains are termed inosilicates. They consist of single chains $(SiO^{2-}_3)_n$ in which the silicon to oxygen atom ratio is 1:3, and double chains $(Si_4O^{6-}_{11})_n$ in which the silicon to oxygen atom ratio is 4:11.

$[SiO_3^{2-}]_n$ and $[Si_4O_{11}]^{6-}$ have chain structure of silicates.

741. Which one of the following statements about the zeolite is false?

(a) They are used as cation exchanges

(b) They have open structure which enables them to take up small molecules

(c) Zeolites are aluminosilicates having three dimensional network.

(d) Some of the SiO_4^{4-} units are replaced by AlO_4^{5-} and AlO_6^{9-} ions in zeolites

NEET-2004

Ans. (d) :

(a) Zeolites are natural ion exchanger as in permutit water softeners hence it is correct.

(b) Zeolites are like molecular sieves. They trap small molecules such as water. ammonia and CO_2 in their interstices. It is true.

(c) Zeolites are aluminosilicates having three dimensional network. they are termed aluminisilicates because some of the Si^{4+} ions may be replaced by Al^{3+} ions it is ture.

(d) In zeolites some of the Si^{4+} ions may be replaced by Al^{3+}. This results in unbalance anionic charge to main-tain electrical neutrality positive ions must be introduced.

Thus, statement (d) is false.

742. Hydrogen gas is not liberated when the following metal is added to dil HCl

(a) Ag (b) Zn

(c) Mg (d) Sn

Karnataka-CET, 2008

Ans. (a) : Silver (Ag) do not liberates hydrogen from HCl as the silver is less reactive than

Among the given metals only Ag is present below hydrogen in electrochemical series, so it does not evolve hydrogen with dil HCl.

$$Ag + dil\,HCl \longrightarrow No\,reaction$$

743. Which of the following is incorrect statement?

(a) SnF_4 is ionic in nature

(b) PbF_4 is covalent in nature

(c) $SiCl_4$ is easily hydrolysed

(d) GeX_4 (X = F, Cl, Br, I) is more stable than GeX_2.

NEET-2019

@apna_pdf

Ans. (b) : PbF_4 is covalent in nature.
PbF_4 is not covalent as Pb is large in size and F is very small in size hence by Fajan's rule PbF_4 is not covalent.

744. Name the type of the structure of silicate in which one oxygen atom of $[SiO_4]^{4-}$ is shared?
(a) Sheet silicate
(b) Pyrosilicate
(c) Three dimensional silicate
(d) Linear chain silicate.

JIPMER-2014, NEET-2011

Ans. (b) : Silicates are inorganic chain compounds formed by tetrahedral units $[SiO_4]^{4-}$.
In pyrosillicates, linear chain silicates and three dimensional silicates 1, 2 and 4 oxygen of SiO_4^{4-} shared respectively.

745. It is because of inability of ns^2 electrons of the valence shell to participate in bonding that
(a) Sn^{2+} is oxidising while Pb^{4+} is reducing
(b) Sn^{2+} and Pb^{4+} are both oxidising and reducing
(c) Sn^{4+} is reducing while Pb^{4+} is oxidising
(d) Sn^{2+} is reducing while Pb^{4+} is oxidising

NEET-2017

Ans. (d) : Sn^{2+} is reducing while Pb^{4+} is oxidising. Sn^{4+} is more stable than Sn^{2+} while Pb^{2+} is more stable than Pb^{4+} due to inert pair effect hence Sn^{2+} oxidizes to Sn^{4+} acts as reducing agent and Pb^{4+} reduces to Pb^{2+} and acts as oxidising agent.

746. A nuclide of an alkaline earth metal undergoes radioactive decay by emission of three α particles in succession. The group of the resulting daughter element would belong to
(a) Group 14 (b) Group 16
(c) Group 4 (d) Group 6

JIPMER-2007

Ans. (a) Suppose,
Nuclide is $_{12}Mg^{24}$ (∵ Alkaline earth metal)
It undergoes 3 α-particles emission

$$\therefore \quad {}_{12}Mg^{24} \xrightarrow{3\,{}_2He^4} {}_6X^{12}$$

$${}_6X^{12} = {}_6C^{12}$$

∴ It belongs to group 14.

747. Carbon and silicon belong to (IV) group. The maximum coordination number of carbon in commonly occurring compounds is 4, whereas that of silicon is 6. This is due to
(a) availability of low lying d-orbital's in silicon
(b) large size of silicon
(c) more electropositive nature of silicon
(d) both (b) and (c)

NEET-1994

Ans. (a) : Availability of low lying d-orbital's in silicon. Corbon atom has no d-orbits hence does not show coordination number more than 4 while silicon has 6 (six) because it has vacant d–orbital in its valence shell so it can expand its valency using these available vacant d–orbital and form 6 coordination number.

748. The element Z = 114 has been discovered recently. It will belong to which of the following family/group and electronic configuration?
(a) Carbon family, $[Rn]\ 5f^{14}\ 6d^{10}\ 7s^2\ 7p^2$
(b) Oxygen family, $[Rn]\ 5f^{14}\ 6d^{10}\ 7s^2\ 7p^4$
(c) Nitrogen family, $[Rn]\ 5f^{14}\ 6d^{10}\ 7s^2\ 7p^6$
(d) Halogen family, $[Rn]\ 5f^{14}\ 6d^{10}\ 7s^2\ 7p^5$

NEET-2017

Ans. (a) : Carbon family : $[Rn]\ 5f^{14}, 6d^{10}, 7s^2, 7p^2$
Atomic number of Rn = 86
∴ Hence, the element belongs to carbon family and electronic configuration is $[Rn], 5f^{14}, 6d^{10}, 7s^2, 7p^2$ shows correct atomic number (Z) is 114.

749. Which of the following compounds is the hardest material?
(a) Be_2C (b) SiC
(c) B_4C (d) Graphite

Tripura JEE-2022

Ans. (c) : Boron carbide (B_4C) is the hardest material after diamond and cubic boron nitride.

750. Carbon atom consists of electrons, protons and neutrons. If the mass attributed to neutron were halved and that attributed to the electron were doubled, the atomic mass of $_6C^{12}$ would be approximately
(a) same (b) doubled
(c) halved (d) reduced by 25%

UP CPMT-2013

Ans. (d) : (i) There is no change by doubling mass on electrons, because there are only 6-electrons in carbon atom which have negligible mass (6/1837 of the mass of a proton).
(ii) However, by reducing mass of neutron half, total atomic mass becomes 6 (protons) +3 (neutrons) instead 6 (protons) +6 (neutrons).
Thus, the new atomic mass of $_6C^{12}$ would be

$$\frac{3}{12} \times 100 = 25\%$$

Thus, the atomic mass of $_6C^{12}$ is reduced by 25%.

751. Ge (II) compounds are powerful reducing agents where as Pb (IV) compounds are strong oxidants. It can be due to
(a) Pb is more electropositive than Ge
(b) ionisation potential of lead is less than of Ge
(c) ionic radii of Pb^{2-} and Pb^{++} are larger than those of Ge^{2+} and Ge^{4+}
(d) more pronounced inert pair effect in lead than Ge

UP CPMT-2011

Ans. (d) : Inert pair effect is more pronounced in heavier members like Pb. Hence, Pb (IV) compounds act as strong oxidising agents and are reduced to more stable Pb(II) compounds.

752. Darking of surfaces painted with white lead is due to
(a) H_2S (b) CO_2
(c) Cu (d) O_2

UP CPMT-2009

Ans. (a): White lead reacts with H_2S of the atmosphere and forms lead sulphide (PbS) which is black in colour. Due to this reason, the surface painted with white lead becomes dark after sometime.

@apna_pdf

753. Ordinary glass is formed by mixing of

(a) $Na_2CO_3 + CaCO_3$

(b) $Na_2CO_3 + CaCO_3 + \text{silica}$

(c) silica + Na_2CO_3

(d) silica + borax

UP CPMT-2009

Ans. (b): On the heating of sodium carbonate (Na_2CO_3), calcium carbonate ($CaCO_3$) and silica (SiO_2) at the 1700K forms ordinary glass or soda glass.

Reaction given below:

$$Na_2CO_3 + SiO_2 + CaCO_3 \xrightarrow{1700\,K} \underset{\text{ordinary glass}}{Na_2SiO_3CaSiO_34SiO_2} + CO_2$$

754. SiO_2 is reacted with sodium carbonate. What is the gas liberated?

(a) CO (b) O_2

(c) CO_2 (d) O_3

UP CPMT-2008

Ans. (c): When silica is heated with metal carbonate, it form silicates.

$SiO_2 + Na_2CO_3 \xrightarrow{\Delta} Na_2SiO_3 + CO_2 \uparrow$

755. White lead is

(a) Pb_3O_4

(b) PbO

(c) $2PbCO_3Pb(OH)_2$

(d) $Pb(CH_3COO)_2\,Pb(OH)_2$

UPTU/UPSEE-2008

UP CPMT-2007

Ans. (c) : White lead is $2PbCO_3Pb(OH)_2$. It is also known as basic lead carbonate.

Note:– White lead is useful for the manufacturing of white paints.

756. The oxidation number of carbon in CH_2O is

(a) -2 (b) +2

(c) 0 (d) +4

UP CPMT-2004

Ans. (c) : The sum of oxidation states of all atoms in a molecule is zero.

Let the oxidation number of carbon be 'x'.

CH_2O

or $x + (2 \times 1) + (-2) = 0$

or $x + 2 - 2 = 0$

$\therefore$ $x = 0$

757. The purest form of coal is

(a) Peat (b) Anthracite

(c) Bituminous (d) Lignite

UP CPMT-2003

Ans. (b) : Anthracite is the purest form of coal because it has highest percentage of carbon in it. Anthracite contains in between 92.1 to 98% in a coal.

758. Sindoor is represented by

(a) $Pb(NO_3)_2$ (b) $PbCO_3 \cdot Pb(OH)_2$

(c) $Pb(OH)_2 \cdot 4PbCO_3$ (d) Pb_3O_4

UP CPMT-2002

Ans. (d) : $Pb(NO_3)_2$ – Lead Nitrate

$PbCO_3.Pb(OH)_2$ – Basic lead carbonate

Pb_3O_4 – Sindoor (poisonous)

Sindoor is a red powder. Chemically red lead is lead tetroxide. Pb_3O_4 or $2PbO.PbO_2$.

759. Reducing power of Ge^{+2}, Sn^{+2} and Pb^{2+} decrease in the order

(a) $Ge^{+2} > Sn^{+2} > Pb^{+2}$ (b) $Sn^{+2} > Ge^{+2} > Pb^{+2}$

(c) $Pb^{+2} > Sn^{+2} > Ge^{+2}$ (d) $Sn^{+2} > Pb^{+2} > Ge^{+2}$

UP CPMT-2001

Ans. (a) : If the oxidation state of the elements is same, then the reducing power of elements decreases with increase in stability of cation.

The stability of +2 oxidation state of elements of group 14 increase down the group due to inert pair effect.

$\therefore$ $Pb^{2+} > Sn^{2+} > Ge^{2+}$

(reducing order of stability)

$\therefore$ $Ge^{2+} > Sn^{2+} > Pb^{2+}$

(decreasing order of reducing character)

760. When an iron object is plated with tin, tin does not act as sacrificial anode in protecting against corrosion, because

(a) tin is more reactive than iron

(b) tin is less reactive than iron

(c) reactivity of tin and iron is same

(d) tin is oxidizing agent while iron is not so

JIPMER-2016

Ans. (b) : Tin is less reactive than iron.

As we know, tin is less reactive than iron so when we placed iron object with tin, it does not act as sacrificial anode in protecting against corrosion.

761. Pb reacts with dilute HNO_3 produces:

(a) NO (b) NH_4NO_3

(c) N_2O_5 (d) NO_2

UPTU/UPSEE-2006

Ans. (a) : Pb reacts with dilute HNO_3 produces NO gas.

$Pb + (\text{dil})\ HNO_3 \rightarrow Pb(NO_3)_2 + NO + H_2O$

762. The elements commonly used for making transistors are:

(a) C and Si (b) Ga and In

(c) P and As (d) Si and Ge

UPTU/UPSEE-2006

Ans. (d) : Transistors are semiconductor devices hence Si and Ge are used for making them.

763. Red lead is

(a) PbO (b) Pb_3O_4

(c) PbO_2 (d) Pb_4O_3

UPTU/UPSEE-2015

Ans. (b) : Red lead pigment prepared by heating PbO in revolving furnace with excess of air about 450°C

$$6PbO + O_2 \xrightarrow{450\,^{\circ}C} 2Pb_3O_4\ (\text{Red lead})$$

764. Silicon doped with gallium forms

(a) n-type semiconductor

(b) both n and p-type semiconductor

(c) an intrinsic semiconductor

(d) p-type semiconductor

Karnataka-CET-2020

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Ans. (d) : p-type semiconductor semi-trivalent impurity makes the conductor p-type and pentavalent impurity makes the semi-conductor n-type, since Ga is trivalent hence makes Si p-type semiconductor when doped in Si-crystal.

765. Which of the following statements is not correct?
(a) Silicon is extensively used as a semiconductor
(b) Carborundum is SiC
(c) Silicon occurs in free state in nature
(d) Mica contains the element silicon

WB-JEE-2009

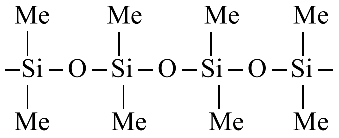
Ans. (c) : Silicon does not occurs in free state in nature. Silicons occurs in nature either form of silica or silicates. So, Option (c) is not correct.

766. Silicon oil is obtained from the hydrolysis and polymerisation of
(a) trimethylchlorosilane and dimethyldichlorosilane
(b) trimethylchlorosilane and methyldichlorsilane
(c) methyltrichlorosilane and dimethyldichlorosilane
(d) triethylchlorosilane and dimethyldichlorosilane

WB-JEE-2013

Ans. (a) : Trimethylchlorosilane and dimethyldichlorosilane.
Silicon oil is a polymer of trimethylchlorosilane and dimethylchlorisilane. It is used as broad-spectrum antifoaming agents.

$Si(Me_3)Cl + Si(Me)_2\,Cl_2 \xrightarrow{H2O, polymerisation}$



$$-\underset{Me}{\overset{Me}{Si}}-O-\underset{Me}{\overset{Me}{Si}}-O-\underset{Me}{\overset{Me}{Si}}-O-\underset{Me}{\overset{Me}{Si}}-$$

767. The main reason that $SiCl_4$ is easily hydrolysed as compared to CCl_4 is that
(a) Si–Cl bond is weaker than C – Cl bond
(b) $SiCl_4$ can form hydrogen bonds
(c) $SiCl_4$ is covalent
(d) Si can extend its coordination number beyond four

WB-JEE-2018

Ans. (d) : Si can extend it coordination number beyond four and $SiCl_4$ is easily hydrolyzed.
Due to presence of d-orbitals Si can extend where as carbon has no d-orbitals hence do not hydrolysed.

768. Which of the following statements is not correct?
(a) In CO_2 molecule, carbon hybridisation is sp
(b) Fullerenes are made by heating graphite in an electric arc in the presence of argon gas
(c) Both $[SiF_6]^{2-}$ and $[SiCl_6]^{2-}$ ions are known
(d) In CO molecule, there are one 'sigma' (σ) and tow "pi" (π) bonds.

AP EAMCET-2017

Ans. (c) : SiF_6^{2-} is known, as F has small size and thus, the ion is quite stable unlike $SiCl_6^{2-}$ in which size of Cl atom is large which is stabilize it

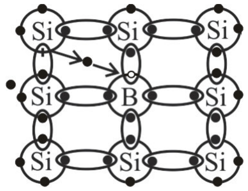
769. Which one of the following elements, when present as an impurity in silicon makes it a p-type semiconductor?
(a) As (b) P
(c) In (d) Sb

AP EAMCET (Engg.) - 2012

Ans. (c) : When a trivalent impurity is added to an intrinsic or pure semiconductor, Then it is said to be an p–semiconductor

13 Group Elements

⇒ Indium (In) has 3 valency, and when it is used in doping in silicon crystal then there is hole formation and p-type of semiconductor is formed.



770. The INCORRECT statement regarding the structure of C_{60} is:
(a) It contains 12 six-membered rings and 24 five-membered rings.
(b) The six-membered rings are fused to both six and five-membered rings.
(c) The five-membered rings are fused only to six-membered rings.
(d) Each carbon atom forms three sigma bonds.

JEE Main 16.03.2021, Shift-II

Ans. (a) : The structure of C_{60} contains the 20 hexagons and 12 pentagons, Both rings attached to each other and making the three sigma bond, Buckminster fullerene is a type of fullerene with the formula C_{60}.

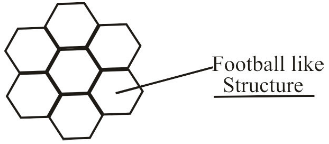
771. Fullerene with formula C_{60} has a structure where every carbon atom is
(a) sp-hybridized (b) sp^2-hybridized
(c) sp^3-hybridized (d) not hybridized.

COMEDK-2014

Ans. (b) : In fullerene with formula C_{60}, all the carbon atoms are equal and they undergo sp^2 hybridization.

Fullerene –

(1) Allotrope of carbon
(2) Its structure similar to graphite
(3) Good conductor of electricity
(4) Partial closed mesh structure
(5) C_{60} , C_{70}
(6) sp^2 hybridization



772. Which statement is wrong?
(a) Beryl is an example of cyclic silicate.
(b) Mg_2SiO_4 is orthosilicat.

@apna_pdf

(c) Basic structural unit in silicates is the SiO_4 tetrahedron.
(d) Feldspars are not aluminosilicates.

Karnataka NEET 2013

Ans. (d) : Feldspars, any of a group of aluminosilicate minerals that contains calcium, sodium or potassium feldspars make up more than half of earth is crust and professional literature about them constitutes a large percentage of the literature of mineralogy.

773. Assertion: Diamond is a bad conductor.
Reason: Graphite is a good conductor.
(a) If both Assertion and Reason are correct and Reason is a correct explanation of the Assertion.
(b) If both Assertion and Reason are correct but Reason is not a correct explanation of the Assertion.
(c) If the Assertion is correct but Reason is incorrect.
(d) If both the Assertion and Reason are incorrect.
(e) If the Assertion is incorrect but the Reason is correct.

(AIIMS-2002)

Ans. (b) : (1) Diamond is a bad conductor of electricity but good conductor of heat, electricity is conducted in a crystal by electrons that are relatively free but in diamond each carbon atom is covalently bonded with four other carbon atoms and there are no free electrons.

(2) Due to the free electrons in graphite framework, graphite can perform electricity. Therefore graphite is said to be a good conductor electricity.

774. Thermodynamically, the most stable form of carbon is

(a) Diamond	(b) Graphite
(c) Fullerenes	(d) Coal

(AIIMS-2009)

Ans. (b): The most stable form of carbon is graphite.
Graphite contains one delocalized electron per carbon these cause greater attraction between carbon atom hence giving stronger bonds, more stability to the structure.

775. In diamond crystal, each carbon atom is linked with carbon atoms. The number of carbon atoms linked is:

(a) 2	(b) 4
(c) 3	(d) 1

(AIIMS-2001)

Ans. (b): In the diamond crystal, each atom is bounded with four other carbon atoms by strong covalent bond. The central carbon atoms are at the four vertices of a regular tetrahedron. The other carbon atoms are in turn tetrahedrally bonded to four atom each. Each carbon atoms is an sp^3–hybridised state so each is linked with four other carbons by σ-bond.

776. Buckminster fullerene contains
(a) 12 six membered rings and 6 five membered rings
(b) 20 six membered rings and 12 five membered rings
(c) 12 six membered rings and 20 five membered rings
(d) 5 six membered rings and 12 five membered rings

Assam CEE-2019

Ans. (c) : A Buckminister fullerene C_{60} contains 20 five member rings and 12 six member rings is a six-member ring is fused with six or five member rings whereas a five member ring can only fuse with six member rings.

(1) It is third form of carbon known as fullerence was discovered by H.W. Kroto e smelly and R.F. curl in 1985

(2) C_{60} molecule has shape like a soccer ball and is called Buckminister fullerence

This ball shaped molecule has 60 vertices and each one is occupied by one carbon atom.

777. Buckminster- fullerene is a variety of

(a) boron	(b) carbon
(c) ammonia	(d) fluorine

CG PET -2009

Ans. (b) : Buckminister fullerence is an allotropic form of carbon with formula C_{60}. It is a spherical molecule. It has a shape of soccer ball. There are sixty equidistant spaces on the sphere that are occupied by C-atoms. Each C-atom of fullerene is sp^2- hybridised.

778. Which one of the following is a good conductor of electricity?

(a) Diamond	(b) Graphite
(c) Silicon	(d) amorphous carbon

CG PET -2006

Ans. (b) : Good conductor are material that allow an electric current to pass through them example- metals like copper, silver etc are good conductors. Graphite is also a good conductor of electricity they are used for making conducting wires

⇒ Poor conductors are minerals that do not allow an electric current to pass through them

Example – wood, diamond, plastic, pure water etc.

779. Which is the most thermodynamically stable form of carbon?

(a) Carbon black	(b) Graphene
(c) Graphite	(d) Diamond

CG PET -2017

Ans. (c) : Graphite is thermodynamically the most stable form of carbon. Graphite has delocalized π–electrons over the entire sheet. This delocalization lowers the energy of the system, leading to greater thermodynamic stability.

780. Which of the following order of acidic strength is correct?
(a) $HClO > HClO_2 > HClO_3 > HClO_4$
(b) $HClO_4 > HClO_2 > HClO_3 > HClO$
(c) $HClO_2 > HClO > HClO_4 > HClO_3$
(d) $HClO_4 > HClO_3 > HClO_2 > HClO$

GUJCET-2019

Ans. (d) : As electronegativity of the halogen groups decreases, the order of acidic strength also decreases,
Thus the acidic strength follows the order-
$HClO_4 > HClO_3 > HClO_2 > HClO$

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781. **The C–C bond length is maximum in**

(a) graphite (b) C_{70}
(c) C_{60} (d) diamond

(JEE Main-2019, 12 April Shift-II)

Ans. (d) : Carbon – carbon bond length is maximum in diamond having value 154 pm, because the diamond has a purely single bond. Here each carbon atoms undergoes sp^3 hybridisation.

Carbon allotrope	**C-C bond length**
Diamond	154 pm
Graphite	141.5 pm
C_{60}	138.3 pm and 143.5 pm
C_{70}	Eight type of bond lengths from 0.137 pm to 0.146 pm

782. **The number of pentagons in C_{60} and trigons (triangles) in white phosphorus, respectively, are**

(a) 20 and 3 (b) 12 and 4
(c) 20 and 4 (d) 12 and 3

(JEE Main-2019, 10 April Shift-II)

Ans. (b) : C_{60} is a molecule that consists of 60 carbon atom, arranged as 12 pentagons and 20 hexagons. The shape is the same as that of a soccer ball.

Total no. of pentagons in C_{60} =12

Total no. of trigons (Triangles) in white Phosphorous (P_4) = 4

783. **C_{60} an allotrope of carbon contains**

(a) 16 hexagons and 16 pentagons
(b) 20 hexagons and 12 pentagons
(c) 12 hexagons and 20 pentagons
(d) 18 hexagons and 14 pentagons

(JEE Main-2019, 9 April Shift-I)

Ans. (b) : C_{60} particle has gloriously symmetrical structure. It is an intertwined ring of aromatic framework containing 20 hexagons and 12 pentagons of sp^2 hybridized C atoms.

- It is a fullerene having a shape look soccer ball and called Buckminster fullerene.

784. **The hardest substance is**

(a) Iron (b) Steel
(c) Diamond (d) Graphite

JIPMER-2005

Ans. (c) : Diamond is the hardest substance

- It is a crystalline carbon and usually nearly colourless
- Diamonds are also chemically resistant and have the highest thermal conductivity of any natural material.

785. **Graphite is soft while diamond is hard because**

(a) graphite is in powder form
(b) diamond has sp^2 hybridisation but graphite has sp^3 hybridisation
(c) graphite is in planar form while diamond is in tetrahedral form
(d) graphite is covalent and diamond is ionic

JIPMER-2005

Ans. (c) : Diamond and graphite both are the allotrope of carbon.

Diamond	**Graphite**
1. Diamond has a crystalline structure	1. Graphite has layered structure
2. Diamond is formed by tetrahedral units in which each carbon atom is sp^3 hybridised	2. Graphite has a planner geometry in which each carbon atom is sp^2 hybridised by forming three sigma σ and one pi π bond
3. Diamond is the hardest naturally occurring substance	3. The graphite is soft and has a greasy touch

786. **Which of the following statement is correct for isotope of carbon?**

(a) graphite is conductor of electricity
(b) diamond have all sp^3 carbon
(c) graphite is more stable thermodynamically than diamond
(d) All are correct

JIPMER-2019

Ans. (d) : (1) Graphite is anisotropic and owing to its in plane metallic bonding it behaves as behaves as brilliant thermal and electrical conductor.

(2) The carbon atoms, here are sp^3 hybridized, and the bond lengths of the carbon-carbon atom are equal.

(3) Graphite is more stable thermodynamically than diamond

All given statement about Diamond and graphite are correct.

787. **Which of the following is not allotrope of carbon?**

(a) Diamond (b) Fullerene
(c) Soot (d) Graphite

JIPMER-2019

Ans. (c) : Diamond, Graphite and fullerene (substances that include nanotubes and buck balls, such buckminster fullerene) are three allotropes of pure carbon.

788. **Hybridised states of carbon in graphite and diamond are respectively**

(a) sp^3, sp^3 (b) sp^3, sp^2
(c) sp^2, sp^2 (d) sp^2, sp^3

Karnataka-CET-2013

Ans. (d) :

(1) The structure of graphite is planer and the carbon atoms are sp^2 hybridized

(2) In diamond, carbon atoms are arranged in a tetrahedral arrangement so, it has a sp^3 hybridization.

789. **Graphite is a soft solid lubricant extremely difficult to melt. The reason for this anomalous behavior in the graphite.**

(a) is an allotropic form of carbon
(b) is a non–crystalline substance
(c) has carbon atoms arranged in large plates of rings of strongly bond carbon atoms with weak interplate bonds
(d) has molecules of variable molecular masses like polymers

Karnataka-CET-2007
UPTU/UPSEE-2007, AIEEE–2003

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Ans. (c) : Graphite is a two-dimensional sheet like structure and each carbon have sp^2 hybridized. It is a soft solid lubricant extremely difficult to melt. The reason for this anomalous behavior is that graphite has carbon atoms arranged in large plates of rings of strongly bound carbon atoms with weak interplate bonds.

790. The number of six membered and five membered rings in Buckminster Fullerene respectively is

(a) 20, 12	(b) 12, 20
(c) 14, 18	(d) 14, 11

Kerala-CEE-29.08.2021
Karnataka-CET-2021

Ans. (a) : Buckminster fullerene is an allotrope of carbon. It has a shape of soccer ball. It is made up of twenty hexagons and twelve pentagons and has a cage like fused ring structure.

791. Thermodynamically, in which form of carbon is the most stable?

(a) Coal	(b) Fullerenes
(c) Diamond	(d) Graphite

Manipal-2016

Ans. (d) : Thermodynamically, graphite is the most stable form of carbon.
Graphite contains one delocalized electron per carbon these cause greater attraction between carbon atom hence giving stronger bonds, more stability to the structure.

792. Which statement is not correct about fullerene C_{60}?

(a) It contains 20 six membered rings and 12 five membered rings
(b) All carbon atoms undergo sp^2 hybridisation
(c) A six membered ring is fused with six membered rings only
(d) A five membered ring is fused with six membered ring only

MHT CET-2014

Ans. (c) : C_{60} (fullerene) looks like a soccer ball and contains 20 six membered rings and 12 five membered rings of carbon atoms.
⇒ Six membered rings are fused with both six membered as well as five membered rings while five membered rings attached only with six membered rings.

793. Which of the following does not show electrical conduction?

(a) Diamond	(b) Graphite
(c) Potassium	(d) Sodium

NEET-1999

Ans. (a) : Sodium, potassium and graphite all three are electric conductor except diamond which is an insulator of electric current due to the absence of free electron.

794. Percentage of lead in lead pencil is

(a) 80	(b) 20
(c) zero	(d) 70

NEET-1999

Ans. (c) : There is no percentage of lead in lead pencils, or we can say zero percentage of lead. Pencils are nowadays made up of graphite which is an allotrope of carbon.

795. In graphite, electrons are

(a) localised on each C-atom
(b) localised on every third C-atom
(c) spread out between the structure
(d) present in antibonding orbital

NEET-1997, 1993

Ans. (c) : In graphite, each carbon is sp^2 hybridized and the single occupied unhybridized p – orbital's of C – atoms overlap side wise to give π - electron cloud which is delocalized and thus the electrons are spread out between the structure.

796. Which of the following types of forces bind together the carbon atoms in diamond?

(a) Ionic	(b) Covalent
(c) Dipolar	(d) van der Walls

NEET-1992

Ans. (b) : Carbon atoms in diamond are liked each other by covalent bond. In diamond, each carbon atom undergoes sp^3 hybridization and is covalently bounded to four other carbon atoms by single bonds.

797. Which of the following is an insulator?

(a) Graphite	(b) Aluminium
(c) Diamond	(d) Silicon

NEET-1992

Ans. (c) : Diamond is an insulator of electric current due to the absence of free electron. In 4th group elements as we move down the group, Si acts as semiconductor.

798. Graphite is a good conductor of electricity. Its electrical conductivity is due to the fact that

(a) It is an allotrope of carbon
(b) It has C atoms arranged in large plates of rings of strongly bound C atoms
(c) In it C atoms are sp^2 hybridized
(d) It is a non-crystalline substance

UP CPMT-2010

Ans. (c) : In graphite, each carbon atom is sp^2 hybridised. The remaining fourth electron of each carbon atom is free to move. These free electrons make the graphite, good conductor of electricity.

799. Inorganic graphite is

(a) BN	(b) BF_3
(c) B_2H_6	(d) None of these

UP CPMT-2005

Ans. (a) : BN is borazon or boron nitride. It exists two crystallographic modifications. The hexagonal form has a simple layer structure similar to graphite. So, it is called inorganic graphite. The other form is cubic which is very hard and acts as insulator like diamond.

800. Buckminster fullerene is:

(a) pure graphite	(b) C-60
(c) diamond	(d) C-90

UPTU/UPSEE-2006

Ans. (b) : Buck minister fullerene (C_{60}) is a spherical carbon allotrope where 60 atoms are assembled in pentagons and hexagons, in a geometry similar to a soccer ball all the carbon atom are connected by single and double bonds, these are often called Buck balls.

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6. Nitrogen Family

801. Consider the following reactions:

$PCl_3 + H_2O \rightarrow A + HCl\ ,\ A + H_2O \rightarrow B + HCl$

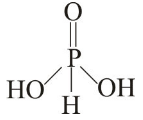
The number of ionisable protons present in the product B is

JEE Main-25.06.2022, Shift-II

Ans. (2) : $PCl_3 + \underset{\text{(Partial Hydrolysis)}}{H_2O} \longrightarrow \underset{A}{P(OH)_2Cl} + HCl$

$P(OH)_2Cl \xrightarrow[\text{Hydrolysic}]{H_2O} \underset{B}{H_3PO_3}$

Phosphorous acid



No of ionizable proton is "2"

802. The number of bridged oxygen atoms present in compound B formed from the following reactions is

$Pb(NO_3)_2 \xrightarrow{673K} A + PbO + O_2\ ,$

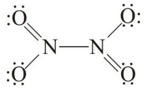
$A \xrightarrow{\text{Dimerise}} B$

(a) 0 (b) 1
(c) 2 (d) 3

JEE Main-25.06.2022, Shift-II

Ans. (a) : $Pb(NO_3)_2 \xrightarrow{673K} \underset{A}{4NO_2} + 2PbO + O_2$

$2NO_2 \xrightarrow{\text{Dimerisation}} \underset{B}{N_2O_4}$



No Bridge Oxygen in N_2O_4
Correction option is (a).

803. $(NH_4)_2Cr_2O_7$ **on heating liberates a gas. The same gas will be obtained by**

(a) Treating H_2O_2 with $NaNO_2$
(b) Treating Mg_3N_2 with H_2O
(c) Heating NH_4NO_3
(d) Heating NH_4NO_2

Karnataka CET-17.06.2022, Shift-II

Ans. (d) : Heating of ammonium dichromate $(NH_4)_2Cr_2O_7$ liberates nitrogen gas (N_2).

$$(NH_4)_2Cr_2O_7 \longrightarrow N_2(g) + Cr_2O_3 + 4H_2O$$

Heating of Ammonium Nitrite (NH_4NO_2) liberates Nitrogen gas (N_2).

$$NH_4NO_2 \longrightarrow N_2(g) + 2H_2O$$

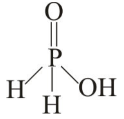
So, Correct option is d "Heating NH_4NO_2"

804. The strong reducing property of hypophosphorus acid is due to

(a) Two P-H bonds
(b) Presence of phosphorus in its highest oxidation state
(c) Its concentration
(d) The positive valency of phosphorus

Karnataka CET-17.06.2022, Shift-II

Ans. (a) : Hypophosphorus acid



H_3PO_2 having strong reducing behaviour. This reducing behaviour is due to the two P-H Bond.
All oxy acid of phosphorus having P-H bond act as strong reducing agent.
So, Correct option is 'a'

805. PCl_5 is well known, but NCl_5 in not. Because,

(a) Nitrogen is less reactive than phosphorous
(b) Nitrogen doesn't have d-orbitals in its valence shell.
(c) Catenation tendency is weaker in nitrogen than phosphorous.
(d) Size of phosphorous is larger than nitrogen

JEE Main-24.06.2022, Shift-II

Ans. (b) : NCl_5 is not known because nitrogen does not have d-orbitals is valence shell and PCl_5 is well known because phosphorous has vacant d-orbital in its valence shell which enable it to expand its octet.

806. Consider the following reaction:

A + alkali → B (Major Product)

If B is an oxoacid of phosphorus with no P-H bond, then A is:

(a) White P_4 (b) Red P_4
(c) P_2O_3 (d) H_3PO_3

JEE Main-26.06.2022, Shift-I

Ans. (b) : $P_4(\text{white}) + \text{Alkali} \longrightarrow H_3PO_4$

807. The highest industrial consumption of molecular hydrogen is to produce compound element:

(a) Carbon (b) Nitrogen
(c) Oxygen (d) Chlorine

JEE Main-24.06.2022, Shift-I

Ans. (b) : Industrial method of preparation of NH_3 is hydrogen combines with nitrogen to produce ammonia in Habers process.

$$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$$

808. The most stable trihalide of nitrogen is:

(a) NF_3 (b) NCl_3
(c) NBr_3 (d) NI_3

JEE Main-24.06.2022, Shift-I

Ans. (a) : Stability of covalent compound is directly proportional to its bond strength. Stability of covalent compound α bond strength order of stability are -

$NF_3 > NCl_3 > NBr_3 + NI_3$

The stability of trihalides decreases as we move down the group due to weaking of N–X bond strength.

809. Heating white phosphorus with conc. NaOH solution gives mainly:

(a) Na_3P and H_2O
(b) H_3PO and NaH

@apna_pdf

(c) $P(OH)_3$ and NaH_2PO_4
(d) PH_3 and NaH_2PO_2

JEE Main-27.06.2022, Shift-I

Ans. (d) : $P_4(white) + NaOH \rightarrow PH_3 + NaH_2PO_2 + H_2O$
In above reaction on heating white phosphorus with concentrated sodium hydroxide (NaOH) gives phosphine (PH_3) and sodium hypophosphite (NaH_2PO_2)

810. The oxoacid of phosphorus that is easily obtained from a reaction of alkali and white phosphorus and has two P-H bonds, is:
(a) Phosponic acid
(b) Phosphinic acid
(c) Pyrophosphorus acid
(d) Hypophosphoric acid

JEE Main-29.06.2022, Shift-I

Ans. (b) : When alkali react with white phosphorous then phosphinic acid is formed.
White phosphorous + Alkali → H_3PO_2
(Phosphinic acid)

811. Which statement is correct for dinitrogen pentoxide
(a) In the gas phase it decomposes into NO_2, NO and O_2
(b) Solid N_2O_5 is ionic
(c) Covalent in solution and gas phase
(d) Coloured deligueseent solid

CG PET-22.05.2022

Ans. (b) : Solid N_2O_5 is ionic because x-ray diffraction shows that solid N_2O_5 exist as NO_2^+, NO_3^- (nitronium nitrate). The bond between a metal and non-metal are usually ionic.

812. Which one of the following is not used as fertilizer?
(a) Ammonium nitrate
(b) Ammonium sulphide
(c) Ammonium phosphate
(d) Ammonium sulphate

NDA (II)-2018

Ans. (b) : Ammonium sulphide is not used in fertilizer. This is because a fertilizer is used to increase the concentration of Nitrogen, Phosphorus and Potassium.

813. Which one of the following reactions will give NO (nitric oxide) gas as one of the products?
(a) $3Cu + 8HNO_3\ (dilute) \rightarrow$
(b) $Cu + 4HNO_3\ (conc.) \rightarrow$
(c) $4Zn + 10HNO_3\ (dilute) \rightarrow$
(d) $Zn + 4HNO_3\ (conc.) \rightarrow$

NDA (II)-2018

Ans. (a) : In the reaction ,

$$3Cu + 8HNO_3 \rightarrow 3Cu(NO_3)_2 + 2NO\uparrow + 4H_2O$$

Hence, on reaction of $3Cu + 8HNO_3$ will give NO(nitric oxide) while other will give NO_2 (nitrogen dioxide.)

814. Which one of the following is a tribasic acid?
(a) Hydrochloric acid (b) Nitric acid
(c) Sulphuric acid (d) Phosphoric acid

NDA (II)-2018

Ans. (d) Phosphoric acid is a tribasic acid. Phosphoric acid is a colorless solid, it is commonly encountered as on 85% aqueous solution, which is a colorless, odourless solution and non-volatile syrup liquid.

815. The reaction takes place in two steps as

(i) $NO_2Cl(g) \xrightarrow{k_1} NO_2(g) + Cl(g)$

(ii) $NO_2Cl(g) + Cl(g) \xrightarrow{k_2} NO_2(g) + Cl(g)$

Identify the reaction intermediate.
(a) $NO_2Cl(g)$ (b) $NO_2(g)$
(c) $Cl_2(g)$ (d) $Cl(g)$

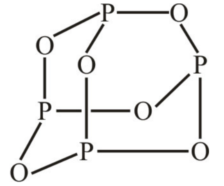
MHT CET-2016

Ans. (d) : The given reaction follows the two step kinetic. Cl(g) is regenerated in the first step and consumed in the second step. Here, Cl(g) is the intermediate in the given reactions.

816. The number of oxygen atoms bonded to one phosphorus atom in P_4O_6 is
(a) 4 (b) 3
(c) 6 (d) 5

AP EAMCET- 2004

Ans. (b) : The structure of P_4O_6 is-



Hence, the three oxygen atom bonded to one phosphorus atom in P_4O_6.

817. Which of the following does not exhibit allotropy?
(a) P (b) Bi
(c) Sb (d) As

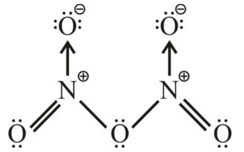
AP-EAMCET (Med.)-1999

Ans. (b) : Bismuth does not exhibit allotropy.
- Phosphorous has exist number of allotrope (i) red, (ii) white, (iii) scarlet phosphorous etc.
- Arsenic exists in three allotropic forms such as grey, yellow and black.
- Similarly, antimony exists in three allotropic form as α-antimony, β-antimony and metallic form.

818. The total number of N-O bonds present in N_2O_5 molecule are:
(a) 4 (b) 5
(c) 6 (d) 7

SCRA 2012

Ans. (c) : The structure of nitrogen pentoxide is:



Hence, the total number of N-O bonds are 6.

819. In Haber's process for the manufacturing of ammonia best yields are obtained under which one of the following conditions?
(a) 250°C to 380°C and 1 atm using a catalyst
(b) 380°C to 450°C and 100 atm using a catalyst
(c) 380°C to 450°C and 200 atm using a catalyst
(d) 200°C to 250°C and 100 atm using a catalyst

SCRA 2012

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Ans. (c) : On a large scale, ammonia is manufactured by Haber's process. The optimum conditions for the production of ammonia are a pressure of 200 atm and a temperature of 380°C to 450°C and use of a catalyst such as iron oxide.

$$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$$

820. NH_3 on passing through which one of the following is most significantly absorbed?

(a) P_2O_5	(b) CaO
(c) Na_2O	(d) TiO_2

SCRA 2012

Ans. (a) : P_2O_5 can absorb ammonia but CaO can not absorb ammonia. CaO absorbs only moisture.

$$P_2O_5 + 6NH_3 + 3H_2O \longrightarrow 2(NH_4)_3PO_4$$

821. In the manufacture of ammonia by Haber process high pressure is maintained because

(a) all reactants and product are gases
(b) reaction is exothermic
(c) the moles of the product are less than the moles of reactants
(d) reactions is a reversible reaction

SCRA-2015

Ans. (c): Haber process is used in the manufacturing of ammonia from nitrogen and hydrogen. Ammonia by Haber process high pressure is maintained because the moles of the products are less than that moles of reactants.

$$N_2 + 3H_2 \underset{200\,atm}{\overset{400-450\,^{o}C}{\rightleftharpoons}} 2NH_3$$
$$\text{Fe, catalyst}$$

822. Consider the following statements:
Statement I : Phosphorus - 32 decays to sulphur-32 with emission of a β particle
Statement II : The neutron to proton ratio is less than 1.0 for all light stable nuclides.
Which one of the following is correct in respect of the above statements?

(a) Both the statements are true and statement II is the correct explanation of statement I
(b) Both the statements are true but statement II is not the correct explanation of statement I
(c) Statement I is true, but statement II is false
(d) Statement I is false, but statement II is true

SCRA-2015

Ans. (b): Phosphorous -32 decays to sulphur-32 with emission of a β-particles and the ratio of neutron to proton is nearly 1.5 and whereas for the lighter nuclei is nearly 1.0 .

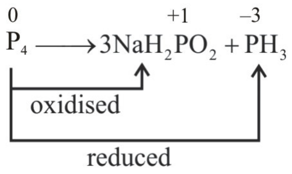
$$^{32}_{15}P \longrightarrow {}^{32}_{16}S + O_{-1}\beta$$

823. Consider the following reaction:
$P_4 + 3NaOH + 3H_2O \rightarrow 3NaH_2PO_2 + PH_3$
In the above reaction,
1. Phosphorus is oxidized.
2. Phosphorus is reduced.
Which of the above is/are correct?

(a) 1 only	(b) 2 only
(c) Both 1 and 2	(d) Neither 1 nor 2

SCRA-2015

Ans. (c): Given the reaction
$P_4 + 3NaOH + 3H_2O \rightarrow 3NaH_2PO_2 + PH_3$
In P_4 oxidation state of P = 0
In NaH_2PO_2 oxidation state of P = 1 + 2 + x – 4 = 0
x = +1
In PH_3 oxidation state of P = x + 3 (+1) = 0
x = –3



824. The boiling point of NH_3 is much higher than that of PH_3 because

(a) NH_3 undergoes umbrella inversion
(b) NH_3 has larger molecular weight
(c) NH_3 forms inter-molecular hydrogen bonds
(d) NH_3 contains ionic bonds whereas PH_3 contains covalent bonds

SCRA-2015

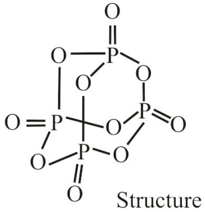
Ans. (c): The boiling point of NH_3 is higher than that of PH_3 because NH_3 has strong intermolecular H bonding between themselves.
whereas in PH_3 there is no hydrogen bonding.

825. Number of sigma bonds in P_4O_{10} is-

(a) 6	(b) 7
(c) 17	(d) 16

BCECE-2018

Ans. (d) : The number of sigma bonds (σ bonds) in P_4O_{10} is 16.



Structure of P_4O_{10}

826. Which of the following oxides of nitrogen is anhydride of HNO_3?

(a) N_2O_3	(b) N_2O_4
(c) N_2O_5	(d) N_2O

AP EAMCET- 1991

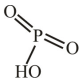
Ans. (c) : $N_2O_5 + H_2O \rightarrow 2HNO_3$
∴ Conc. HNO_3 on distillation with P_2O_5 gives N_2O_5.
Hence, N_2O_5 is the anhydride of nitric acid.

827. Meta- phosphoric acid is represented by

(a) H_3PO_3	(b) H_2PO_3
(c) HPO_3	(d) $H_4P_2O_7$

AP EAMCET- 1994

Ans. (c) : Metaphosphoric acid is HPO_3.



1 + x + 3(–2) = 0
x – 5 = 0
x = +5
Hence, the oxidation state P is +5

@apna_pdf

828. While phosphorus form PCl_5, nitrogen does not form NCl_5 because

(a) Nitrogen is more electronegative than phosphorus
(b) Nitrogen atom is smaller than phosphorus
(c) The ionization energy of nitrogen is greater than that of phosphorus
(d) Unlike Phosphorus, nitrogen has no 'd' orbital in its valence shell

AP EAMCET- 1995

Ans. (d) : The electronic configuration of N and P is –

$_7N = 1s^2, 2s^2, 2p^3$

$_{15}P = 1s^2, 2s^2, 2p^6, 3s^2, 3p^3, 3d^0$

∴ Nitrogen due to absence of d-orbitals does not form NCl_5.

829. Catalyst used in the manufacture of HNO_3 in Ostwald process

(a) Platinum gauze (b) V_2O_5
(c) Fe/Mo (d) MnO_2

JEE Main 07.04.2018

Ans. (a) : Nitric acid is manufactured by the Ostwald process, the catalyst is platinum gauze.

$$4NH = 3 + 5O_2 \xrightarrow[500K,9bar]{Pt/Rh\ gauge.} 4NO + 6H_2O$$

$$2NO + O_2 \rightleftharpoons 2NO_2$$

$$3NO_3(g) + H_2O(l) \xrightarrow[gauze]{Platinum} 2HNO_3(g) + NOC(g)$$

830. Which of the following is correct with respect to the V^{th} group elements?

(a) All the elements exhibit allotropy
(b) Except nitrogen all elements exhibit allotropy
(c) All elements except nitrogen and bismuth exhibit allotropy
(d) All elements except nitrogen and arsenic exhibit allotropy

AP EAMCET- 1995

Ans. (b) : The V^{th} group elements contains the following elements– N, P, As, Sb and Bi. Except nitrogen all elements exhibit allotropy.

831. The oxy acid of phosphorus in which phosphorus has the lowest oxidation state is

(a) Hypophosphorus acid
(b) Orthophosphoric acid
(c) Pyrophosphoric acid
(d) Metaphosphoric acid

AP EAMCET- 1995

Ans. (a) : Hypophosphorus acid has the lowest oxidation state i.e. +1. The chemical formula of the oxyacid is H_3PO_2.

Similarly,

O.S. of orthophosphoric acid (H_3PO_4) = +5
O.S. of pyrophosphoric acid ($H_4P_2O_7$) = +5
O.S. of metaphosphoric acid (HPO_3) = +5

832. Which of the following nitrogen halides is most stable?

(a) NI_3 (b) NBr_3
(c) NCl_3 (d) NF_3

AP EAMCET- 1995

Ans. (d) : NF_3 is stable and highly inert gas at room temperature. It is because fluorine and nitrogen have comparable sizes and electronegativity.

833. The industrial preparation of nitric acid by Ostwald's process involves

(a) Reduction of NH_3 (b) Oxidation of NH_3
(c) Hydrogenation of NH_3 (d) Hydrolysis of NH_3

AP EAMCET- 1999

Ans. (b) : The industrial preparation of nitric acid by Ostwald's process involve is-

$$4NH_3 + 5O_2 \rightarrow 4NO + 6H_2O$$

$$2NO + O_2 \rightarrow 2NO_2$$

$$2NO_2 + H_2O + [O] \rightarrow 2HNO_3$$

Hence, the oxidation of NH_3 take place.

834. What are the products formed when ammonia reacts with excess chlorine?

(a) N_2 and NCl_3 (b) NCl_3 and HCl
(c) N_2 and NH_4Cl (d) N_2 and HCl

AP EAMCET- 2002

Ans. (b) : When ammonia reacts with excess amount of chlorine then nitrogen trichloride is formed.

$$\underset{\text{Ammonia}}{NH_3} + \underset{\text{(excess)}}{3Cl_2} \rightarrow NCl_3 + 3HCl$$

Ammonia reacts with chlorine to create nitrogen gas and hydrogen chloride vapour.

835. PCl_3 on hydrolysis gives:

(a) $HCl + PH_3$ (b) $HCl + H_3PO_4$
(c) $HCl + H_3PO_3$ (d) $HCl + POCl_3$

AP EAMCET (Medical) -1998

Ans. (c): PCl_3 on hydrolysis gives phosphorous acid and hydrochloric acid. The reaction is as follows–

$$PCl_3 + 3H_2O \rightarrow \underset{\substack{\text{Phosphorous}\\ \text{acid}}}{H_3PO_3} + 3HCl$$

836. Which one of the following statements is correct with respect to basic character?

(a) $PH_3 > P(CH_3)_3$ (b) $PH_3 = NH_3$
(c) $PH_3 > NH_3$ (d) $P(CH_3)_3 > PH_3$

AP EAMCET- 2002

Ans. (d) : NH_3 is more basic than PH_3 due to the electronegativity of N atom. Presence of three CH_3 group on P atom increase the election density and make the loss of electron easier i.e. $P(CH_3)_3 > PH_3$

837. One mole of N_2H_4 loses 10 moles of electrons to form a new compound Z. Assuming that all the nitrogens appear in the new compound, what is the oxidation state of nitrogen in Z? (There is no change in the oxidation state of hydrogen).

(a) –1 (b) –3
(c) +3 (d) +5

AP EAMCET (Engg.) - 2012

Ans. (c) $N_2H_4 \rightarrow (Z) + 10e$

∵ Z contains all n-atoms.

$$N_2^{2-} \longrightarrow {}_2N^{a+} + 10e^-$$

∴ $2a - [2\times(-2)] = 10$

∴ $a = +3$

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838. Which one of the following cannot form an amphoteric oxide?

(a) Al (b) Sn

(c) Sb (d) P

AP EAMCET (Engg.) - 2012

Ans. (d) : P does not form the amphoteric oxide P form the covalent oxide covalent oxides are acidic in nature. Ampboteric oxides are formed by elements like Al, Sn and Sb. Since phosphorus is non-metal it forms acidic oxides.

839. Which of the element of nitrogen family produce maximum number of oxy-acids

(a) N (b) P

(c) As (d) Sb

MPPET-2008

Ans. (b) : Phosphorous (P) element of nitrogen family produce maximum number of oxy- acids.

840. Consider the following statements :

In the Haber method of synthesis of ammonia

1. increase of pressure favours the formation of NH_3

2. decreases of pressure produces more NH_3

3. increase of temperature dissociates NH_3

4. addition of inert gas favours the formation of NH_3

Which of the statements given above are correct ?

(a) 1 and 3 (b) 2 and 4

(c) 1 and 4 (d) 2 and 3

SCRA - 2009

Ans. (a) : Consider, the reaction of nitrogen gas (N_2) with hydrogen gas (H_2) to form ammonia (NH_3).

$$N_{2(g)} + 3H_{2(g)} \rightleftharpoons 2NH_{3(g)} + 92\,kJ\,mol^{-1} \left(\Delta H = -92 kJ\,mol^{-1}\right)$$

It is an exothermic reaction. So low temperature is required to perform this reaction.

If, we increase pressure then volume decreases, the equilibrium will shift to the right, counteracting the pressure increase by shifting to the side with fewer moles of gas that exert less pressure. So, high pressure will be required for formation of NH_3.

An inert gas will not react with either the reactants or the products, so, it will have no effect on the product or reactant ratio, and therefore, it will have no effect on equilibrium.

841. Which reactions (s) among the following produce Dinitrogen ?

(a) $NH_4Cl(aq) + NaNO_2(aq) \longrightarrow$

(b) $NH_2CONH_2 + 2H_2O \longrightarrow$

(c) $Ba(N_3)_2 \longrightarrow$

(d) $NH_4Cl + Ca(OH)_2 \longrightarrow$

AP EAPCET 24.08.2021 Shift-II

Ans. (a, c):

(i) $NH_4Cl(aq) + NaNO_2(aq) \longrightarrow N_2 + NaCl + 2H_2O$

(ii) $NH_2CONH_2 + 2H_2O \longrightarrow CO_2 + 2NH_3$

(iii) $Ba(N_3)_2 \xrightarrow{\Delta} Ba + 3N_2$

(iv) $NH_4Cl + Ca(OH)_2 \longrightarrow COCl_2 + NH_3 + H_2O$

So, the option (a) and (c) produce dinitrogen.

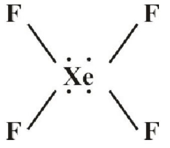
842. Shape of XeF_4 molecule is ____

(a) Pyramidal (b) Square planar

(c) Triangular planar (d) Linear

AP EAPCET 24.08.2021 Shift-II

Ans. (b): XeF_4 molecule has



So, the shape of is XeF_4 square planar.

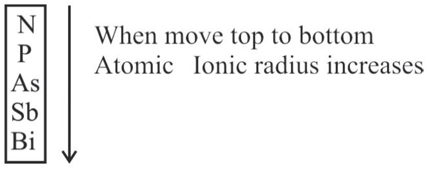
843. Ionic radius (in Å) for As^{3+}, Sb^{3+} and Bi^{3+} follow the order

(a) $As^{3+} > Sb^{3+} > Bi^{3+}$ (b) $Sb^{3+} > Bi^{3+} > As^{3+}$

(c) $Bi^{3+} > As^{3+} > Sb^{3+}$ (d) $Bi^{3+} > Sb^{3+} > As^{3+}$

AP EAMCET (Engg.) 2001

Ans. (d) : Ionic radius is directly proportional to molar mass in a group.



So, $Bi^{3+} > Sb^{3+} > As^{3+}$

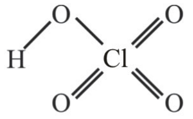
844. Which of the following is not a peroxy acid?

(a) Perphosphoric acid (b) Pernitric acid

(c) Perdisulphuric acid (d) Perchloric acid

AP EAMCET- 2007

Ans. (d) : Perchloric acid ($HClO_4$) is not a peroxy acid.



(Perchloric acid)

- Perphosphoric acid is the oxy acid of nitrogen family element i.e. P. The molecular formula of perphosphoric acid is H_3PO_5.
- Pernitric acid (HNO_4) is the oxy acid of nitrogen after peroxynitrous acid.
- Peroxydisulfuric acid is an inorganic compound with a chemical formula $H_2S_2O_8$. This is the oxy acid of sulphur.

845. The oxoacid of sulphur which contains two sulphur atoms in different oxidation states is

(a) pyrosulphurous acid

(b) hyposulphurous acid

(c) pyrosulphuric acid

(d) persulphuric acid

AP EAMCET (Engg.) 2012

Ans. (a) : Disulphurous acid or pyrosolphurous acid is an oxoacid of sulpur with the formula $H_2S_2O_5$.

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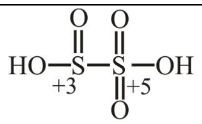
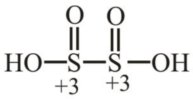
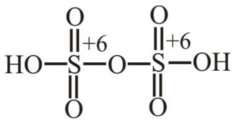
(i) 

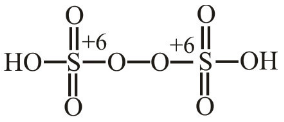
Pyrosulphuric acid

(ii) 

Hyposulphurous acid

(iii) 

Pyrosulphuric acid

(iv) 

Peroxodisulphuric acid

Since the oxidation state of two S-atom in Pyrosulphuric acid is different.

846. Which one of the following is used in the preparation of cellulose nitrate ?

(a) KNO_3 (b) HNO_3

(c) KNO_2 (d) HNO_2

AP EAMCET (Engg.) 2012

Ans. (b) : Cellulose nitrate is generally prepared by the nitration of cellulose with nitric acid or a mixture of nitric and some other acid.

$$3HNO_3 + C_6H_{10}O_5 \longrightarrow C_6H_7(NO_2)_3O_5 + 3H_2O$$

847. The product(s) formed when H_2O_2 reacts with disodium hydrogen phosphate is

(a) $P_2O_5 \cdot Na_3PO_4$ (b) $Na_2HPO_4 \cdot H_2O_2$

(c) $NaH_2\ PO_{4,}H_2O$ (d) $Na_2H\ PO_4 \cdot H_2O$

AP EAMCET (Engg.) 2012

Ans. (b) : $H_2O_2 + Na_2HPO_4 \longrightarrow \underset{\text{addition product}}{Na_2HPO_4.H_2O_2}$

H_2O_2 forms addition product with disodium hydrogen phosphate (Na_2HPO_4).

848. Nitrogen shows maximum covalency of 4 whereas other heavier elements of the group show higher covalency because,

(a) it has higher electronegativity

(b) it has smaller size

(c) it has only 4 orbitals available in the valence shell.

(d) it prefers to form multiple bonds with atoms.

COMEDK-2014

Ans. (c) : The maximum covalency of nitrogen is 4 because due to absence of d-orbital. Only four orbital i.e. one 2s and three 2p orbitals are available in the valence shell.

849. Solid A reacts with strong $NaOH_{(aq)}$ liberating a foul smelling gas B which spontaneously burn in air giving smoky rings. A and B are respectively

(a) P_{red} and PH_3 (b) P_{white} and PH_3

(c) S and H_2S (d) P_{white} and H_2S

COMEDK 2014

Ans. (b) : Solid white phosphorus (P_4) reacts with strong NaOH(aq) librating a foul smelling gas phosphine (PH_3) which spontaneously burn in air give smoky rings.

$$\underset{\text{White phosphorus}}{P_4} + 3NaOH + 3H_2O \longrightarrow \underset{\text{Phosphine}}{PH_3} + \underset{\text{Sodiumhypophosphite}}{3NaH_2PO_2}$$

850. N_2 does not show property of catenation because

(a) it has no 'd' orbitals in the valence shell

(b) interelectronic repulsion between non bonding electrons is greater

(c) $N \equiv N$ has high bond enthalpy

(d) nitrogen has very high ionization enthalpy.

COMEDK 2015

Ans. (b) : In the N-N bond, more electrons are present on N due to which inter electronic repulsions generated and reduced the property of catenation.

851. Which of the following reactions does not produce PH_3?

(a) White phosphorus with water

(b) White phosphorus with conc. NaOH

(c) Metal phosphide with dil. HCl

(d) Metal phosphides with water

COMEDK-2015

Ans. (a) :

(a) $\underset{\text{White phosphorus}}{P_4} + H_2O \longrightarrow \text{No reaction occure}$

(b) $P_4 + 3NaOH + 3H_2O \longrightarrow \underset{\text{Phosphine}}{PH_3} + 3NaH_2PO_2$

(c) $Ca_3P_2 + 6HCl \rightarrow 3CaCl_2 + 2PH_3$

(d) $Ca_3P_2 + 6H_2O \rightarrow 3Ca(OH)_2 + 2PH_3$

852. PCl_3 on hydrolysis gives

(a) H_3PO_3 (b) HPO_3

(c) H_3PO_4 (d) $POCl_3$

COMEDK-2019

Ans. (a) : PCl_3 is a colourless oily liquid and hydrolysis in the presence of moisture to give the orthophosphorus acid.

$$\underset{\text{Phosphorustrichloride}}{PCl_3} + 3H_2O \longrightarrow \underset{\text{orthophosphorus acid}}{H_3PO_3} + 3HCl$$

853. $Pb_3O_4 + 4HNO_3 \longrightarrow 2Pb(NO_3)_2 + PbO_2 + 2H_2O$

Which is true about the lead ions in Pb_3O_4?

(a) Pb^{2+} reacts with HNO_3 to give lead nitrate.

(b) Pb^{4+} reacts with HNO_3 to give lead mitrate.

(c) Pb^{2+} reacts with HNO_3 to give PbO_2

(d) Pb^{4+} reacts with HNO_3 to give PbO_2.

COMEDK-2015

Ans. (a) : Pb_3O_4 is actually a stoichiometric mixture of PbO_2+PbO and only PbO i.e., Pb^{2+} reacts with HNO_3 to form $Pb(NO_3)_2$.

@apna_pdf

854. Which of the following chemicals does not liberate hydrogen gas on reaction with aluminium metal?

(a) Dil. sulphuric acid
(b) Aqueous sodium hydroxide
(c) Dil. hydrochloric acid
(d) Conc. nitric acid

COMEDK-2015

Ans. (d) : Dilute and concentrated HNO_3 has no effect on Al. Aluminium is rendered passive by nitric acid due to the formation of a thin film of oxide (Al_2O_3) on its surface.

$$2Al_{(s)} + 6HCl_{(aq.)} \rightarrow 2Al^{3+}_{(aq.)} + 6Cl^{-}_{(aq.)} + 3H_{2(g)}$$

Aluminium dissolves in dil. HCl and liberates dihydrogen.

Aluminium also reacts with aqueous alkali and liberates dihydrogen.

$$2Al_{(s)} + 2NaOH_{(aq.)} + 6H_2O_{(l)} \longrightarrow 2Na[Al(OH)_4]_{(aq.)} + 3H_{2(g)}$$

$$2Al + 6HNO_3(\text{conc.}) \longrightarrow Al_2O_3 + 6NO_2 + 3H_2O$$

$$2Al + 6H_2SO_4 \longrightarrow Al_2(SO_4)_3 + 3SO_2 + 6H_2O$$

855. Concentrated nitric acid with aluminium gives

(a) nitric oxide
(b) nitrogen peroxide
(c) hydrogen
(d) passive metal.

COMEDK-2018

Ans. (d) : Whe aluminium reacts with nitric acid, nitrogen dioxide gas is evolved.

$Al + 6HNO_3 \rightarrow Al(NO_3)_3 + 3NO_2 + 3H_2O$

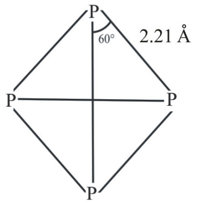
So, concentrated nitric acid with Al becomes passive due to the formation of a thin protective layer of its oxide on the surface of metal which prevents further reaction.

856. The atomicity of phosphorus is X and the PPP bond angle in the molecule is Y. What are X and Y?

(a) X = 4, Y = 90°
(b) X = 4, Y = 60°
(c) X = 3, Y = 120°
(d) X = 2, Y = 180°

AP-EAMCET (Medical), 2003

Ans. (b) : The molecular formula of white phosphorus is P_4. The four atoms of phosphorus present in the molecule are arranged at the corners of a tetrahedral. So, the PPP bond angle is 60°.



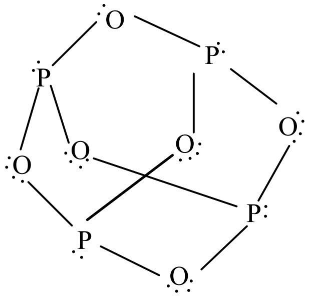
Hence, X and Y are 4 and 60° respectively.

857. The number of P—O bonds and lone pair of electrons present in P_4O_6 molecule are, respectively

(a) 12, 16
(b) 12, 12
(c) 8, 8
(d) 12, 4

AP-EAMCET (Medical), 2008

Ans. (a) : The structure of P_4O_6 is given as-



The number of bonds and lone pairs are 12 and 16 respectively.

858. Which one of the following is an oxy acid?

(a) $Ba(OH)_2$
(b) $Mg(OH)_3$
(c) H_3PO_3
(d) HCl

AP-EAMCET (Medical), 2001

Ans. (c) :

(a) $Ba(OH)_2$	– base
(b) $Mg(OH)_3$	– base
(c) H_3PO_3	– oxy acid
(d) HCl	– non oxy acid

859. Which one of the following is used in the industrial preparation of nitric acid by Ostwald's process?

(a) N_2
(b) NH_4NO_3
(c) N_2O_5
(d) NH_3

AP-EAMCET (Medical), 2001

Ans. (d) : By Haber's process, the ammonia obtained is mixed with 10 volumes of air and passed over a platinum at 750–900°C when NH_3 is oxidised to HNO_3.

$$4NH_3 + 5O_2 \xrightarrow{Pt} 4NO + 6H_2O$$

$$2NO + O_2 \longrightarrow 2NO_2$$

$$4NO_2 + 2H_2O + O_2 \longrightarrow 4HNO_3$$

860. Aqueous sodium hydroxide reacts with white phosphorus to form phosphine and:

(a) NaH_2PO_2
(b) P_2O_5
(c) Na_3PO_3
(d) P_2O_3

AP-EAMCET (Medical), 2001

Ans. (a) : Sodium hydroxide P_4 to form PH_3 and sodium hypophosphite (NaH_2PO_2).

$$\underset{\text{White phosphorus}}{P_4} + 3NaOH + 3H_2O \rightarrow \underset{\text{Phosphine}}{PH_3} + \underset{\text{Sodium hypo phosphite}}{3NaH_2PO_2}$$

861. Which one of the following statements is correct?

(a) 2s orbital is spherical with two nodal planes
(b) The de-Broglie wavelength (λ) of a particle of mass 'm' and velocity 'v' is equal to mv/h
(c) The principal quantum number (n) indicates the shape of the orbital
(d) The electronic configuration of phosphorous is given by [Ne] $3s^2 3p_x^1 3p_y^1 3p_z^1$

AP-EAMCET (Medical), 2002

@apna_pdf

Ans. (d) : The atomic number of phosphorus is 15. Electronic configuration of $_{15}P$ is $1s^2, 2s^2, 2p^6, 3s^2, 3p^3$ or [Ne] $3s^2, 3p_x^1, 3p_y^1, 3p_z^1$. Hence, the statement is true.

- As we know, 2s orbital is spherical but it has one nodal plane i.e. $n–l–1 = 2 – 0 – 1 = 1$. Hence, statement is false.
- According to the electron duality of de-Broglie equation –

$$\lambda = \frac{h}{mv}$$

Hence, statement is false.

- The principal quantum number (n) indicates the size of the orbital whereas azimuthal quantum no. indicates the shape of the orbital.

862. Two grams of sulphur is completely burnt in oxygen to form SO_2. In this reaction, what is the volume (in litres) of oxygen consumed at STP?
(Atomic weight of sulphur and oxygen are 32 and 16 respectively).

(a) $\frac{16}{22.4}$ (b) $\frac{22.4}{16}$
(c) $\frac{22.4}{32}$ (d) $\frac{32}{22.4}$

AP-EAMCET (Medical), 2002

Ans. (b) : The following reaction occur which is given below –

$$S + O_2 \rightarrow SO_2$$

Molecular weight of SO_2 = $32 + 2 \times 16 = 64g$
Volume of oxygen (1 mole), at STP = 22.4L
At STP,
$\because$ 32g of sulphur requires O_2 = 22.4 L
$\therefore$ 2g of sulphur requires $O_2 = \frac{22.4 \times 2}{32} = \frac{22.4}{16}$ L

863. Which one of the following elements does not form the compound, M_4O_{10} (M = elements)?

(a) P (b) Sb
(c) As (d) Bi

AP-EAMCET (Medical), 2002

Ans. (d) : The stability of higher oxidation states decreases down the group due to inert pair effect.
Hence Bi hardly forms +5 oxidation state due to inert pair effect.

864. Which of the following has the highest proton affinity ?

(a) Stibine (SbH_3) (b) Arsine (AsH_3)
(c) Phosphine (PH_3) (d) Ammonia (NH_3)

GUJCET-2007

Ans. (d) : The hydrides of group 15 elements shows low basicity. When we move down the group, NH_3 is more basic so it has highest affinity for hydrogen.
Ammonia has the highest proton affinity

$$NH_3 + H^+ \rightarrow NH_4^+$$

Decreases in the order

$$NH_3 > PH_3 > AsH_3 > SbH_3$$

865. The correct option from below is

(a) Both α – and β – forms of black phosphorus can be made from red phosphorus
(b) White phosphorus is more reactive due to angular strain in the P_4- molecule
(c) Red phosphorus can be prepared from white phosphorus under open air condition
(d) Red phosphorus is poisonous and soluble in carbon disulphide

TS-EAMCET 09.08.2021, Shift-I

Ans. (b) : White phosphorus is more reactive due to angular strain in the P_4 molecule. It is less stable. Therefore more reactive.

- Red phosphorus is obtained by heating the white phosphorus at a high temperature around 573K.

866. The correct order of reducing ability of the following hydrides is

(a) $BiH_3 > SbH_3 > PH_3 > NH_3$
(b) $NH_3 > PH_3 > SbH_3 > BiH_3$
(c) $SbH_3 > BiH_3 > PH_3 > NH_3$
(d) $PH_3 > BiH_3 > SbH_3 > NH_3$

TS EAMCET 05.08.2021, Shift-I

Ans. (a) : The reducing ability depends on the stability of the hydride and due to decrease in their bond dissociation enthalpy. Hence, the reducing ability order

$$BiH_3 > SbH_3 > AsH_3 > PH_3 > NH_3$$

867. Match List- I with List -II:

List-I	**List-II**
Name of oxo acid	**Oxidation state of 'P'**
(a) Hypophosphorous acid	(i) +5
(b) Orthophosphoric acid	(ii) +4
(c) Hypophosphoric acid	(iii) + 3
(d) Orthophosphorous acid	(iv) +2
	(v) +1

Choose the correct answer from the options given below:

(a) (a)-(v), (b)-(iv), (c)-(ii), (d)-(iii)
(b) (a)-(iv), (b)-(i), (c)-(ii), (d)-(iii)
(c) (a)-(iv), (b)-(v), (c)-(ii), (d)-(iii)
(d) (a)-(v), (b)-(i), (c)-(ii), (d)-(iii)

JEE Main 16.03.2021, Shift-I

Ans. (d) : (a) Hypophosphorous acid (H_3PO_2) –

$$+3 + x - 4 = 0 \Rightarrow x = +1$$

(b) Orthophosphoric acid (H_3PO_4)–

$$+3 + x - 8 = 0 \Rightarrow x = +5$$

(c) Hypophosphoric acid ($H_4P_2O_6$)–

$$+4 + 2x - 12 = 0 \Rightarrow x = +4$$

(d) Orthophosphorous acid (H_3PO_3)–

$$+3 + x - 6 = 0 \Rightarrow x = +3$$

Hence, (d) is the correct option.

868. Which of the following has highest ratio of reducing hydrogen/OH:

(a) Orthophosphoric acid
(b) Hypophosphorus acid
(c) Phosphorus acid
(d) Pyrophosphoric acid

AIIMS 25 May 2019 (Evening)

@apna_pdf

Ans. (b): Reducing hydrogen :- Hydrogen attached directly to central metal.

(1) Orthphosphoric acid (H_3PO_4) ratio

$$\frac{\text{Reducing hydrogen}}{\text{OH group}} = \frac{0}{3} = 0$$

(2) Hypophosphorus acid (H_3PO_2) ratio

$$\frac{\text{Reducing hydrogen}}{\text{OH group}} = \frac{2}{1} = 2$$

(3) Phosphorus acid (H_3PO_3) ratio

$$\frac{\text{Reducing hydrogen}}{\text{OH group}} = \frac{1}{2}$$

(3) Pyrophosphoric acid ($H_4P_2O_7$) ratio =

$$\frac{\text{Reducing hydrogen}}{\text{OH group}} = \frac{0}{4} = 0$$

869. The following are some statements related to VA group hydrides,

I. Reducing property increases from NH_3 to BiH_3.

II. Tendency to donate lone pair decreases from NH_3 to BiH_3.

III. Thermal stability of hydrides decreases from NH_3 to BiH_3.

IV. Bond angle of hydrides decreases from NH_3 to BiH_3

The correct statements are

(a) I, II, III and IV (b) I, III, and IV

(c) I, II and IV (d) I and IV

AP EAMCET- 2007

Ans. (a) : (i) Reducing property increases from NH_3 to BiH_3 i.e. $NH_3 < PH_3 < AsH_3 < SbH_3 < BiH_3$ as the stability of hydride decreases down the group. It's reducing power increases.

(ii) Tendency to donate lone pair decreases from NH_3 to BiH_3 i.e. $NH_3 > PH_3 > AsH_3 > SbH_3 > BiH_3$ because the electron density of central atom decreases.

(iii) Thermal stability of hydrides decrease from NH_3 to BiH_3 i.e. $NH_3 > PH_3 > AsH_3 > SbH_3 > BiH_3$ because thermal stability increases with decrease in the size of central atom.

(iv) Bond angle of hydrides decreases from NH_3 to BiH_3 i.e. $NH_3 > PH_3 > AsH_3 > SbH_3 > BiH_3$.

870. Which metals upon heating in presence of air followed by hydrolysis gives ammonia?

(a) Li, K (b) Rb, Mg

(c) Li, Mg (d) Ca, K

AIIMS 25 May 2019 (Morning)

Ans. (c):

$$6Li + N_2 \rightarrow 2Li_3N$$

$$Li_3N + 3H_2O \rightarrow 3\,LiOH + NH_3$$

$$3\,Mg + N_2 \rightarrow Mg_3N_2$$

$$Mg_3N_2 + 6H_2O \rightarrow 3Mg(OH)_2 + 2NH_3$$

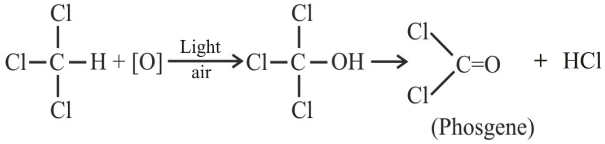
871. When chloroform is exposed to air and sunlight, it gives

(a) mustard gas (b) phosgene

(c) carbon tetrachloride (d) lewisite

AIIMS-1994

Ans. (b): When chloroform is exposed to air and sunlight it gives phosgene.



872. The correct order of reducing abilities of hydrides of V group elements is

(a) $NH_3 < PH_3 < AsH_3 < SbH_3 < BiH_3$

(b) $NH_3 > PH_3 > AsH_3 > SbH_3 > BiH_3$

(c) $NH_3 < PH_3 > AsH_3 > SbH_3 > BiH_3$

(d) $SbH_3 > BiH_3 > AsH_3 > NH_3 > PH_3$

AP EAMCET-2008

Ans. (a) : The reducing character of hydrides of group - 15 elements increases from top to bottom because of E-H strength.

$NH_3 < PH_3 < AsH_3 < SbH_3 < BiH_3$.

873. In the following reaction, the products are

$P_4 + 3NaOH + 3H_2O \rightarrow ?$

(a) $PH_3 + 3NaH_2PO_2$ (b) $PH_3 + 3NaHPO_2$

(c) $PH_3 + 3Na_2HPO_2$ (d) $PH_3 + 3NaH_2PO_3$

Jharkhand – 2019

Ans. (a) : The given reaction,

$$P_4 + 3NaOH + 3H_2O \rightarrow PH_3 + 3NaH_2PO_2$$

Oxidation state of P in $P_4 = 0$

Oxidation state of P in $PH_3 = -3$

Oxidation state of P in $NaH_2PO_2 = +1$

P undergoes both oxidation and reduction. So this is an example of disproportionation reaction.

874. Hypophosphorus acid is a good reducing agent because

(a) it contains two P – OH bonds

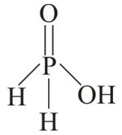
(b) it contains two P – H bonds

(c) it contains two P = O bonds

(d) it contains one P – H bond and one P – OH bond

Jharkhand – 2019

Ans. (b) : Hypophosphorous acid as well as its salts are strong reducing agents. It is only one ionisable hydrogen atom. Hypophosphorous acid (H_3PO_2) is a good reducing agent because it contains two P – H bonds.



875. 3 moles of ethanol react with one mole of phosphorus tribromide to form 3 moles of bromoethane and one mole of X. Which of the following is X?

(a) H_3PO_4 (b) H_3PO_2

(c) HPO_3 (d) H_3PO_3

AP-EAMCET-2001

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Ans. (d) : 3 moles of ethanol react with one mole of phosphorus tribromide to form 3 moles of bromoethane and one mole of orthophosphorous acid (H_3PO_3).

$$\underset{\text{ethanol}}{3CH_3CH_2OH} + PBr_3 \rightarrow \underset{\text{Bromoethane}}{3CH_3CH_2Br} + \underset{(X)}{H_3PO_3}$$

876. Assertion: H_3PO_4 and H_3PO_3 both are present in fertilizers.

Reason: H_3PO_4 increases the solubility of fertilizers.

(a) If both Assertion and Reason are correct and the Reason is the correct explanation of Assertion.
(b) If both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.
(c) If Assertion is correct but Reason is incorrect.
(d) If both the Assertion and Reason are incorrect.

[AIIMS-26 May, 2018(M)]

Ans. (c): H_3PO_4 and H_3PO_3 are the acid of phosphorus they are used for fertilizer due to its strong reducing property. So, Assertion is true but reason is false.

877. Assertion: Although PF_5, PCl_5 and PBr_5 are known, the pentahalides of nitrogen have not been observed.

Reason: Phosphorus has lower electronegativity than nitrogen.

(a) If both Assertion and Reason are correct and the Reason is the correct explanation of Assertion.
(b) If both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.
(c) If Assertion is correct but Reason is incorrect.
(d) If both the Assertion and Reason are incorrect.

[AIIMS-2010]

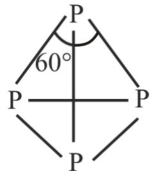
Ans. (b): Nitrogen does not form pentahalides because it does not have d– orbitals. The electro negativity of N is greater than that of phosphorus.

878. False statement about white phosphorus is

(a) It is highly soluble in carbon disulphide
(b) The angle ∠PPP is P_4 molecule is 60°
(c) White P_4 molecules contains four P-P covalent bonds
(d) White phosphorus is the most reactive allotrope of phosphorus

TS-EAMCET (Engg.), 07.08.2021 Shift-II

Ans. (c) : White phosphorus insoluble in H_2O and soluble in C_6H_6, C_2H_5OH, $CHCl_3$ and Carbon disulphide (CS_2).

- 

∠PPP=60°
Six covalent Bond (P–P)
- White phosphorus is most reactive form of phosphorus.
- Translucent in appearance like white waxy solid.
- When mixed with carbon disulphide, it dissolves.

879. Which of the following statements is incorrect?

(a) Red P is toxic
(b) White 'P' is thermodynamically most stable
(c) Black 'P' is thermodynamically most stable
(d) White 'P' is soluble in NaOH and evolves PH_3

[AIIMS-26 May, 2018(M)]

Ans. (a): Red P is not considered as toxic in its pure form.

Red P is non-poisonous and white P is poisonous.

Black phosphorus is the thermodynamically stable from of phosphorus at room temperature and pressure. It is obtained by heating white phosphorus under high pressures (12000 atmosphere).

880. Observe the following statements,

1. The solubility of group V hydrides in water decreases from NH_3 to BiH_3.
2. Phosphorus does not exhibit allotropy.
3. The stability of group V hydrides decreases from NH_3 to BiH_3.

The correct statement(s) are

(a) 1 and 3 (b) 2
(c) 1 and 2 (d) 1, 2 and 3

AP EAMCET (Medical) - 2013

Ans. (a)

1. The solubility of group 15 hydrides in water decreases from NH_3 to BiH_3 because NH_3 forms H-bonding with H_2O but other hydrides are less soluble. Hence, statement is true.
2. All the 15 group elements shows allotropy except bismuth. Phosphorus exists in a number of allotropic forms such as white, red and black. Hence, statement is false.
3. The stability of hydrides decreases from NH_3 to BiH_3 which can be observed from their bond dissociation enthalpy. So, we can say that bond dissociation energy increases from NH_3 to BiH_3. Hence, statement is true.

881. P_4O_{10} is not used to dry NH_3 gas because

(a) P_4O_{10} reacts with moisture in NH_3
(b) P_4O_{10} is not a drying agent
(c) P_4O_{10} is acidic and NH_3 is basic
(d) P_4O_{10} is basic and NH_3 is acidic

[AIIMS-2012]

Ans. (c) : NH_3 is basic and P_4O_{10} is acidic, when they react they form salt.

$$\text{Acid} + \text{base} \longrightarrow \text{salt}$$

P_4O_{10} is not used to dry NH_3 gas.

882. H_2S gas is not evolved when SO_3^{2-} ion reacts with following reagents.

(a) Zn + dil. H_2SO_4 (b) Al + Conc.NaOH
(c) Al + dil.HCl (d) None of these

[AIIMS-2009]

Ans. (b):

$$SO_3^{2-} + 2Al + 2OH^- + 3H_2O \rightarrow S^{2-} + \left[Al(OH)_4\right]^-$$

H_2S gas is not evolved because liberated H_2s is neutralized by NaOH and Na_2S is formed.

@apna_pdf

883. In the nitrogen family the H - M - H bond angle in the hydrides MH_3 gradually becomes closer to 90° on going from N to Sb. This shows that gradually-

(a) The basic strength of hydrides increases.
(b) Almost pure p-orbitals are used for M - H bonding.
(c) The bond energies of M - H bond increases.
(d) The bond pairs of electrons becomes nearer to the central atom.

[AIIMS-2009]

Ans. (b): In nitrogen family the H-M-H bond anlge in hydrides gradually closer to 90° on going from N to Sb because almost pure p-orbitals are used for M-H bonding.

884. Which of the following oxides is most acidic?

(a) Ag_2O (b) V_2O_5
(c) CO (d) N_2O_5

[AIIMS-2009]

Ans. (d): The difference of electronegativities between nitrogen and oxygen is least compared of that of in the other oxides. On moving down the group acidic strength decreases.

885. An element (X) forms compounds of the formula XCl_3, X_2O_5 and Ca_3X_2, but does not form XCl_5. Which of the following is the element.

(a) B (b) Al
(c) N (d) P

[AIIMS-2009]

Ans. (c): Nitrogen form NCl_3, N_2O_5 but it does not form NCl_5 because of absence of d-orbital. It can not extend its covalency by more than three.

886. Choose the correct statement :

(a) White or yellow phosphorus is stored under water.
(b) Ignition temperature of red phosphorus is low
(c) Black phosphorus is non crystalline in nature.
(d) Phosphorus does not form hydrides.

[AIIMS-2009]

Ans. (a): White phosphorus reacts very fast with atmospheric oxygen and catches fire. So it is dipped in water to prevent form oxygen gas supply and it is insoluble in water.

887. The compound, found in nature in gas phase but ionic in solid state is:

(a) PCl_5 (b) CCl_4
(c) PCl_3 (d) $POCl_3$

[AIIMS-2006]

Ans. (a): In gaseous and molten state Pcl_5 in Neutral molecule with trigonal bipyramidal symmetry

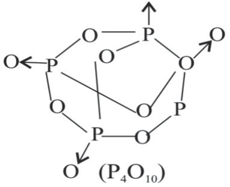
In solid state it remains as PCl_4^+ ,PCl_6^- .

888. The number of P–O–P bridges in the structure of phosphorus pentoxide and phosphorus trioxide are respectively :

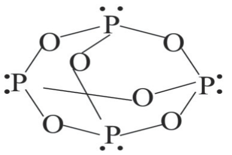
(a) 6,6 (b) 6,5
(c) 5,6 (d) 6,5

[AIIMS-2005]

Ans. (a):



(P_4O_{10})



(P_4O_6)

⇒ Both phosphorus pentoxide and phosphorus trioxide have 6 P–O–P bridges in their structure.

889. The element which forms oxides in all oxidation states varying from +1 to +5 is

(a) N (b) P
(c) As (d) Sb

[AIIMS-2004]

Ans. (a): N_2 has wide spectrum of oxidation state, from +1 to +5. It forms oxides in all oxidation state, $N_2O(+1)$, $NO(+2)$, $N_2O_3(+3)$, $NO_2(+4)$ $N_2O_5(+5)$.

890. The statement true for N_3^- is :

(a) it has non-linear structure
(b) it is called paeudohalogen
(c) the formal oxidation state of nitrogen in this anion is –1
(d) it is isoelectronic with NO_2

[AIIMS-2004]

Ans. (c): g

- The azide ion (N_3^-) has 16 valence electrons and is isoelectronic with CO_2
- The azide ion (N_3^-) is linear (N–N–N) like CO_2 molecule.
- The formal oxidation state of nitrogen in this anion is –1, because the net charge on the ion is –1.

891. The true statement for the acids of phosphorus. H_3PO_2, H_3PO_3 and H_3PO_4 is :

(a) the order of their acidity is $H_3PO_4 < H_3PO_4 < H_3PO_2$
(b) all of them are reducing in nature
(c) all of them are tribasic acids
(d) the geometry of phosphorus is tetrahedral in all the three

[AIIMS-2003]

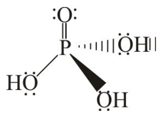
Ans. (d): H_3PO_4, H_3PO_4, H_3PO_2 as sp^3 hybridised all are tetrahedral.
the order of their acidity is $H_3PO_4 < H_3PO_4 < H_3PO_2$

892. Which of the following compound is a tribasic acid ?

(a) H_3PO_2 (b) H_3PO_4
(c) H_3PO_3 (d) $H_4P_2O_7$

[AIIMS-2001, 2002]

Ans. (b):



H_3PO_4 is a tribasic acid as it has three acidic protons. Its salts are called phosphates.

893. The correct decreasing order of basic strength is :

(a) $AsH_3 > SbH_3 > PH_3 > NH_3$
(b) $SbH_3 > AsH_3 > PH_3 > NH_3$

@apna_pdf

(c) $NH_3 > PH_3 > AsH_3 > SbH_3$
(d) $PH_3 > AsH_3 > SbH_3 > NH_3$

[AIIMS-1999]

Ans. (c): As size of central atom increase the lone pair of electrons occupies a larger volume. In other words electron density on the central atom decreases and consequently its tendency to donate a pair of electron decreases along with basic character from NH_3 to SbH_3

$$NH_3 > PH_3 > AsH_3 > SbH_3$$

894. The laughing gas is :

(a) NO
(b) N_2O
(c) N_2O_4
(d) N_2O_5

[AIIMS-1998]

Ans. (b): Nitrous oxide is commonly known as laughing gas. It is colorless, non-flammable gas. It is oxide of nitrogen and its chemical formula is N_2O.

895. Phosphine is generally prepared in the laboratory :

(a) By heating phosphorus in a current of hydrogen
(b) By heating white phosphorus with an aqueous solution of caustic potash
(c) By decomposition of P_2H_2 at 110°C
(d) By heating red phosphorus with an aqueous solution of caustic soda

JEE Main 14.01.2020

Ans. (b) : Phosphine is generally prepared in the laboratory by heating white phosphorous with an aqueous solution of caustic potash.

$$\underset{\text{White}}{P_4} + 3NaOH + 3H_2O \rightarrow \underset{\text{Phosphine}}{PH_3} + 3NaH_2PO_2$$

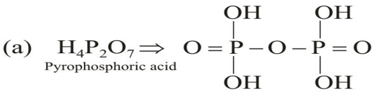
The concentration of phosphine varies in the atmosphere. It plays a vital role in the phosphorous biochemical cycle.

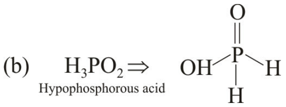
896. Which of the following oxy-acids has the maximum number of hydrogens directly attached to phosphorus?

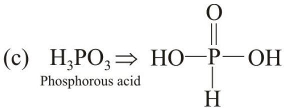
(a) $H_4P_2O_7$
(b) H_3PO_2
(c) H_3PO_3
(d) H_3PO_4

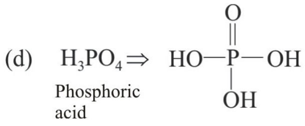
AIPMT- 1999

Ans. (b) :









By referring the structures we see that, H_3PO_2 has maximum number of hydrogen attached to phosphorus.

897. Group 15 elements have more electron gain enthalpy than group 16-elements. The correct reason for this is

(a) Half-filled stability of gp. 15 elements.
(b) Poor shielding in gp. 15
(c) Poor shielding in gp. 16
(d) Half-filled stability of gp. 16 elements

VITEEE-2016

Ans. (a) : The atoms having half-filled and fully filled orbitals are comparatively more stable, hence energy is required to remove the electron from such atoms. Therefore group 15 element have more electron gain enthalpy than group 16 elements.

898. With excess of water, both P_2O_5 and PCl_5 give

(a) H_3PO_3
(b) H_3PO_2
(c) H_3PO_4
(d) $H_4P_2O_7$

VITEEE-2015

Ans. (c) : With excess of water, both P_2O_5 and PCl_5 give H_3PO_4

$$P_2O_5 + 3H_2O \rightarrow 2H_3PO_4$$
(Ortho phosphoric acid)

$$PCl_5 + 4H_2O \rightarrow H_3PO_4 + 5HCl$$
(Colourless solid)

899. When copper is treated with a certain concentration of nitric acid, nitric oxide and nitrogen dioxide are liberated in equal volumes according to the equation,

$$xCu + yHNO_3 \rightarrow Cu(NO_3)_2 + NO + NO_2 + H_2O$$

The coefficients of x and y are respectively

(a) 2 and 3
(b) 2 and 6
(c) 1 and 3
(d) 3 and 8

VITEEE-2015

Ans. (b) : Balanced equation are

$$3Cu + 8HNO_3 \longrightarrow 3Cu(NO_3)_2 + \underset{\substack{\text{nitric}\\\text{oxide}}}{2NO} + H_2O \quad ....(i)$$

$$Cu + 4HNO_3 \longrightarrow Cu(NO_3)_2 + \underset{\substack{\text{nitrogen}\\\text{dioxide}}}{2NO_2} + 2H_2O \quad ....(ii)$$

Addition equation (i) and (ii) we get,

$$4Cu+12HNO_3 \rightarrow 4Cu(HNO_3)_2 + 2NO_2+2NO + 6H_2O$$
$$2Cu+6HNO_3 \rightarrow 2Cu(HNO_3)_2 + NO_2+NO + 3H_2O$$

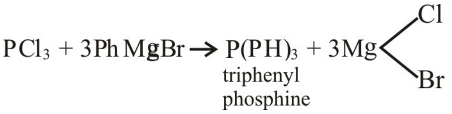
Thus coefficients x and y of Cu and HNO_3 are 2 and 6.

900. Reaction of PCl_3 and PhMgBr would give

(a) bromobenzene
(b) chlorobenzene
(c) triphenylphosphine
(d) dichlorobenzene

VITEEE- 2008

Ans. (c) : When phosphorus trichloride reacts with phenyl magnesium bromide (Grignard's reagent), all the three chlorine atoms of PCl_3 are replaced by phenyl group of phenyl magnesium bromide and triphenyl phosphine is obtained.



$$PCl_3 + 3PhMgBr \rightarrow \underset{\substack{\text{triphenyl}\\\text{phosphine}}}{P(PH)_3} + 3Mg\begin{cases}Cl\\Br\end{cases}$$

901. NH_3 group in a coordination compound is named as

(a) ammonium
(b) ammine
(c) amine
(d) ammonia

VITEEE- 2006

@apna_pdf

Ans. (b) : NH_3 (Ammine) is a neutral ligand with zero charge and named 'ammine'. However, two very important exceptions to this rule are H_2O (Aqua) NH_3 Ammine.

902. The total number of σ and π-bonds in pyrophosphoric acid are respectively

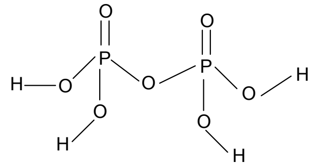
(a) 8, 2 (b) 10, 2

(c) 12, 2 (d) 8, 4

AP-EAMCET- (Engg.)-2011

Ans. (c) :

The structure of pyrophosphoric acid ($H_4P_2O_7$)



Pyrophosphoric acid $\left(H_4P_2O_7\right)$

Thus, it contains 12σ and 2π bonds.

903. Calgon is

(a) Na_2HPO_4 (b) Na_3PO_4

(c) $Na_6P_6O_{18}$ (d) NaH_2PO_4

AP-EAMCET – 2016

Ans. (c) : Calgon is a sodium hexametaphosphate $Na_6P_6O_{18}$. It is used for softening hard water. Calgon is a trade name of a complex salt.

- Disodium phosphate is the inorganic compound with the formula Na_2HPO_4. It is water soluble white powders. It is used in conjuction with trisodium phosphate in foods and water softening treatment.
- Chemical name of Na_3PO_4 is sodium phosphate. It is trisodium salt of phosphoric acid H_3PO_4.
- Sodium dihydrogen phosphate compound with the chemical formula NaH_2PO_4.

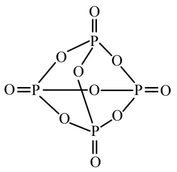
904. The number of oxygen atoms bonded to each phosphorus atom in P_4O_{10} is :

(a) 3 (b) 4

(c) 5 (d) 2

AP-EAMCET (Engg.)-2004

Ans. (b) : The structure of P_4O_{10} is given as :



Hence, there are four oxygen atom bonded to each phosphorus atom.

905. The oxide of nitrogen formed by thermal decomposition of NH_4NO_3 is

(a) NO (b) N_2O

(c) N_2O_5 (d) NO_2

AP-EAMCET- (Engg.) - 2010

Ans. (b) : The thermal decomposition of NH_4NO_3 is nitrous oxide.

$$NH_4NO_3 \xrightarrow[\text{at}\,250^\circ C]{\Delta} N_2O + 2H_2O$$

Hence, N_2O is nitrous oxide. It is also known as laughing gas.

906. Solvay process is used in the manufacture of

(a) K_2CO_3 (b) $KHCO_3$

(c) Na_2CO_3 (d) $CaCl_2$

AP-EAMCET- (Engg.) - 2010

Ans. (c) : The solvay process or ammonia-soda process is the industrial process for the production of sodium carbonate (Na_2CO_3).

$$\underset{\text{Sodiumbicarbonate}}{2NaHCO_3} \xrightarrow{\Delta} \underset{\text{Sodiumcarbonate}}{Na_2CO_3} + H_2O + CO_2.$$

This process can not be used in manufacture of potassium carbonate as potassium bicarbonate is soluble in the solution of NH_4Cl and KCl.

907. Which one of the following is not correct?

(a) Pyrophosphoric acid is a tetrabasic acid

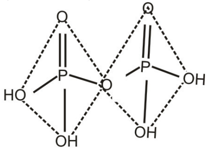
(b) Pyrophosphoric acid contains P—O—P linkage

(c) Pyrophosphoric acid contains two P—H bonds

(d) Orthophosphoric acid can be prepared by dissolving P_4O_{10} in water

AP-EAMCET (Engg.) 2013

Ans. (c) : The structure of Pyrophosphoric acid ($H_4P_2O_7$) is —



$\left(H_4P_2O_7\right)$

In pyrophosphoric acid four P–OH bonds,

two P – O bonds and one P– O – P linkage.

So, option (c) is not correct.

908. Which is in the decreasing order of boiling points of V group hydrides ?

(a) $NH_3 > PH_3 > AsH_3 > SbH_3$

(b) $SbH_3 > AsH_3 > PH_3 > NH_3$

(c) $PH_3 > NH_3 > AsH_3 > SbH_3$

(d) $SbH_3 > NH_3 > AsH_3 > PH_3$

AP - EAMCET (Medical) - 2007

Ans. (d) : The boiling point of hydrides of group 15 elements are given as :

	SbH_3 >	NH_3 >	AsH_3 >	PH_3
Boiling point–	254.6	238.5	210.6	185.5

909. Which of the following is not correct?

(a) Hydrolysis of NCl_3 gives NH_3 and HOCl

(b) NH_3 is less stable than PH_3

(c) NH_3 is a weak reducing reagent compared to PH_3

(d) Nitric oxide in solid state exhibits diamagnetic property

AP-EAMCET (Engg.)-2005

@apna_pdf

Ans. (b) : (a) Nitrogen trichloride undergo hydrolysis in presence of hot water to give ammonia and hypochlorous acid.

$$NCl_3 + 3H_2O \rightarrow NH_3 + 3HOCl$$

Hence, the statement is true.

(b) Ammonia (NH_3) is the most stable hydride in 15th group. So, order of bond strength of hydride is $NH_3 > PH_3 > AsH_3 > SbH_3$. So, order of stability of hydride of elements of 15th group is $NH_3 > PH_3 > AsH_3 > SbH_3$. Hence, the statement is false.

(c) The reducing power of hydrides increases from NH_3 to BiH_3 which can be observed from their bond dissociation enthalpy. Thus, statement is true.

(d) Nitric oxide in solid state exhibits diamagnetic character because unpaired electrons gets paired up in dimer form of solid. Thus, the statement is true.

Hence, only statement (b) is not correct.

910. Which of the following is more stable?

(a) N_2 (b) O_2

(c) Li_2 (d) All of these

SRMJEEE – 2011

Ans. (a) : Element–	N_2	O_2	Li_2
Bond order–	3	2	1

911. Which among the following has the garlic taste?

(a) P_2O_3 (b) H_3PO_4

(c) PCl_3 (d) H_3PO_3

SRMJEEE – 2009

Ans. (d) :

H_3PO_3 has the garlic taste.

P_2O_3 is garlic odour.

H_3PO_4 is Pleasant taste

PCl_3 : is sour taste.

912. P – O – P bond is present in

(a) pyrophosphoric acid

(b) orthophosphoric acid

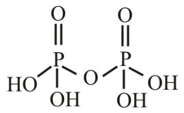
(c) phosphorous acid

(d) hypophosphorous acid.

SRMJEEE – 2013

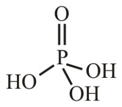
Ans. (a) : P – O – P bond are present in pyrophosphoric acid.

(i)



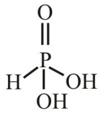
Pyrophosphoric acid

(ii)



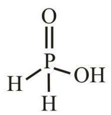
Orthophosphoric acid

(iii)



Phosphorous acid

(iv)



Hypophosphorous acid

Hence, the option (a) is correct.

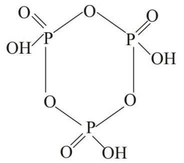
913. The number of P–O–P bonds in trimetaphosphoric acid is

(a) 0 (b) 2

(c) 3 (d) 6

AMU-2019

Ans. (c) : The number of P–O–P bond in cyclic metaphosphoric acid is three.



Hence, there are 3 P–O–P bonds.

914. The best reducing agent among the following is

(a) NH_3 (b) SbH_3

(c) PH_3 (d) AsH_3

AMU-2018

Ans. (b) : The reducing character of hydrides of group 15 elements increases down the group

$NH_3 < PH_3 < AsH_3 < SbH_3$

Number of shells is highest in 'Sb' which means the outermost electron is most loosely held in Sb. Therefore, SbH_3 is the strongest reducing agent.

915. Which of the following have same number of electrons in the outermost orbit?

(a) Pb, Sb (b) N, O

(c) As, Bi (d) P, Ca

BITSAT 2010

Ans. (c) : The outermost orbit has the same number of electron in As, Bi

Arsenic (As) and Birmuth (Bi) are in the same group

So, they have the same valence electron configuration

$As = 3d^{10}, 4s^2, 4p^3$

$Bi = 4f^{14}, 5d^{10}, 6s^2, 6p^3$

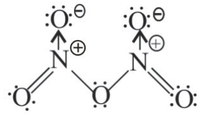
916. What is the number of nitrogen-nitrogen bonds in N_2O_5?

(a) 1 (b) 0

(c) 1.5 (d) None

AMU-2017

Ans. (b) : The structure of



The number of nitrogen -nitrogen bonds in N_2O_5 is zero.

917. Which of the following oxides of nitrogen is blue in nature?

(a) NO (b) N_2O_3

(c) N_2O_5 (d) NO_2

AMU-2017

Ans. (b) : Dinitrogen trioxide N_2O_3 is blue colours in liquid and solid state but in gaseous state it is brown in colour.

918. The number of P–O–P bonds in cyclic meta phosphoric acid is

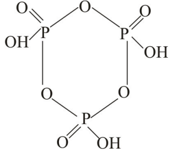
(a) zero (b) two

(c) three (d) four

AMU-2016

@apna_pdf

Ans. (c) : The chemical formula of cyclic metaphosphoric acid is ($P_3O_9H_3$).



The number of P–O–P bond in cyclic metaphosphosphoric acid is three.

919. Which of the following statements is wrong about the oxides of nitrogen?

(a) N_2O_5 is an anhydride of HNO_3
(b) NO is an acidic oxide
(c) N_2O_3 is an anhydride of HNO_2
(d) NO is not anhydride of an acid.

AMU-2016

Ans. (b) :

$\left.\begin{matrix} N_2O \\ NO \end{matrix}\right\}$ Neutral

$\left.\begin{matrix} NO_2 \\ N_2O_3 \\ N_2O_5 \end{matrix}\right\}$ Acidic

Oxides of nitrogen acts as a oxidizing as well as a reducing agent.

920. The molecule which is linear is

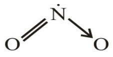
(a) N_2O
(b) NO_2
(c) SO_2
(d) H_2O

AMU-2016

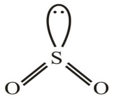
Ans. (a) : N_2O is linear molecule.

$N_2O \Rightarrow N \equiv N \rightarrow O$

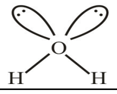
$NO_2 \Rightarrow$



$SO_2 \Rightarrow$



$H_2O \Rightarrow$



921. P_4O_{10} dissolves in water to give

(a) phosphorous acid
(b) orthophosphoric acid
(c) hypophosphorous acid
(d) pyrophosphoric acid

AMU-2011

Ans. (b) : P_4H_{10} has a great affinity for water. The final product is orthophosphoric acid.

$$P_4H_{10} \xrightarrow[\text{Hydrolysis}]{H_2O} \underset{\text{orthophosphoric acid}}{H_3PO_4}$$

922. Phosphine can be prepared by the reaction of water with

(a) calcium phosphide
(b) calcium hydride
(c) calcium dihydrogen phosphate
(d) calcium phosphate

AMU – 2010

Ans. (a) : $Ca_3P_2 + 6H_2O \rightarrow 3Ca(OH)_2 + 2PH_3$

923. Which of the following will dissolve in excess of ammonia?

(a) AgI
(b) AgBr
(c) AgCl
(d) None of these

AMU – 2010

Ans. (c) : (a) AgI does not dissolve in NH_4OH solution.
(b) AgBr is sparingly soluble in NH_4OH solution.

$AgBr + 2NH_4OH \rightarrow \underset{\text{Sparingly soluble}}{[Ag(NH_3)_2]Br} + 2H_2O$

(c) AgCl dissolves in NH_4OH by forming a complex salt.

$AgCl + 2NH_4Cl \rightarrow \underset{\text{Soluble complex}}{[Ag(NH_3)_2]Cl} + 2H_2O$

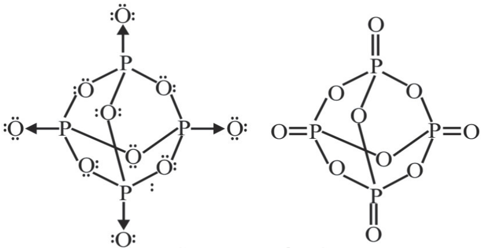
Hence, option (c) is correct.

924. In the structure of P_4O_{10} molecule the number of σ(sigma) and π(pi) bonds are

(a) 12 sigma and 4 pi
(b) 16 sigma and 4 pi
(c) 10 sigma and 4 pi
(d) 8 sigma and 4 pi

AMU – 2008

Ans. (b) : The structure of P_4O_{10} is similar to P_4O_6 with a difference that each phosphorous atom is linked with an additional oxygen atom with the help of a co-ordinate linkage involving a pair of electrons on each phosphorous atom . It has 16σ and 4π bonds.



Structure of P_4O_{10}

925. Carius method is used for the quantitative estimation of

(a) carbon
(b) halogens
(c) nitrogen
(d) sulphur

AMU–2006

Ans. (b) : The quantitative estimation of the halogens (Cl, Br or I) in organic compounds is done by Carius method.

926. Which of the following compounds will give phosphoric acid on reaction with water?

(a) PCl_5
(b) P_4O_6
(c) P_4O_{10}
(d) Ca_2P_2

AMU–2006

Ans. (b) : P_4O_6 reacts with water to give phosphoric acid.

$$P_4O_6 + 6H_2O \rightarrow 4H_3PO_3$$

Phosphoric acid

927. Which of the following metals will react with N_2 to from nitride ?

(a) Li
(b) Na
(c) K
(d) Rb

AMU-2004

Ans. (a) : On heating, Li readily combines with nitrogen to form the nitride (Li_3N).

$Li(s) + N_2(g) \rightarrow 2Li_3N(s)$

@apna_pdf

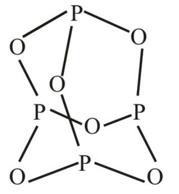
928. In P_4O_6, the number of oxygen atoms bonded to each phosphorus atom is

(a) 4 (b) 3

(c) 2 (d) 1.5

AMU–2001

Ans. (b) : In P_4O_6, the P atoms lie the corners of a tetrahedron and the six oxygen atoms are present along the edges in between the P atoms. Each P atom is covalently bonded to three oxygen atoms each of which is bonded to 2 P atoms.



Structure of P_4O_6

929. Anomalous behaviour of nitrogen is due to

(a) Small size and high electronegativity

(b) non-availability of d-orbitals in valency shells

(c) ease of multiple bond formation

(d) all of the above

Assam CEE-2018

Ans. (d) : Nitrogen differs from the rest of his family elements. Because its properties we know that on moving top to bottom (down the group) size of an atom decreases. In the group 15 nitrogen is smaller in size. Nitrogen has very high ionization energy because of its stable half-filled configuration. Nitrogen has electronic configuration is $1s^2, 2s^2, 2p^3$.

Here p-orbital is half- filled. Nitrogen has high electronegativity

930. The oxidation state of phosphorous in H_3PO_3, $H_4P_2O_6$ and $H_4P_2O_7$, respectively are

(a) +, 1+3, +4 (b) +3, +4, +5

(c) +3, +4, +4 (d) +3, +5, +4

Assam CEE-2021

Ans. (b) : The oxidation state of phosphorous-

$H_3PO_3 = 3 + x - 6 = 0, \quad x = 3$

$H_4P_2O_6 = 4 + 2x - 12 = 0, \quad x = 4$

$H_4P_2O_7 = 4 + 2x - 14 = 0, \quad x = 5$

931. The sides of safety matches contains

(a) red phosphorus + sand powder

(b) P_4S_3

(c) $Ca_3(PO)_4$ + glass pieces

(d) $KClO_3$, KNO_3, sulphur + antimony

BCECE-2007

Ans. (a) : The sides a safety matches contain red phosphorus and sand powder. The striking surface or sides of the safety matchbox contain red phosphorus, powder glass and glue. When the rubbing of safety matches on the striking surface the friction generates enough heat to converted a trace of the red phosphorus into white phosphorus. While the head of match stick contain P_4S_3

932. Zinc and cold dil. HNO_3 reacts to produce

(a) NO (b) NO_2

(c) NH_4NO_3 (d) $ZnNO_3$

BCECE-2007

Ans. (c) : $4Zn + 10HNO_3 \rightarrow 4Zn(NO_3)_2 + NH_4NO_3 + 3H_2O$

Zinc react with cold and very dilute nitric acid yields zinc carbonate and ammonium -nitrate.

933. Which of the following is kept in water?

(a) White phosphorus (b) Sodium

(c) Potassium (d) Calcium

BCECE-2005

Ans. (a) : White phosphorus is very reactive isotope of phosphorus. Phosphorus is kept in water due to in burn at 30°C. It is soluble in organic solvents.

934. The most favourable condition for the manufacture of NH_3 is :

(a) high temperature and high pressure

(b) low temperature and low pressure

(c) high temperature and low pressure

(d) low temperature and high pressure

BCECE-2004

Ans. (d) : The manufacture of NH_3 takes place by the Haber's process as below:

$$N_2(g) + 3H_2(g) \rightarrow 2NH_3(g) + 22.4 \text{ kcal.}$$

Low temperature and high pressure are favourable conditions for formation of NH_3

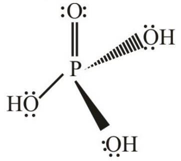
935. Which is tribasic acid ?

(a) H_3PO_2 (b) H_3PO_4

(c) $H_4P_2O_7$ (d) H_3PO_3

BCECE-2008

Ans. (b) : H_3PO_4 or phosphoric acid is a tribasic acid. It can be written as $PO(OH)_3$



936. Three reactions involving $H_2PO_4^-$ are given below–

I. $H_3PO_4 + H_2O \longrightarrow H_3O^+ + H_2PO_4^-$

II. $H_2PO_4^- + H_2O \longrightarrow HPO_4^{2-} + H_3O^+$

III. $H_2PO_4^- + OH^- \longrightarrow H_3PO_4 + O^{2-}$

In which of the above does $H_2PO_4^-$ act as an acid?

(a) II only (b) I and II

(c) III only (d) I only

BCECE-2014

Ans. (a) : $H_2PO_4^- + H_2O \rightarrow HPO_4^{2-} + H_3O^+$

in second reaction $H_2PO_4^-$ acts as on acid because acid gives H^+ in aqueous medium

$H_2PO_4^-{}_{(aq)} + H_2O_{(l)} \rightarrow H_3O^+ + HPO_4^{2-}{}_{(aq)}$

937. The product (s) formed when H_2O_2 reacts with disodium hydrogen phosphate is–

(a) P_2O_5. Na_3PO_4 (b) Na_2HPO_4. H_2O_2

(c) $NaH_2PO_4.H_2O$ (d) Na_2HPO_4. H_2O

BCECE-2014

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Ans. (b) : Disodium hydrogen phosphate (Na_2HPO_4) react with hydrogen peroxide (H_2O_2) forms $Na_2HPO_4 \cdot H_2O_2$

$$Na_2HPO_4 + H_2O_2 \rightarrow Na_2HPO_4.H_2O_2$$

938. Hydrolysis of PCl_3 produces

(a) $H_3PO_3 + HCl$ (b) $H_3PO_3 + H_2O$

(c) $H_3PO_4 + HCl$ (d) $PH_3 + HClO$

BCECE-2016

Ans. (a) : $PCl_3+3H_2O \rightarrow H_3PO_3+3HCl$

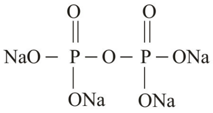
939. Sodium pyrophosphate is

(a) $Na_2P_2O_7$ (b) $Na_4P_2O_7$

(c) $NaPO_4$ (d) Na_2PO_4

[BITSAT-2008]

Ans. (b) : Sodium pyrophosphate is a salt of pyrophosphoric acid ($H_4P_2O_7$) and its chemical formula is $Na_4P_2O_7$



$$NaO-\overset{\overset{O}{\parallel}}{\underset{\underset{ONa}{|}}{P}}-O-\overset{\overset{O}{\parallel}}{\underset{\underset{ONa}{|}}{P}}-ONa$$

940. Phosphine is not obtained by the reaction

(a) White P is heated with NaOH

(b) Red P is heated with NaOH

(c) Ca_3P_2 reacts with water

(d) Phosphourus trioxide is boiled with water

[BITSAT-2011]

Ans. (b) : When red phosphorus react with NaOH, $H_4P_2O_6$ is obtained

$$P_4(Red) + NaOH \rightarrow H_4P_2O_6$$

Hence, phosphine (PH_3) is not obtained.

So, option (b) is not correct.

941. Which liberates ammonia when treated with water?

(a) Li_3N (b) Mg_3N_2

(c) $CaCN_2$ (d) All

[BITSAT-2010]

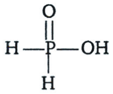
Ans. (d) : All Nitrates release NH_3 on reacting with H_2O

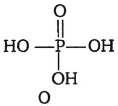
$Li_3N+H_2O \rightarrow LiO+NH_3$

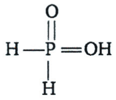
$Mg_3N_2+H_2O \rightarrow MgO+NH_3$

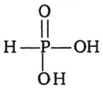
$CaN_2+H_2O \rightarrow CaCO_3+NH_3$

942. Formula of hypophosphorus acid is :

(a) 

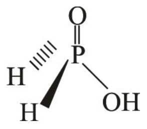
(b) 

(c) 

(d) 

BCECE-2005

Ans. (a) :



Formula of hypophosphorus acid is H_3PO_2.

It is also known as monobasic acid.

943. Which of the following shows nitrogen with its increasing order of oxidation number?

(a) $NO < N_2O < NO_2 < NO_3^- < NH_4^+$

(b) $NH_4^+ < N_2O < NO_2 < NO_3^- < NO$

(c) $NH_4^+ < N_2O < NO < NO_2 < NO_3^-$

(d) $NH_4^+ < NO < N_2O < NO_2 < NO_3^-$

[BITSAT-2017]

Ans. (c) :

Compound	**O.S of N**
N_2O	+1
NO	+2
NO_2	+4
NO_3^-	+5
NH_4^+	–3

Therefore increasing order of oxidation state of N is

$$NH_4^+ < N_2O < NO < NO_2 < NO_3^-$$

944. Which of these doesn't exist?

(a) PH_3 (b) PH_5

(c) LuH_3 (d) PF_5

[BITSAT-2017]

Ans. (b) : PH_3 exists but PH_5 does not exist due to the absence of d-orbital contraction.

945. Which of the following is a strong base?

(a) PH_3 (b) AsH_3

(c) NH_3 (d) SbH_3

[BITSAT-2015]

Ans. (c) : NH_3 is a strong base the decreasing order of the basic character is $NH_3 > PH_3 > AsH_3 > SbH_3$

Basic character decreases down the group from N to Bi due to increase in atomic size.

$NH_3 > PH_3 > AsH_3 > SbH_3$

946. Phosphine is not obtained by which of the following reaction?

(a) White P is heated with NaOH.

(b) Red P is heated with NaOH.

(c) Ca_3P_2 reacts with water.

(d) None of these

[BITSAT-2021]

Ans. (b) : Phosphine is also obtained when calcium phosphide is heated with water.

$$Ca_3P_2 + 6H_2O \rightarrow 2PH_3 + 3Ca(OH)_2$$

When red phosphorus reacts with NaOH $H_4P_2O_6$ is obtained.

$P_4(Red) + NaOH \rightarrow H_4P_2O_6$

947. Hydrolysis of NCl_3 gives NH_3 and X. Which of the following is X?

(a) $HClO_4$ (b) $HClO_3$

(c) HOCl (d) $HClO_2$

[BITSAT-2021]

Ans. (c) : Hydrolysis is the process of using water to break down a molecule into two parts. If we see the word hydrolysis we can automatically think of term 'reaction with water'

@apna_pdf

The general formula of a hydrolysis reaction

$AB + H_2O \rightarrow AH + BOH$

So,

Reaction will be as follows

$NCl_3 + 3H_2O \rightarrow NH_3 + 3HOCl$

948. Which of the following has the highest pπ–pπ bonding tendency? [BITSAT-2021]

(a) N (b) P

(c) As (d) Sb

[BITSAT-2021]

Ans. (a) : Due to small size and higher electro negativity carbon has the highest tendency to form multiple bonds either with itself or with the other atoms of similar size such as oxygen and nitrogen.

949. Nitrogen is obtained by the thermal decomposition of:

(a) NH_4NO_2 (b) NH_4NO_3

(c) $AgNO_3$ (d) $Pb(NO_3)_2$

[BITSAT-2021]

Ans. (a) :

(a) $NH_4NO_2 \rightarrow N_2 + 2H_2O$

(b) $NH_4NO_3 \rightarrow N_2O + 2H_2O$

(c) $AgNO_3 \rightarrow Ag + NO_2 + \frac{1}{2}O_2$

So, nitrogen is obtained from NH_4NO_2

950. P_4O_{10} on reacting with water does not form

(a) tetrametaphosphoric acid

(b) Phosphorus acid

(c) orthophosphoric acid

(d) pyrophosphoric acid

CG PET- 2011

Ans. (b) : Phosphorus pentoxide, P_4O_{10} has great affinity for water and gives orthophosphoric acid as final product.

$$P_4O_{10} + 2H_2O\,(Cold) \rightarrow \underset{\text{Metaphosphoric acid}}{4HPO_3}$$

$$P_4O_{10} + 6H_2O(Hot) \rightarrow \underset{\text{Phosphoric acid}}{4H_3PO_4}$$

951. The bond present in N_2O_5 are

(a) only ionic

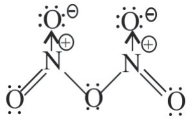
(b) covalent and coordinate

(c) only covalent

(d) covalent and ionic

CG PET- 2013

Ans. (b) : In N_2O_5, the combining atoms are nitrogen and oxygen. As both of them are non-metals. Hence, they share electrons when both of them chemically combine.



There are both covalent and coordinate bonds.

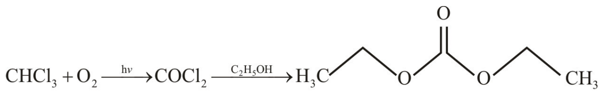
952. The compound added to prevent chloroform to form phosgene gas (poisonous gas) is

(a) CH_3COOH (b) CH_3OH

(c) CH_3COCH_3 (d) C_2H_5OH

CG PET -2007

Ans. (d) : Chloroform in presence of atmospheric oxygen, gets converted to poisonous gas phosgene ($COCl_2$). In order to prevent this oxidation, alcohol is added which converts phosgene to alkyl carbonate.



953. The element which liberates oxygen gas from water is

(a) P (b) Na

(c) F (d) I

CG PET -2007

Ans. (c) : Fluorine liberates oxygen gas from water.

$2F_2 + 2H_2O \rightarrow 4HF + O_2$.

954. Very dilute nitric acid reacts with zinc to form zinc nitrate and

(a) ammonium nitrate (b) NO_2

(c) NO (d) N_2O

CG PET -2007

Ans. (a) : Zinc, reacts with very dilute nitric acid gives zinc nitrate and ammonium nitrate.

$[Zn + 2HNO_3 \longrightarrow Zn(NO_3)_2 + 2H] \times 4$

$HNO_3 + 8H \rightarrow NH_3 + 3H_2O$

$NH_3 + HNO_3 \rightarrow NH_4NO_3$

$4Zn + 10HNO_3 \rightarrow 4Zn(NO_3)_2 + NH_4NO_3 + 3H_2O$

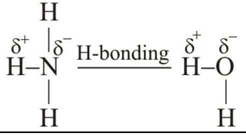
955. Which of the following exhibits highest solubility in water?

(a) NH_3 (b) PH_3

(c) AsH_3 (d) SbH_3

CG PET -2007

Ans. (a) : Compounds which forms inter molecular hydrogen bond with water is supposed to be soluble in water. NH_3 forms inter molecular hydrogen bond with water, so it is exhibits highest solubility in water.



956. $NaOH + P_4 + H_2O \longrightarrow ?$

(a) $PH_3 + NaH_2PO_2$ (b) $PH_3 + Na_2PO_4$

(c) $PH_3 + Na_2HPO_2$ (d) $H_3PO_4 + NaO$

BCECE-2004

Ans. (a) : : $NaOH + P_4 + H_2O \rightarrow PH_3 + NaH_2PO_2$

957. The passivity of iron in concentrated nitric acid is due to

(a) ferric nitrate coating on the metal

(b) ammonium nitrate coating on the metal

(c) a thin oxide layer coating on the metal

(d) a hydride coating on the metal

CG PET -2004

Ans. (c) : When iron reacts with concentrated HNO_3, a thin oxide layer is formed on the metal surface. So, iron become passive.

@apna_pdf

958. When heated NH_3 is passed over CuO gas evolved is :

(a) N_2 (b) N_2O
(c) HNO_3 (d) NO_2

BCECE-2005

Ans. (a) : When ammonia is heated and passed over solid copper (II) oxide at high temperatures nitrogen gas is forms. This N_2 is not pure as it would be in the heating of NaN_3 like compounds.

$$2NH_3(g)+3CuO(s) \rightarrow N_2(g)+3Cu(s)+3H_2O(g)$$

959. In the following reaction

$$P_4+3NaOH+3H_2O \rightarrow PH_3+3NaH_2PO_2$$

(a) phosphorus is oxidised
(b) phosphorus is oxidised and reduced
(c) phosphorus is reduced
(d) sodium is oxidised

CG PET -2004

Ans. (b) :

$$\overset{(0)}{P_4}+3NaOH+3H_2O \rightarrow \overset{(-3)}{PH_3}+3NaH_2\overset{(+1)}{P}O_2$$

Rcduction

oxidation

960. The formula of phosphate of a metal, M is MPO_4. The formula of its nitrate will be

(a) MNO_3 (b) $M(NO_3)_2$
(c) $M(NO_3)_3$ (d) $M_2(NO_3)_3$

CG PET -2006, 2004

Ans. (c) : In MPO_4 the oxidation state of M is +3. So, the formula of nitrate is $M(NO_3)_3$.

961. In the mixture of conc. H_2SO_4 and HNO_3 the nitration species is

(a) N_2O_4 (b) NO_2^+
(c) NO_2 (d) NO_2^-

CG PET -2005

Ans. (b) : $H_2SO_4+HNO_3 \rightarrow H_2NO_3^++H_5O_4^-$

$$H_2NO_3^+ \rightarrow H_2O+NO_2^+$$

The electrophile in nitration of benzene is nitronium ion (NO_2^+).

962. A deep brown gas is formed by mixing two colourless gases which are

(a) NO_2 and O_2 (b) N_2O and NO
(c) NO and O_2 (d) NH_3 and HCl

CG PET -2005

Ans. (c) : The chemical name of the deep coloured brown gas is nitrogen dioxide (NO_2).
NO_2 is acidic in nature and gives anhydrides of nitric and nitrous oxide which are brown in colour.

$$\underset{\text{Nitric oxide}}{2NO}+\underset{\text{oxygen gas}}{O_2} \longrightarrow \underset{\text{Nitrogen di-oxide}}{2NO_2}\text{ (Brown gas)}$$

Colourless gases : – NO and O_2

963. Which of the following, on heating with ammonia gives urotropin?

(a) Formaldehyde (b) Acetaldehyde
(c) Acetone (d) Benzaldehyde

CG PET -2006

Ans. (a) : When formaldehyde reacts with ammonia, a well known urinary antiseptic urotropine (also called hexamethylenentetramine) is obtained.

$$6HCHO+4NH_3 \rightarrow (CH_2)_6N_4+4H_2O$$

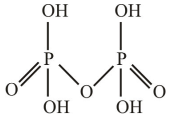
Hence, Urotropine is formed by the action of Ammonia on Formaldehyde.

964. Which is the correct options for bonds and their number in pyrophosphoric acid ?

(a) Two P–OH, Four P = O, One P–O–P
(b) Four P–OH, One P = O, One P–O–P
(c) Two P–OH, Four P = O, Two P–O–P
(d) Four P–OH, Two P = O, One P–O–P

GUJCET-2022

Ans. (d): Pyrophosphoric Acid–Pyrophosphate is the conjugate base of Pyrophosphoric acid and is corrosive as well as toxic in nature. Pyrophosphoric acid is a medium-strong inorganic hygroscopic by nature and is a colourless as well as odourless chemical.



P–OH = 4
P=O = 2
P–O–P =1

965. Concentrated HNO_3 oxidize white phosphorus into which substance?

(a) H_3PO_2 (b) $H_4P_2O_7$
(c) H_3PO_4 (d) H_3PO_3

GUJCET-2020

Ans. (c) : Concentrated nitric acid oxidises phosphorus to phosphoric acid according to the following equation–

$$P+5HNO_3 \rightarrow H_3PO_4+5NO_2+H_2O$$

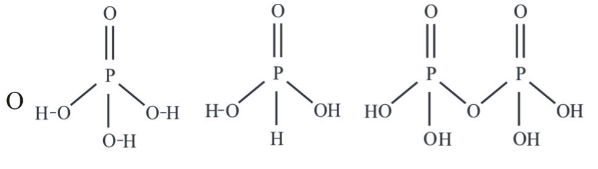
966. In which of the following acid, the maximum number of hydrogen atoms are joined directly with phosphorous?

(a) Phosphoric acid (b) Phosphorous acid
(c) Pyrophsphoric acid (d) Phosphonic acid

GUJCET-2017

Ans. (b) : Phosphoric acid; H_3PO_4
Phosphorus acid; H_3PO_3
Pyrophosphoric acid; $H_4P_2O_7$

So, in H_3PO_3, one Hydrogen atom is attached to phosphorus directly.



H_3PO_4 H_3PO_3 $H_4P_2O_7$

967. Which of the following hydride is the most stable?

(a) PH_3 (b) SbH_3
(c) NH_3 (d) AsH_3

GUJCET-2019

@apna_pdf

Ans. (c) : The stability of hydride decreases from N to Bi. SO, NH_3 most stable

NH_3 is the most stable hydride among the hydrides of group 15 elements, because the strength of E–H (Here E = N, P, As, Sb or Br) bond decreases down the group due to increase in the size of the central atom.

968. Which product will be obtained in the following reaction?

Reaction : $P_4(g) + 3NaOH(aq) + 2H_2O(l) \rightarrow$

(a) $PH_3(g) + 3Na_2HPO_2(aq)$

(b) $PH_3(g) + 3NaH_2PO_2(aq)$

(c) $2PH_3(g) + 3Na_2HPO_2(aq)$

(d) $2PH_3(g) + 3NaH_2PO_2(aq)$

GUJCET-2016
GUJCET-2015

Ans. (b) :

$$P_4(g) + 3NaOH(aq) + 2H_2O(l) \rightarrow PH_3(g) + \underset{\text{(Sodium hypophosphite)}}{3NaH_2PO_2(aq)}$$

In above reaction:–

- Phosphorus is oxidized
- Phosphorus is reduced

This reaction is used for the preparation of phosphine gas in the laboratory.

969. For the hydrides of nitrogen family, in going down the group :

(a) Stability decreases
(b) Reducing activity decreases
(c) Bond angle HEH increases
(d) Boiling point increases

HP CET-2018

Ans. (a) : (increases / decreases)

$$[NH_3 >> PH_3 > AsH_3 > SbH_3 >> BiH_3]$$

Moving down the group

→Increases size of atom

→ Metallic character increases

Acid → H^+	(N) ——— H
Basic → OH^-	(P) ——— H
	(As) ——— H
Basic character↑	Basic character↓

970. PCl_3 and PCl_5 both exist; NCl_3 exists but NCl_5 does not exist. It is due to

(a) lower electronegativity of P than N
(b) lower tendency of N to form covalent bond
(c) availability of vacant d-orbital in P but not in N
(d) statement is itself incorrect

(AIEEE 2002)

Ans. (c) : PCl_3 and PCl_5 both exist and NCl_3 exist but NCl_5 does not exist. It is due to in Nitrogen, vacant d-orbitals are not available.

But in case of phosphorous vacant 3d–orbitals are available.

971. In which of the following arrangements, the sequence is not strictly according to the property written against it?

(a) $CO_2 < SiO_2 < SnO_2 < PbO_2$: increasing oxidising power
(b) HF < HCl < HBr < HI : increasing acid strength
(c) $NH_3 < PH_3 < AsH_3 < SbH_3$: increasing basic strength
(d) B < C < O < N : increasing first ionisation enthalpy

(AIEEE 2009)

Ans. (c) : The correct increasing basic strength

$SbH_3 < AsH_3 < PH_3 < NH_3$

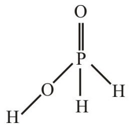
NH_3 is most basic because of its small size, the electron density of electron pair is concentrated over small region.

972. Good reducing nature of H_3PO_2 is attributed to the presence of

(a) two P–H bonds
(b) one P–H bond
(c) two P–OH bonds
(d) one P–OH bond

(JEE Main 2019, 9 Jan Shift-II)

Ans. (a) : The structure of H_3PO_2 (hypophosphorous) acid is,



H_3PO_2 is good reducing agent due to presence of two P–H bonds.

973. The metal that forms nitride by reacting directly with N_2 of air, is

(a) Rb
(b) K
(c) Cs
(d) Li

(JEE Main 2019, 9 Jan Shift-II)

Ans. (d) : Only Li react directly with N_2 out of alkali metals

$4Li + O_2 \rightarrow 2Li_2O$

$6Li + N_2 \rightarrow 2Li_3N$

974. The pair that contains two P–H bonds in each of the oxoacids is

(a) $H_4P_2O_5$ and $H_4P_2O_6$
(b) H_3PO_3 and H_3PO_2
(c) $H_4P_2O_5$ and H_3PO_3
(d) H_3PO_2 and $H_4P_2O_5$

(JEE Main 2019, 10 Jan Shift-II)

Ans. (d) : Before solving this question, we should know what oxoacids are, as the name suggest, oxoacids are the acids that contain oxygen. All the oxoacids of phosphorus have one P–OH bond and one P=O bond. They have different oxidation states. It these cases the oxidation state of phosphorus is less than +5.

975. The compound that does not produce nitrogen gas by the thermal decomposition is

(a) $Ba(N_3)_2$
(b) $(NH_4)_2Cr_2O_7$
(c) NH_4NO_2
(d) $(NH_4)_2SO_4$

(JEE main 2018)

Ans. (d) : $(NH_4)_2Cr_2O_7 \xrightarrow{\Delta} N_2 + 4H_2O + Cr_2O_3$

$NH_4NO_2 \xrightarrow{\Delta} N_2 + 2H_2O$

$(NH_4)_2SO_4 \xrightarrow{\Delta} 2NH_3 + H_2SO_4$

@apna_pdf

$$Ba(N_3)_2 \xrightarrow{\Delta} Ba + 3N_2$$

Among all the given compounds, only $(NH_4)_2SO_4$ does not form dinitrogen on heating, it produces ammonia gas.

976. The species in which the N-atom is in a state of sp hybridisation is

(a) NO_2^- (b) NO_3^-

(c) NO_2 (d) NO_2^+

(JEE main 2016)

Ans. (d) : The hybridization of NO_2^+ is sp hybridisation. It is a linear molecule. NO_2^-, NO_3^- and NO_2 does not have sp hybridization.

$$NO_2^- \rightarrow n = \frac{1}{2}(5+0+1)$$
$$= \frac{1}{2}\times 6 = 3$$
$$= sp^2$$
$$NO_3^- \rightarrow n = \frac{1}{2}(5+0+1)$$
$$= sp^2$$
$$NO_2^+ \rightarrow n = \frac{1}{2}(5+0-1)$$
$$= sp$$
$$[:\ddot{O}=N=\ddot{O}:]^+$$

Therefore, the correct option is (d).

977. The pair in which phosphorus atoms have a formal oxidation state of +3 is

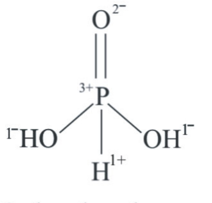
(a) pyrophosphorus and hypophosphoric acids
(b) orthophosphorus and hypophosphoric acids
(c) phrophosphorus and pyrophosphoric acids
(d) orthophosphorus and pyrophosphorous acids

(JEE Main 2016)

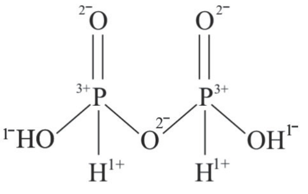
Ans. (d) : Orthophosphorus and pyrophosphorous acids have a formal oxidation state of +3 for phosphorous atoms.

In $H_3PO_3 \Rightarrow 3\times1 + x + (-2\times3)$
$\Rightarrow 3 + x - 6 = 0$
$\Rightarrow x = 6 - 3$
$\Rightarrow x = 3$

In $H_4P_2O_5 \Rightarrow 4\times1 + x\times2 + (-2\times5) = 0$
$\Rightarrow 4 + 2x - 10 = 0$
$\Rightarrow 2x = 6$
$\Rightarrow x = 3$



Ortho phosphorus acid



Pyrophosphorus acid

Hence, the correct option is (d).

978. Which one of the following properties is not shown by NO?

(a) It is diamagnetic in gaseous state
(b) It is a neutral oxide
(c) It combines with oxygen to form nitrogen dioxide
(d) Its bond order is 2.5

(JEE main 2014)

Ans. (a) : NO is nitric oxide . NO reacts with O_2 to form NO_2. This reaction is used to prepare NO2 and give as,

$$2NO + O_2 \rightarrow 2NO_2$$

- An anti bonding orbital of NO has one unpaired electron and so, it is paramagnetic in nature.
- The bond order of NO is calculated as $\frac{8-3}{2} = \frac{5}{2} = 2.5$

So, option (a) is wrong.

979. Which of the following statements is wrong?

(a) The stability of hydrides increases from NH_3 to BiH_3 in group 15 of the periodic table
(b) Nitrogen can't form dπ-pπ bond
(c) Single N–N bond is weaker than the single P–P bond
(d) N_2O_4 has two resonance structure

(AIEEE 2011)

Ans. (a) : Thermal stability of the hydrides decrease as we go down the group in the periodic table for group 15 (N–family)

$BiH_3 < SbH_3 < AsH_3 < PH_3 < NH_3$

Least stable Most stable

(b) Due to absence of d–orbital, nitrogen can't form dπ–pπ; thus it is correct.

(c) The N–N bond (B.E 160 KJ mol^{-1}) is weaker than P–P bond (BE 209 KJ mol^{-1}). Thus, it is correct.

(d) N_2O_4 can form two resonance structure thus it is also correct.

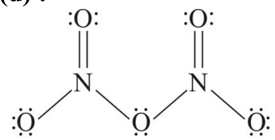
980. The oxide without nitrogen-nitrogen bond is

(a) N_2O (b) N_2O_4

(c) N_2O_3 (d) N_2O_5

(JEE Main 2021, 1 Sep Shift-II)

Ans. (d) :



N_2O_5 does not contain any N – N bonds

981. Which one of the following is formed (mainly) when red phosphorus is heated in a sealed tube at 803 K?

(a) White phosphorus
(b) Yellow phosphorus
(c) β- black phosphorus
(d) α- black phosphorus

(JEE Main 2021, 27 Aug Shift-II)

Ans. (d) : When red phosphorus is heated in a sealed tube at 803K, α- black phosphorus is formed.

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$$\text{Red phosphorous}\ \xrightarrow[\text{high p.}]{473K} \beta-\underset{\text{(Rhombohedral)}}{\text{black phosphorous}}$$

$$\text{Red phosphorous}\ \xrightarrow[\text{sealed tube}]{803K} \alpha-\underset{\text{(monoclinic)}}{\text{black phosphorous}}$$

982. The oxidation states of 'P' in $H_4P_2O_7$, $H_4P_2O_5$ and $H_4P_2O_6$ respectively are

(a) 7, 5 and 6 (b) 5, 4 and 3
(c) 5, 3 and 4 (d) 6, 4 and 5

(JEE Main 2021, 27 July Shift-I)

Ans. (c) : Oxidation states of 'P' in $H_4P_2O_7$, $H_4P_2O_5$ and $H_4P_2O_6$ is 5, 3 & 4 respectively

$H_4P_2O_7$
$2x + 4(+1) +7(-2) = 0$
$x = +5$
$H_4P_2O_5$
$2x + 4(+1) +5(-2) = 0$
$x = +3$
$H_4P_2O_6$
$2 x + 4(+1) +6(-2) = 0$
$x = +4$

983. Which one of the following group-15 hydride is the strongest reducing agent?

(a) AsH_3 (b) BiH_3
(c) PH_3 (d) SbH_3

(JEE Main 2021, 22 July Shift-II)

Ans. (b) : Among 15th group hydrides, BiH_3 is strongest reducing agent because Bi–H bond dissociation energy is very less.

984. Chemical nature of the nitrogen oxide compound obtained from a reaction of concentrated nitric acid and P_4O_{10} (in 4:1 ratio) is

(a) acidic (b) basic
(c) amphoteric (d) neutral

(JEE Main 2021, 20 July Shift-I)

Ans. (a) : $4HNO_3 + 1P_4O_{10} \longrightarrow 2N_2O_5 + (HPO_3)_4$
Nitric acid
N_2O_5 — Dinitrogen pentoxide
(acidic in nature)

985. Regular use of which of the following fertilizers increases the acidity of soil?

(a) Potassium nitrate
(b) Urea
(c) Superphosphate of lime
(d) Ammonium sulphate

(AIEEE 2007)

Ans. (d) : Regular use of ammonium sulphate increases the acidity of soil.

$(NH_4)_2\ SO_4$ is a salt of strong acid and weak base on hydrolysis it will produce H^+ ion.

$$NH_4^+ + H_2O \rightleftharpoons NH_4OH + H^+$$

$(NH_4)_2\ SO_4 \rightarrow 2NH_3 + H_2SO_4$

To prevent acidity, slaked lime is added to neutralize the acid.

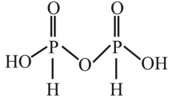
986. The number of ionisable hydrogens present in the product obtained from a reaction of phosphorus trichloride and phosphonic acid is

(a) 3 (b) 0
(c) 2 (d) 1

(JEE Main 2021, 18 March SHift-I)

Ans. (c) : $PCl_3 + H_3PO_3 + H_2O \rightarrow H_4P_2O_5 + HCl$

Pyrophosphrous acid



The structure of pyrophosphrous acid shows that it has two acidic or ionisable hydrogen.

987. The set that represents the pair of neutral oxides of nitrogen is

(a) NO and N_2O (b) N_2O and N_2O_3
(c) N_2O and NO_2 (d) NO and NO_2

(JEE Main 2021, 17 March Shift-II)

Ans. (a) : NO and N_2O are neutral oxides while N_2O_3, NO_2 and N_2O_5 are acidic oxides. Neutral oxides are those oxides which show neither basic nor acidic properties when they react with water.

988. Which of the following compound cannot act as Lewis base?

(a) NF_3 (b) PCl_5
(c) SF_4 (d) CIF_3

(JEE Main 2021, 17 March Shift-I)

Ans. (b) : Lewis base– Chemical species which has capability to donate electron pair. In NF_3, SF_4, ClF_3 having lone pair therefore act as Lewis base.

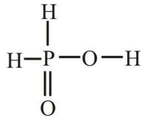
NF_3 has no vacant orbital neither in nitrogen nor in fluorine so it cannot accept the electron and hence, cannot act as Lewis acid but for PCl_5 has no L.P. Hence, it cannot acts as a base but ClF_3 (3B.P +2C.P) & SF_4(4 B.P +1 L.P).

989. The number hydrogen atom(s) attached to phosphorus atom in hypophosphorous acid is

(a) Three (b) one
(c) two (d) zero

(AIEEE 2005)

Ans. (c) : Molecular formula of Hypophosphorous acid is H_3PO_2.



Hypophosphorus acid (H_3PO_2) is monobasic acid and has only one ionisable H, two H-atoms are directly attached to phosphorus.

990. A group 15 element, which is a metal and forms a hydride with strongest reducing power among group 15 hydrides. The element is

(a) Sb (b) P
(c) As (d) Bi

(JEE Main 2021, 16 March Shift-I)

Ans. (d) : $\left.\begin{matrix}N\\P\end{matrix}\right]$ —— Non metal

$\left.\begin{matrix}As\\Sb\end{matrix}\right]$ —— Metalloid

$\left.Bi\right]$ —— Metal

@apna_pdf

Hydrides of group 15 elements are NH_3, PH_3, AsH_3, SbH_3, BiH_3 in NH_3, hydrogen atom gets partial positive charge due to less electronegativity.
But in BiH_3, hydrogen atom gets partial negative charge because hydrogen is more electronegative than bismuth. i.e. BiH_3 is a strong reducing agent than others because we know that H^- is a strong reducing agent.

991. Find A, B and C in the following reactions:
$NH_3 + A + CO_2 \rightarrow (NH_4)_2CO_3$
$(NH_4)_2CO_3 + H_2O + B \rightarrow NH_4HCO_3$
$NH_4HCO_3 + NaCl \rightarrow NH_4Cl + C$
(a) A–O_2, B–CO_2, C–Na_2CO_3
(b) A–H_2O, B–O_2, C–Na_2CO_3
(c) A– H_2O, B–O_2, C–$NaHCO_3$
(d) A– H_2O, B–CO_2, C–$NaHCO_3$

(JEE Main 2021, 26 Feb Shift-I)

Ans. (d) : $2NH_3 + \underset{(A)}{H_2O} + CO_2 \rightarrow (NH_4)_2CO_3$

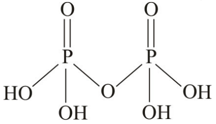
$(NH_4)_2 CO_3 + H_2O + \underset{(B)}{CO_2} \rightarrow 2NH_4 HCO_3$

$NH_4HCO_3 + NaCl \rightarrow \underset{(C)}{NaHCO_3} + NH_4Cl$

992. In a molecule of pyrophosphoric acid, the number of P–OH, P = O and P–O–P bonds/moiety(ies) respectively are
(a) 2, 4 and 1 (b) 3, 3, and 3
(c) 4, 2, and 0 (d) 4, 2, and 1

(JEE Main 2020, 3 Sep Shift-I)

Ans. (d) H_4P_2O (pyrophosphoric acid)



P – OH bonds = 4
P = O bonds = 2
P – O – P linkage = 1

So, option (d) is correct.

993. Reaction of ammonia with excess Cl_2 gives
(a) NH_4Cl and N_2 (b) NH_4Cl and HCl
(c) NCl_3 and NH_4Cl (d) NCl_3 and HCl

(JEE Main 2020, 5 Sep Shift-II)

Ans. (d) : Pure chlorine gas may react vigorously with ammonia gas. An excessive mix of the two gases in air can produce hazardous compounds such as nitrogen trichloride.
The following reaction takes place.
$NH_3 + 3Cl_2 \rightarrow NCl_3 + 3HCl$
Ammonia reacts with excess of chlorine to form NCl_3 and HCl.

994. The correct statement with respect to dinitrogen is
(a) N_2 is paramagnetic in nature.
(b) it can combine with dioxygen at 25^0C.
(c) liquid dinitrogen is not used in cryosurgery
(d) it can be used as an inert diluent for reactive chemicals.

(JEE Main 2020, 6 Sep Shift-I)

Ans. (d) : (a) $N_2=14e^-$.
It has unpaired e^- in its bonding and antibonding molecule then it is paramagnetic.
(b) $N_2+O_2 \rightarrow 2NO$
(c) Cryosurgery – Extreme cold to destroy abnormal liq. N_2 used to freeze cancer cell. So, used in cryosurgery.
(d) In iron and chemical industry inert diluents for reactive chemicals.

995. The reaction of NO with N_2O_4 at 250 K gives
(a) N_2O (b) NO_2
(c) N_2O_3 (d) N_2O_5

(JEE Main 2020, 6 Sep Shift-II)

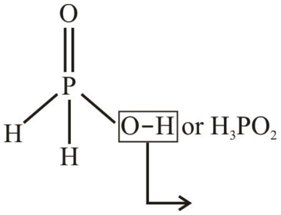
Ans. (c) : $2NO + N_2O_4 \xrightarrow{250K} 2N_2O_3$ (blue solid)

996. White phosphorus on reaction with concentrated HaOH solution in an inert atmosphere of CO_2 gives phosphine and compound (X). (X) on acidification with HCl gives compound (Y). The basicity of compound (Y). The basicity of compound (Y) is
(a) 4 (b) 3
(c) 2 (d) 1

(JEE Main 2020, 8 Jan Shift-II)

Ans. (d) : The basicity of compound Y is 1.

$$\begin{tikzcd} P_4+NaOH+H_2O \arrow[r] & PH_3+NaH_2PO_2 \arrow[d, "HCl"] \\ & H_3PO_2 \end{tikzcd}$$



Only one ionisable H ions are there in it.

$\boxed{\text{Basicity} = 1}$

997. Ammonia forms the complex ion $[Cu(NH_3)_4]^{2+}$ with copper ions in the alkaline solutions but not in acidic solutions. What is the reason for it?
(a) In acidic solutions, hydration protects copper ions
(b) In acidic solutions, protons coordinate with ammonia molecules forming NH_4^+ ions and N its molecules are not available
(c) In alkaline solutions, insoluble $(Cu(OH)_2$ is precipitated which is soluble in excess of any alkali
(d) Copper hydroxide is an amphoteric substance

(AIEEE 2003)

Ans. (b) : In acidic solutions protons coordinate with ammonia molecules forming NH_4^+ ions and NH_3 molecules are not available.
In acidic solution, N atoms of NH_3 donates forming NH_4^+ ions.
Therefore, lone pair electrons of NH_3 are not available for forming the complex with copper ions.

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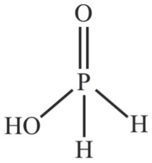
998. The oxyacid of phosphorous which is reducing nature, among the following is

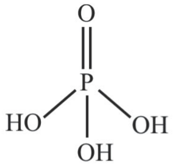
(a) Orthophosphoric acid
(b) Mtetaphosphoric acid
(c) Pyrophosphoric acid
(d) Phosphinic acid.

J & K CET-(2016)

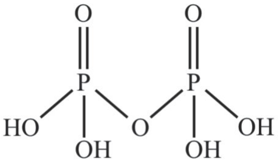
Ans. (d) :



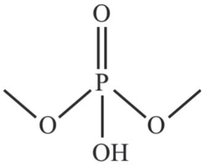
Phosphoric acid(H_3PO_2)



Orthophosphoric acid(H_3PO_4)



Pyrophosphoric acid($H_4P_2O_7$)



Metaphosphoric acid$(HPO_3)_n$

999. Who has synthesised the organic compound 'urea' for the first time?

(a) Friedrich Wohler
(b) Berzelius
(c) Kolbe
(d) Berthelot

J & K CET-(2014)

Ans. (a) : German chemist Friedrich Wholer prepared urea in a laboratory in 1828 form ammonium cyanate.

$$NH_4CNO \rightarrow (H_2N)2CO$$

This was the first time an organic compound was artificially synthesized from inorganic starting materials, without the involvement of living organisms.

1000. Phosphorus pentoxide (P_2O_5) is the starting material for phosphate esters used as surfactants and extraction agents. P_2O_5 is extensively used as.

(a) reducing agent
(b) preservative
(c) oxidizing agent
(d) dehydrating agent

J & K CET-(2017)

Ans. (d) : P_2O_5 is powerful dehydrating agent.

$$4HNO_3 + P_4O_{10} \rightarrow 2N_2O_5 + 4HPO_3$$
$$2H_2SO_4 + P_4O_{10} \rightarrow 2SO_3 + 4HPO_3$$
$$4HClO_4 + P_4O_{10} \rightarrow 2Cl_2O_7 + 4HPO_3$$

1001. What will be the resultant products formed when the phosphorus halide PBr_5 splits up?

(a) $[PBr_4]^+$ and Br^-
(b) $[PBr_6]^-$ and $[PBr_4]^+$
(c) $[PBr_4]^+$
(d) $[PBr_6]^-$

J & K CET-(2018)

Ans. (a) : $PBr_5 \rightleftharpoons [PBr_4]^+ [Br^-]$

1002. An organic compound A is oxidised with Na_2O_2 followed by boiling with HNO_3. The resultant solution is then treated with ammonium molybdate to yield a yellow precipitate.
Based on above observation, the element present in the given compound is

(a) nitrogen
(b) phosphorus
(c) fluorine
(d) sulphur

(JEE Main 2019, 12 April Shift-I)

Ans. (b) : Phosphorus is detected in the form of yellow ppt (precipitate) of ammonium phosphate molybdate on reaction with ammonium molybdate.
The solution is boiled with nitric acid and then treated with ammonium molybdate to produced conary yellow precipitate.

$Na_3+PO_4+3HNO_3 \rightarrow H_3PO_4 + 3Na\,NO_3$

$H_3PO_4+ 12\,(NH_4)_2\,MoO_4+ 21\,HNO_3 \rightarrow (NH_4)_3$

$\downarrow$ $PO_4.12MoO_3\downarrow+21NH_4NO_3+12H_2O$

(Ammonium
molybdate)

1003. Which of the following statements about liquid nitrogen is true?

(a) It is unreactive.
(b) it is used in cryosurgery.
(c) It does not decompose organic compounds.
(d) It is very stable.

J & K CET-(2010)

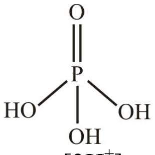
Ans. (b) : It is used in cryosurgery removal of cancer and skin lesions. It is used as a part of the medical gas mixture for lung function test.

1004. Which of the following is a tribasic acid?

(a) H_3PO_4
(b) $H_4P_2O_7$
(c) $H_4P_2O_7$
(d) $H_4P_2O_6$

J & K CET-(2005)

Ans. (a) : Basicity of an Acid– No. of replacable H^+ ion Orthophosphoric acid or phosphoric acid H_3PO_4 is tribasic acid.



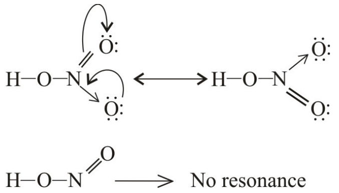
$[3H^+]$

1005. Which of the following statements is true?

(a) H_3PO_3 is a stronger acid than H_2SO_3
(b) In aqueous medium, HF is a stronger acid than HCl
(c) $HClO_4$ is weaker acid than $HClO_3$
(d) HNO_3 is a stronger acid than HNO_2

(AIEEE 2006)

Ans. (d) : Resonance stabilization is done in conjugate base of HNO_3 and not in HNO_2. Hence, HNO_3 is stronger acid than HNO_2



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1006. Which of the following pentafluorides can't be formed?

(a) PF_5 (b) AsF_5

(c) SbF_5 (d) BiF_5

J & K CET-(2003)

Ans. (d) : Bismuth due to inert pair effect exists with only +3 oxidation state. +5 oxidation state is uncommon for Bi. So, bismuth does not form pentahalide.

1007. Which of the following is metaphosphoric acid?

(a) $H_3P_3O_9$ (b) $H_5P_3O_{10}$

(c) $H_9P_2O_7$ (d) H_3PO_4

J & K CET-(2002)

Ans. (a) : $3HPO_3 \Rightarrow (HPO_3)_3 \Rightarrow$ Trimetaphosphoric acid $\Rightarrow H_3P_3O_9$

1008. Which of the following non-metal possesses the atomicity double than that of phosphorus?

(a) oxygen (b) sulphur

(c) nitrogen (d) arsenic

J & K CET-(2001)

Ans. (b) : Atomicity is defined as the total number of atoms present in a molecule.

Sulphur – S_8 – 8

$\therefore$ S > P > N = O

1009. Anomalous behavior of nitrogen is due to

(a) small size and high electronegativity

(b) non-availability of d-orbitals in the valency shell

(c) ease of multiple bond formation

(d) all of the above

J & K CET-(2000)

Ans. (d) : Nitrogen differs from other members of the group due to its smaller size, high electronegativity, high IE and non availability of d-orbitals. Nitrogen has unique ability to form $P\pi–P\pi$ multiple bonds with itself and with other elements having small size and high electronegativity. Generally, electronegativity decreases down the group with increase in atomic size.

1010. Which of the following oxides of nitrogen is the anhydride of nitrous acid?

(a) NO (b) N_2O_3

(c) N_2O_4 (d) N_2O_5

J & K CET-(1999)

Ans. (b) : Two oxides of nitrogen are acid anhydrides, that is, they react with water to form nitrogen-

$N_2O_3 \rightarrow 2HNO_2$

Containing oxyacids, Dinitrogen trioxide (N_2O_3) is the anhydride of nitrous acid, HNO_2, and dinitrogen pentoxide (N_2O_5) is the anhydride of nitric acid HNO_3.

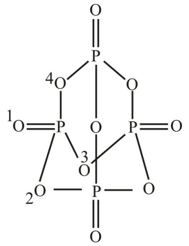
1011. In P_4O_{10} the number of oxygen atoms bonded to each phosphorus atom is

(a) 2.5 (b) 3

(c) 4 (d) 5

J & K CET-(1998)

Ans. (b) :



1012. Ammonia can be dried by

(a) conc. H_2SO_4 (b) P_2O_5

(c) anhydrous $CaCl_2$ (d) none of the above

J & K CET-(1998)

Ans. (d) : Both sulphuric acid and phosphorous pentoxide react with ammonia, since they are acidic. Anhydrous copper sulphate is not a drying agent.

1013. Oxidation state of phosphorus in pyrophosphoric acid is :

(a) +5 (b) +3

(c) +4 (d) +1

JCECE - 2006

Ans. (a) : Pyrophosphoric acid $H_4P_2O_7$

Let oxidation state of phosphorus is x

$[4 \times 1 + (-2) \times 7 + 2x] = 0$

$2x = 10$

$x = +5$

1014. Kjedahl's method can be used for estimation of nitrogen in

(a) $C_6H_5NO_2$ (b) pyridine

(c) $C_6H_5—N{=}N—C_6H_5$ (d) $C_6H_5NH_2$

JCECE - 2011

Ans. (d) : In nitro or azo compounds or cyclic compounds (in which nitrogen is a part of ring), nitrogen is not completely converted into $(NH_4)_2SO_4$ during digestion. Thus, Kjeldahl's method does not work on such compounds.

1015. Ammonia will not form complex with

(a) Ag^{2+} (b) Pb^{2+}

(c) Cu^{2+} (d) Cd^{2+}

JCECE - 2012

Ans. (b) : Generally d-block elements form complex and lead is a p-block element.

1016. The maximum covalency of nitrogen is

(a) 3 (b) 4

(c) 5 (d) 6

JCECE - 2013

Ans. (b) : Nitrogen does not possess d-orbitals in its valence shell (n = 2). It can have 8 electrons maximum. Therefore, nitrogen cannot extend its covalency beyond 4.

1017. The number of σ-bons in P_4O_{10} is

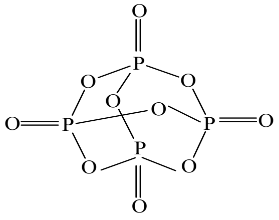
(a) 6 (b) 16

(c) 20 (d) 7

JCECE - 2014

@apna_pdf

Ans. (b) : The number of σ-bonds in P_4O_{10} is 16. There are also 4 π-bonds present in P_4O_{10} molecule.



P_4O_{10} molecule

1018. In Ostwald's process ……………. is used as catalyst.

(a) Ni (b) Pt

(c) Fe (d) V_2O_5

JCECE – 2018, BCECE-2005

Ans. (b) : In Ostwald's process, Pt (platinum) is used as catalyst. This process is used to manufacture nitric acid (HNO_3). Platinum is used to oxidise ammonia by heating with oxygen to form nitric oxide. This reaction is highly exothermic.

$$4NH_3(g) + 5O_2(g) \xrightarrow{Pt} 4NO(g) + 6H_2O(g)$$

1019. $4HNO_3 + P_4O_{10} \rightarrow 4HPO_3 + X$, X is

(a) N_2O_3 (b) N_2O_4

(c) N_2O (d) N_2O_5

JCECE - 2018

Ans. (d) : The X in the reaction is N_2O_5 complete equation is as follows:

$$4HNO_3 + P_4O_{10} \longrightarrow 4HPO_3 + 2N_2O_5$$

This reaction is used to prepare HPO_3, which is formed by the dehydration of HNO_3 with P_4O_{10}.

1020. Which of the following oxide is most acidic?

(a) As_2O_3 (b) P_2O_5

(c) Sb_2O_3 (d) Bi_2O_3

JIPMER-2017

Ans. (b) : More the positive oxidation state of a non – metallic oxide more is its acidic nature. It is very clear that P_2O_5 is the only compound with 5 oxygen atoms, P is going to be in the highest oxidation state.

1021. Which of the following fluorides does not exist?

(a) NF_5 (b) PF_5

(c) AgF_5 (d) SbF_5

JIPMER-2011

Ans. (a) : NF_5 does not exist because N does not form pentahalides due to the absence of d– orbital in its valence shell.

While P, As and sb form pentahalides of the general formula MX_5 (where, M = P, As and Sb) due to the presence of vacant d–orbitals in their respective valence shell.

1022. Yellow phosphorus is kept in

(a) water (b) kerosene

(c) ether (d) alcohol

JIPMER-2004

Ans. (a) : White phosphorus reacts very fast with atmospheric oxygen and catches fire yellow phosphorus was being used in the manufacture of Lucifer matches. So, phosphorus (white or yellow) is kept preserved in water.

1023. Which of the following acids is monobasic?

(a) H_3PO_3 (b) H_3PO_2

(c) H_2SO_3 (d) H_3PO_4

JIPMER-2004

Ans. (b) : The basicity depends on the number of the ionisable hydrogen atom H_3PO_3 contains 2 ionisable hydrogen atom. H_3PO_2(hypophosphorus acid) is a monobasic acid. It gives only one type of salt e.g.NaH_2PO_2

1024. In which of the following, oxidation state of phosphorous is + 3?

(a) Orthophosphoric acid

(b) Pyrophosphoric acid

(c) Orthophosphorous acid

(d) Meta phosphoric acid

JIPMER-2019

Ans. (c) : Orthophosphoric acid H_3PO_4

Pyrophosphoric acid $H_4P_2O_7$

Orthophosphorus acid H_3PO_3

Metaphosphoric acid HPO_3

Thus, Orthophosphoric acid has + 3 oxidation state.

1025. Which of the following pair behaves as strong and weak base hydride respectively NH_3, PH_3, AsH_3, SbH_3, BiH_3

(a) NH_3, PH_3 (b) NH_3, BiH_3

(c) PH_3, BiH_3 (d) BiH_3, AsH_3

JIPMER-2018

Ans. (b) : Strong base has an capability to remove a proton from a very weak acid.

Weak base does not fully dissociate in water.

Basic nature of hydride decreases

$NH_3 > PH_3 > AsH_3 > SbH_3 > BiH_3$

1026. Duma's method involves the determination of nitrogen content in the organs compound in the form of

(a) NH_3 (b) N_2

(c) NaCN (d) $(NH_4)_2SO_4$

JIPMER-2016

Ans. (b) : Dumas' method involves the determination of nitrogen content in the organic compound in form of N_2

$$N_2O + Cu \rightarrow N_2 + CuO$$

$$\%N = \frac{28}{22400} \times \frac{\text{Volume of } N_2 \text{ at N.T.P}}{\text{weight of Compound} \times 100}$$

1027. Phosphorus pentachloride

(a) On hydrolysis gives an oxo-acid of phosphorus which is tribasic

(b) On hydrolysis gives an oxo-acid of phosphorus which is a good reducing agent

(c) Has all the five equivalent bonds

(d) Exists as an ionic solid in which cation has octahedral structure and anion has tetrahedral structure

Karnataka-CET-2020

Ans. (a) : • PCl_5 has trigonal bipyramidal structure.

• $PCl_5 \rightarrow$ Solid exists as – $[PCl_4]^+$ and $[PCl_6^-]$

It has tetrahedral and octahedral structures

• On hydrolysis PCl_5 gives H_3PO_4 – Tribasic.

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$PCl_5 + H_2O \rightarrow POCl_3 + 2HCl$

$POCl_3 + 3H_2O \rightarrow H_3PO_4 + 3HCl$

(Phosphoric acid)

Tri basic

Hence, option (a) is true.

1028. In the reaction of gold with aquaregia, oxidation state of nitrogen changes from

(a) + 4 to +2
(b) + 6 to +4
(c) + 5 to +2
(d) + 3 to +1

Karnataka-CET-2019

Ans. (c) : In the reaction of gold with aquaregia, oxidation state of nitrogen changes from + 5 to +2.

$$\underbrace{Au + 4H^+ + \overset{+5}{N}O_3^- + 4Cl^-}_{aqua-regia} \rightarrow AuCl_4^- + \overset{+2}{N}O + 2H_2O$$

1029. When PbO_2 reacts with concentrated HNO_3, the gas evolved is

(a) NO_2
(b) O_2
(c) N_2
(d) N_2O

Karnataka-CET-2018

Ans. (b) : When PbO_2 (strong oxidizing agent) treated with conc. HNO_3. Lead dioxide accepts electrons from nitric acid and thus oxidizing it to form lead nitrate. In this reaction when PbO_2 reacts with conc. HNO_3, the oxygen gas evolved.

$2PbO_2 + 4\,HNO_3 \rightarrow 2Pb\,(NO_3)_2 + 2H_2O + O_2$

1030. Which of the following property is true for the given sequence?
$NH_3 > PH_3 > AsH_3 > SbH_3 > BiH_3$?

(a) Reducing property
(b) Thermal stability
(c) Bond angle
(d) Acidic character

Karnataka-CET-2021

Ans. (b) : Thermal stability of the hydrides of nitrogen family decreases down the group is -

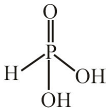
$NH_3 > PH_3 > AsH_3 > SbH_3 > BiH_3$

1031. Among the oxyacids of phosphorus, the dibasic

(a) $H_4P_2O_7$
(b) H_3PO_2
(c) HPO_3
(d) H_3PO_4
(e) H_3PO_3

Kerala-CEE-2010

Ans. (e) : H_3PO_3 shows a dibasic acid property and it contains two P-OH bonds.



1032. The least stable hydride of 15th group elements is

(a) NH_3
(b) PH_3
(c) AsH_3
(d) SbH_3
(e) BiH_3

Kerala-CEE-2011

Ans. (e) : As we move from NH_3 to BiH_3, size of the central atom increases and its tendency to form covalent bond with comparatively small H-atom decreases.

Hence, stability decreases down the group.

the decreasing order is -

$NH_3 > PH_3 > AsH_3 > BiH_3$

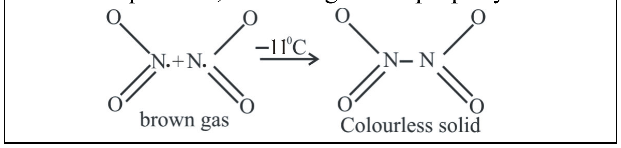
1033. Which one of the following oxides nitrogen dimerises into colourless is solid/liquid on cooling?

(a) N_2O
(b) NO
(c) N_2O_3
(d) NO_2
(e) N_2O_5

Kerala-CEE-2011

Ans. (d) : Nitrogen oxide is a colorless and non-flammable gas, also known as laughing gas.

At low temperature, it shows gaseous property.

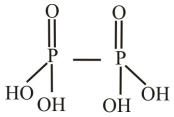


1034. Which one of the following has the maximum number of P—OH bonds?

(a) H_3PO_2
(b) H_3PO_4
(c) H_3PO_3
(d) $H_4P_2O_5$
(e) $H_4P_2O_6$

Kerala-CEE-2015

Ans. (e) : $H_4P_2O_6$ has four P – OH bonds



1035. Consider the following compounds:

(1) $(NH_4)_2Cr_2O_7$
(2) NH_4NO_2
(3) NH_4VO_3
(4) NH_4NO_3

Which compounds(s) yield nitrogen gas upon heating?

(a) 1 and 2
(b) 2 and 3
(c) 3 and 4
(d) 1 and 4
(e) All

Kerala-CEE-2018

Ans. (a) : When Ammonium dichromate heated, then it involves with the decomposition reaction and forms chromium oxide and nitrogen gas.

$$(i)\,(NH_4)_2\,Cr_2O_7 \overset{\Delta}{\rightarrow} Cr_2O_3 + 4H_2O + N_2\Delta\Delta$$

$$(ii)\,NH_4NO_2 \xrightarrow[\Delta]{\text{Thermal decomposition}} 2H_2O + N_2$$

Hence, option (a) is the correct answer.

1036. PCl_3 is stored in a well stoppered bottle since

(a) It decomposes in the presence of moisture
(b) It is decomposed by light
(c) It is highly volatile
(d) It reacts with air to form $POCl_3$
(e) (A) and (C)

Kerala-CEE-2019

Ans. (a) : The phosphorous acid is corrosive and volatile so it gets oxidized.

$PCl_3 + 3H_2O \rightarrow H_3PO_3 + 3HCl$

1037. Acetic acid in liquid ammonia behaves as

(a) Weaker acid than that in water
(b) Stronger acid than that in water
(c) Basic acid
(d) Neutral acid
(e) (C) and (D)

Kerala-CEE-2019

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Ans. (b) :

$$\underset{\text{weak acid}}{CH_3COOH} + \underset{\text{strong base}}{NH_3} \rightleftharpoons \underset{\text{acid}}{NH_3^{\oplus}} + \underset{\text{base}}{CH_3COO^-}$$

CH_3COOH act as an acid. NH_3 accept H^+ ion easily then H_2O So, NH_3 more strong acid.

1038. The compound(s) that does (do) not exist is (are)

(a) BiF_5 (b) PF_5

(c) AsF_5 (d) SbF_5

(e) All the compounds exist

Kerala-CEE-2019

Ans. (a) : Bismuth is a element of 15 group. BiF_5 does not exist because the size of the halogen atom 'F' is very small in comparison with Bi. So, $BiCl_5$ does not exist.

1039. The oxyacid of phosphorus that contains one P-OH, two P-H and one P=O bonds is

(a) Phosphinic acid

(b) Phosphoric acid

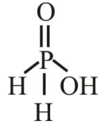
(c) Pyrophosphoric acid

(d) Hypophosphoric acid

(e) Pyrophosphorous acid

Kerala-CEE-2020

Ans. (a) : The formula of Phosphinic acid is H_3PO_2.
Phosphinic acid is a monoprotic acid



It has one P – OH, one P = 0 and two P – H bonds.

1040. Which of the following property is/are true for the given sequence $NH_3 > PH_3 > AsH_3 > SbH_3 > BiH_3$?

(a) Reducing property (b) Thermal stability

(c) Bond angle (d) Acidic character

Kerala-CEE-29.08.2021

Ans. (b&c) Thermal stability and bond angle decreases down the group due to increase in bond length.

1041. Which statement is false for white phosphorus (P_4) ?

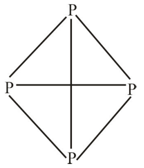
(a) It has six P–P single bonds

(b) It has four P–P single bonds

(c) It has four lone pair of electrons

(d) It has PPP angle 60º **Manipal-2020**

Ans. (b) :



• it has 6 – P – P bond
It has 4 lone pair electron
Bond angle = 60°

1042. In the reaction,

$P_2O_5 + 3CaO \rightarrow Ca_3(PO_4)_2$, P_2O_5 acts as :

(a) acidic flux (b) Basic flux

(c) basic impurity (d) acidic impurity

Manipal-2019

Ans. (a) : P_2O_5 is an acidic oxide, acting as an acidic flux.

1043. Which hydride among the following is strongest reducing agent?

(a) AsH_3 (b) BiH_3

(c) PH_3 (d) SbH_3

MHT CET-02.05.2019, SHIFT-III

Ans. (b) : BiH_3 is the strongest reducing agent among the given compound.
$PH_3 < AsH_3 < SbH_3 < BiH_3$

1044. Which of following is not a property of red phosphorus?

(a) Insoluble in carbon disulphide

(b) It does not show chemiluminescence by action of air

(c) It forms phosphine when treated with hot sodium hydroxide solution

(d) It is non-poisonous

MHT CET-02.05.2019, SHIFT-III

Ans. (c) : Red phosphorus has an iron-grey sheen to it. As with carbon disulphide, it has no odour, is non-poisonous, and is insoluble in water. It does not exhibit chemalumiscence due to air action. It has a melting point of 860 K. It is odorless and is solid at standard temperature and pressure.

1045. Which among the following group 15 elements does not exhibit allotropy?

(a) N (b) As

(c) Sb (d) Bi

MHT CET-02.05.2019, SHIFT-III

Ans. (d) : All the elements of group 15 except Bi shows allotropy. Bismuth alone does not exist with allotropy. Bismuth due to its inert pair effect does not exist with variable oxidation state.

1046. In which among the following compounds, oxidation number of nitrogen is +5?

(a) N_2O (b) N_2O_3

(c) NO_2 (d) HNO_3

MHT CET-03.05.2019, SHIFT-I

Ans. (d) : Oxidation number of nitrogen is + 5 in HNO_3.

$1 + x + 3(-2) = 0$

$x - 5 = 0$

$x = +5$

Where x is the oxidation number.

1047. Oxidation state of nitrogen in nitric oxide is

(a) +2 (b) +3

(c) +4 (d) –2

MHT CET-03.05.2019, SHIFT-I

Ans. (a) : Oxidation number of an atoms is defined as the charge that an atom appears to have on forming ionic bonds with other heteroatoms. An atom having higher electronegativity is given a negative oxidation state.
Oxidation state of nitrogen in nitric oxide (NO) is + 2.
Molecular formula of nitric oxide = NO

$x - 2 = 0$

$x = +2$

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1048. The element which does not belong to group 15 is

(a) As (b) P

(c) Bi (d) Se

MHT CET-03.05.2019, SHIFT-I

Ans. (d) : Element Se belong to group 16 and 4th period with atomic number = 34

Electronic configuration of Se is $4s^2$, $4p^4$.

1049. In which oxidation state, group 15 elements act as Lewis base?

(a) +5 (b) +4

(c) –3 (d) +3

MHT CET-02.05.2019, SHIFT-II

Ans. (c) : The number of electrons in the outermost shell of the group 15 members is 5. In order to make it an octet configuration, it requires 3 more electrons.

Therefore, the more common oxidation for these elements is the –3 oxidation which means adding 3 more electrons.

1050. Which of the following is also called as nitrogen sesquioxide ?

(a) NO_2 (b) N_2O_3

(c) N_2O_4 (d) N_2O_5

MHT CET-02.05.2019, SHIFT-II & III

Ans. (b) : Nitrogen sesquloxide is an oxide containing three atoms of oxygen with two atoms of nitrogen element. It's chemical formula is N_2O_3

$N_2\ O_3$ is formed when the nitrogen dioxide reacts with the nitric oxide and it is a bluish colour liquid having unpleasant odour and has tendency to get dissociated back into the nitrogen dioxide and nitric oxide and it has very low boiling point.

Thus, the oxide of nitrogen which is called as nitrogen sesquioxide is N_2O_3 i.e. dinitrogen trioxide.

1051. Which among the group-15 elements does not exists as tetra atomic molecule?

(a) Nitrogen (b) Phosphorus

(c) Arsenic (d) Antimony

MHT CET-2018

Ans. (a) : Nitrogen due to smaller size, high ionization energy high electronegativity and the absence of d–orbital does not exist as a tetra atomic molecule. It exist in diatomic molecule.

1052. In which substance does nitrogen exhibit the lowest oxidation state?

(a) Nitrogen gas (b) Ammonia

(c) Nitrogen gas (d) Nitric oxide

MHT CET-2018

Ans. (b) : Oxidation state of nitrogen gas (N_2) is zero as both the nitrogen atom possess same electro negativity as well as same number of electrons. The oxidation states of ammonia.

Nitrous oxide and nitric oxide are given below-

Ammonia (NH_3)

$x = 3(1) = 0$

$x = -3$

Nitrous oxide (N_2O)

$2(x) + 1(-2) = 0$

$2x = 2$

$x = +1$

Nitric oxide (NO)

$x + (-2) = 0$

$x = +2$

Thus, nitrogen exhibits lowest oxidation state.

1053. Which among the following oxoacids of phosphorus shows a tendency of disproportionation ?

(a) Phosphinic acid (H_3PO_2)

(b) Orthophosphoric acid (H_3PO_4)

(c) Phosphonic acid (H_3PO_3)

(d) Pyrophosphoric acid ($H_4P_2O_7$)

MHT CET-2018

Ans. (c) : Phosphoric acid (H_3PO_3), Oxoacid of phosphorus shows a tendency of disproportionation. On heating H_3PO_3 disproportionates to give orthophosphoric acid and phosphine gas.

$$4H_3PO_3 \xrightarrow{\Delta} 3H_3PO_4 + PH_3$$

1054. Identify the compound, in which phosphorus exists in the oxidation state of +1.

(a) Phosphonic acid (H_3PO_3)

(b) Phosphinic acid (H_3PO_2)

(c) Pyrophosphorus acid ($H_4P_2O_5$)

(d) Orthophosphoric acid (H_3PO_4)

MHT CET-2017

Ans. (b) : Phosphinic acid (H_3PO_2) is the compound in which phosphorus exists in the oxidation state of + 1.

The oxidation state of P atom in phosphinic acid H_3PO_2 is

$3 + x - 4 = 0$

$x = +1$

1055. Which among the following group 15 element forms most stable pentavalent compount?

(a) Phosphorus (b) Antimony

(c) Bismuth (d) Arsenic

MHT CET-2015

Ans. (a) : In group 15 element, phosphorus having property to form most stable compound like PCl_5, $P_2O_{5.]}$ Because available of d-electrons also on moving down the group, the stability of the +5 oxidation state decreases.

Thus, phosphorus form the most stable pentavalent compounds.

1056. Oxidation number of nitrogen in which among the oxides of nitrogen is the lowest?

(a) Nitric oxide (b) Nitrous oxide

(c) Nitrogen dioxide (d) Nitrogen trioxide

MHT CET-2014

Ans. (b) : (a) Nitric oxide, NO $x - 2 = 0$

$\Rightarrow x = +2$

(b) Nitrous oxide, N_2O_2 $x - 2 = 0$

$\Rightarrow x = +1$

(c) Nitrogen dioxide, NO_2

$x + 2(-2) = 0 \Rightarrow x = +4$

(d) Nitrogen trioxide NO_3

$x + 2x(-3) = 0$

$\Rightarrow x = +6$

Thus , in nitrous oxide, oxidation number of nitrogen is lowest.

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1057. Haber process is used for the production of which of the following?

(a) NH_3 (b) HNO_3

(c) H_2SO_4 (d) O_3

MHT CET-2012

Ans. (a) : Haber process is used for the production of ammonia (NH_3) gas.

$N_2\ (g) + 3H_2\ (g) \rightleftharpoons 2NH_3(g)$

1058. The laughing gas is

(a) N_2O_4 (b) NO

(c) N_2O (d) N_2O_5

[BITSAT-2016], MHT CET-2012

Ans. (c) : Nitrous oxide is knows as laughing gas

Nitrous oxide is used in medical and dental procedures as a sedative. The oxidation number of nitrogen in laughing gas is +1

It is colorless and non-flammable gas and has a slightly scent and taste.

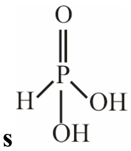
1059. Which of the following phosphorus oxyacids can act as a reducing agent?

(a) H_3PO_3 (b) H_3PO_4

(c) $H_2P_2O_6$ (d) $H_4P_2O_7$

MHT CET-2011

Ans. (a) : The P–H bond accounts for its reducing behavior while two –OH groups accounts for its basicity.



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1060. Nitrogen dioxide and sulphur dioxide have some properties in common. Which property is shown by one of these compounds, but not by the other?

(a) Is soluble in water

(b) Is used as a food preservative

(c) Forms 'Acid-rain'

(d) Is a reducing agent

(NEET-2015, Cancelled)

Ans. (b) : Nitrogen and sulphar both atoms in their oxides have high oxidation states. So, it cannot get further oxidized to higher oxidation states. Acid rain occurs when some gases in the atmosphere react with moisture to form inorganic acids.

1061. Which of the following phosphorus is the most reactive?

(a) Scarlet phosphorus (b) White phosphorus

(c) Red phosphorus (d) Violet phosphorus

(NEET-1999)

Ans. (b) : White phosphorus is insoluble in water and soluble in carbon sulphide and the most reactive, most toxic. It has galic smell and it is most reactive.

1062. Each of the following is true for white and red phosphorus except that they

(a) are both soluble in CS_2

(b) can be oxidized by heating in air

(c) consist of the same kind of atoms

(d) can be converted into one another

(NEET-1989)

Ans. (a) : White and red phosphorus, one the main allotropes of phosphorus. White phosphorus is soluble in carbon disulphide whereas red phosphorus is insoluble in carbon disulphide.

1063. A compound 'X' upon reaction with H_2O produces a colourless gas 'Y' with rotten fish smell Gas 'Y' is absorbed in a solution of $CuSO_4$ to give Cu_3P_2 as one of the products. Predict the compound 'X'.

(a) Ca_3P_2 (b) NH_4Cl

(c) As_2O_3 (d) $Ca(PO_4)$

(Odisha NEET 2019)

Ans. (a) : $\underset{(X)}{Ca_3P_2} + 6H_2O \rightarrow 3Ca(OH)_2 + \underset{\substack{(Y)\\(\text{Rotten fish smell})}}{2PH_3}$

$3CuSO_4 + \underset{(Y)}{2PH_3} \rightarrow \underset{\substack{(\text{Copper}\\\text{Phosphide})}}{Cu_3P_2} + 3H_2SO_4$

Hence, X is Ca_3P_2 (calcium phosphide)

1064. PH_4I + NaOH forms

(a) PH_3 (b) NH_3

(c) P_4O_6 (d) P_4O_{10}

(NEET-1991)

Ans. (a) : When PH_4I and Na OH react, Phosphine gas is obtained

$PH_4I + NaOH \rightarrow PH_3 + NaI + H_2O$

1065. Identify the incorrect statement related to PCl_5 from the following :

(a) PCl_5 molecule is non-reactive

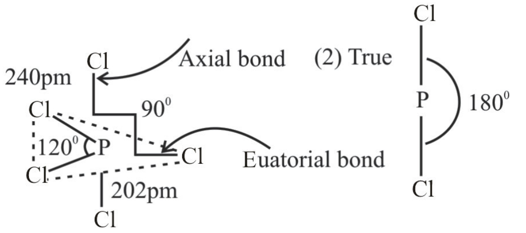
(b) Three equatorial P – Cl bonds make an angle of 120º with each other.

(c) Two axial P – Cl bonds make an angle of 180º with each other

(d) Axial P – Cl bonds are longer than equatorial P – Cl bonds

(NEET 2019)

Ans. (a) : Due to longer and hence weaker axial bonds, PCl_5 is a reactive molecule.



1066. PCl_3 reacts with water to form

(a) PH_3 (b) $H_3\ PO_3$, CHl

(c) $POCl_3$ (d) H_3PO_4

(NEET-1991)

Ans. (b) : PCl_3 reacts with water to form phosphorous acid and hydrochloric acid.

$POCl_3 + 3H_2O \rightarrow H_3PO_3 + 3HCl$

1067. Which of the following oxoacids of phosphorus has strongest reducing property?

(a) $H_4P_2O_7$ (b) H_3PO_3

(c) H_3PO_2 (d) H_3PO_4

(Odisha NEET 2019)

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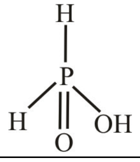
Ans. (c) : Reducing property ∝ no. of P – H bond H_3PO_2 contains maximum P – H bond H_3PO_3 contains one P – H bond and hence, act as reducing agent whereas, rest do not have P – H bond.

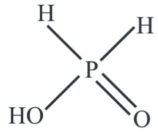


1068. Which is the correct statement for the given acids?

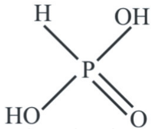
(a) Phosphinic acid is a monoprotic acid while Phosphonic acid is a diprotic acid
(b) Phosphinic acid is a diprotic acid while Phosphonic acid is a monoprotic acid
(c) Both are diprotic acids
(d) Both are triprotic acids

(NEET-I 2012)

Ans. (a) : Phosphinic acid contain one P–OH bond that means one replaceable H ion. So, it is monoprotic acid. Phosphonic acid contain two P–OH bonds that means two replaceable H ion. So, it is diprotic acid



Phosphinic acid
is monoprotic as it
contain one– OH group



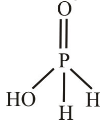
Phosphonic acid
is diprotic as it contains
two – OH group

1069. Strong reducing behaviour of H_3 PO_2 is due to

(a) high electron gain enthalpy of phosphorus
(b) high oxidation state of phosphorus
(c) presence of two-OH groups and one P–H bond
(d) presence of one–OH group and two P–H bonds

(NEET-2015)

Ans. (d) : Strong reducing behavior of H_3PO_2 is due to presence of one – OH group and two P–H bonds.
Hence, it acts as a strong reducing agent.

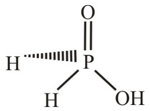


1070. Which of the following statements is not valid for oxoacids of phosphorus?

(a) Orthophosphoric acid is used in the manufacture of triple superphosphate
(b) Hypophosphorous acid is a diprotic acid
(c) All oxoacids contain tetrahedral four coordinated phosphorus
(d) All oxoacids contain alteast one P = O unit and one P – OH group

(NEET-2012)

Ans. (b) : Hypophosphorus acid is a monoprotic acid, as it contains only one P– OH group.



1071. Oxidation state of P in $H_4P_2O_5$, $H_4P_2O_4$, $H_4P_2O_7$ are respectively

(a) +3, +5, +4
(b) +5, +3, +4
(c) +5, +4, +3
(d) +3, +4, +5

(NEET-2010)

Ans. (d) : The oxidation number of P in

$$H_4P_2O_5$$
$$4+2x-10=0$$
$$2x=6$$
$$x=+3$$

The oxidation number of P in

$$H_4P_2O_6$$
$$4+2x-12=0$$
$$2x=8$$
$$x=+4$$

The oxidation number of P in

$$H_4P_2O_7$$
$$4+2x-14=0$$
$$2x=10$$
$$x=+5$$

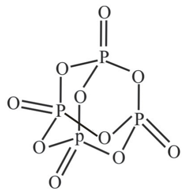
Where x is the oxidation states

1072. How many bridging oxygen atoms are present in P_4O_{10}?

(a) 6
(b) 4
(c) 2
(d) 5

(NEET-Mains 2010)

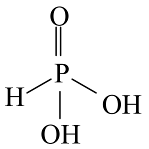
Ans. (a) : 6 bridging oxygen atoms are present in P_4O_{10}.



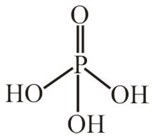
In P_4O_{10} there are 4 phosphorus atoms and 10 oxygen atom. There are P-O-P bond present and each are sp^3 hybridised.
There are six bridging oxygen combine to form tetrahedron.

1073. The structural formula of hypophosphrous acid is

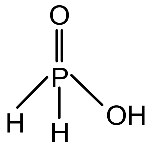
(a)



(b)



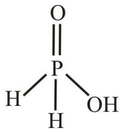
(c)



(d) none of these

(NEET-1997)

Ans. (c) : Hypophosphorous acid (H_3PO_2) is monobasic acid, so, its structure is



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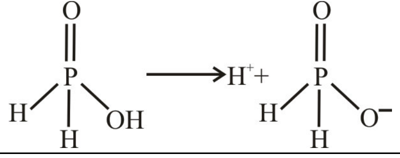
1074. H_3PO_2 is the molecular formula of an acid of phosphorus. Its name and basicity respectively are

(a) phosphorous acid and two
(b) hypophosphorous acid and two
(c) hypophosphorous acid and one
(d) hypophosphoric acid and two

(NEET-1992)

Ans. (c) : The name of H_3PO_2 is hypophosphorous acid when dissolve in water as it contains only one P–OH bond, it give one H ion. So, its basicity is one.



1075. Which one of the following substance is used in the laboratory for fast drying of neutral gases?

(a) Phosphorus pentoxide
(b) Active charcoal
(c) Anhydrous calcium chloride
(d) Na_3PO_4

(NEET-1992)

Ans.(c): Anhydrous $CaCl_2$ is used in the laboratory for fast drying of neutral gases. Phosphorus pentoxide absorbs moisture much readily than anhydrous $CaCl_2$ Active charcoal removes colour impurities.

1076. P_2O_5 is heated with water to give

(a) hypophosphorous acid
(b) phosphorous pentoxide
(c) Active charcoal
(d) Orthophosphoric acid

(NEET-1991)

Ans. (d) : When P_2O_5 or (P_4O_{10}) is heated with water, it form orthophosphoric acid (H_3PO_4)

$P_4O_{10} + 6H_2O \rightarrow 4H_3PO_4$

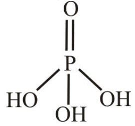
1077. Basicity of orthophsphoric acid is

(a) 2
(b) 3
(c) 4
(d) 5

(NEET-1991)

Ans. (b) : Basicity is the number of acidic hydrogen atoms in the molecule. For hydrogen to be acidic, it must be attached to a strongly electronegative atom.

For orthophosphoric (H_3PO_4)



It is clear from the structure that it contains three replaceable hydrogen atoms.

1078. When orthophosphoric acid is heated to 600 ºC, the product formed is

(a) PH_3
(b) P_2O_5
(c) H_3PO_3
(d) HPO_3

(NEET-1989)

Ans. (d) : When orthophosphoric acid (H_3PO_4) is heated 600ºC, then dehydration takes place and the product formed is metaphosphoric acid (HPO_3)

$$H_3PO_4 \xrightarrow{\Delta} HPO_3 + H_2O$$

1079. In which of the following compounds, nitrogen exhibits highest oxidation state?

(a) N_2H_4
(b) NH_3
(c) N_3H
(d) NH_2OH

(NEET-2012)

Ans. (c) : Oxidation number of nitrogen in N_3H = $-\frac{1}{3}$

$NH_2OH = -1$

$N_2H_4 = -2$

$NH_3 = -3$

1080. Nitrogen forms N_2, but phosphorus does not form P_2, however, it converts P_4, reason is

(a) triple bond present between phosphorus atom
(b) pπ–pπ bonding is weak
(c) pπ–pπ bonding is strong
(d) multiple bonds form easily

(NEET-2001)

Ans. (b) : It case of phosphorous (P) pπ – pπ bonding is weak because of its large atomic size. So, in P_4 each P atom is linked with 3 other P atoms by 3 sigma bonds.

Phosphorous form P_4 because in P_2 pπ – pπ bond is weaker.

1081. Which of the following oxides is most acidic?

(a) As_2O_5
(b) P_2O_5
(c) N_2O_5
(d) Sb_2O_5

(NEET-1999)

Ans. (c) : Covalent oxide – Acidic
Ionic oxide – Basic
Group –15 – N ↓
P
As
Sb

Fajan's Rule:– Smaller the size of cation, bigger the size of anion more the covalent character

Cation	anion
N_2	O_5
P_2	O_5
As_2	O_5
Sb_2	O_5

N_2O_5 is most acidic.

1082. Which of the following has the highest dipole moment?

(a) SbH_3
(b) AsH_3
(c) NH_3
(d) PH_3

(NEET-1997)

Ans. (c) : In the given molecules nitrogen has greater electro negativity. So, it has greater dipole moment and correct order of dipole moment is

$NH_3 > PH_3 > AsH_3 > SbH_3$

1083. The basic character of hydrides of the V group elements decreases in the order

(a) $NH_3 > PH_3 > AsH_3 > SbH_3$
(b) $SbH_3 > AsH_3 > PH_3 > NH_3$
(c) $SbH_3 > PH_3 > AsH_3 > NH_3$
(d) $NH_3 > SbH_3 > PH_3 > AsH_3$

(NEET-1996)

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Ans. (a) : Basic character of hydrides of group 15 elements decreases down the group. The basic character is in the order.
$NH_3 > PH_3 > AsH_3 > SbH_3$

1084. Among the following oxides, the lowest acidic is
(a) As_4O_6 (b) As_4O_{10}
(c) P_4O_6 (d) P_4O_{10}
(NEET-1996)

Ans. (a) : As the oxidation state of central atom increases
The acidic character increase so the correct order of acidic character is –
$$\overset{+5}{P_4O_{10}} > \overset{+3}{P_4O_6} > \overset{+5}{As_4O_{10}} > \overset{+3}{As_4O_6}$$

1085. Which of the following fluorides does not exist?
(a) NF_5 (b) PF_5
(c) AsF_5 (d) SbF_5
(NEET-1993)

Ans. (a) : Due to unavailability of vacant d-orbital, nitrogen does not form pentafluoride. P, As and Sb from pentafluorides due to the presence of vacant d-orbitals.

1086. Which one has the lowest boiling point?
(a) NH_3 (b) PH_3
(c) AsH_3 (d) SbH_3
(NEET-1989)

Ans. (b) : In the hydrides of group number five the boiling points changes as
$$\underset{238.5k}{NH_3} < \underset{185.5k}{PH_3} < \underset{254.6k}{AsH_3} < \underset{254.6k}{SbH_3}$$
Generally mass increases then boiling point increases. The higher boiling point of NH_3 is due to excessive hydrogen bonding. So, PH_3 have lowest point among hydrides of group number i.e. nitrogen family.

1087. Number of electrons shared in the formation of nitrogen molecule is
(a) 6 (b) 10
(c) 2 (d) 8
(NEET-1992)

Ans. (a) : Six electrons are shared in the formation of nitrogen molecule. Nitrogen molecule is diatomic containing a triple bond between two N atoms.

1088. Nitrogen is relatively inactive element because
(a) its atom has a stable electronic configuration
(b) it has low atomic radius
(c) its electronegativity is fairly high
(d) dissociation energy of its molecule is fairly high
(NEET-1992)

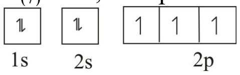
Ans. (d) : N_2 molecule contains triple bond between N atoms having very high dissociation energy (946 kJ mol^{-1}) due to which it is relatively inactive.

1089. Pure nitrogen is prepared in the laboratory by heating a mixture of
(a) $NH_4OH + NaCl$ (b) $NH_4NO_3 + NaCl$
(c) $NH_4Cl + NaOH$ (d) $NH_4Cl + NaNO_2$
(NEET-1991)

Ans. (d) : Pure nitrogen is prepared in the laboratory by heating a mixture of ammonium chloride and sodium nitrite.
$$\underset{\text{ammonium chloride}}{NH_4Cl(aq)} + \underset{\text{Sodium nitrite}}{NaNO_2(aq)} \xrightarrow{\text{Heat}} N_2(g) + 2H_2O(l) + NaCl$$

1090. Which of the following statement is not correct for nitrogen?
(a) Its electronegativity is very high
(b) d-orbitals are available for bonding
(c) It is a typical non-metal
(d) Its molecular size is small
(NEET-1990)

Ans. (b) : Nitrogen does not have vacant d-orbital in its outermost shell.
$N_{(7)} = 1s^2, 2s^2 2p^3$



1091. Urea reacts with water to form A which will decompose to form B. B when passed through $Cu^{2+}(aq)$ deep blue colour solution C is formed. What is the formula of C from the following?
(a) $CuSO_4$ (b) $[Cu(NH_3)_4]^{2+}$
(c) $Cu(OH)_2$ (d) $CuCO_3.Cu(OH)_2$
(NEET 2020)

Ans.(b) :
$$NH_2CONH_2 + H_2O \rightarrow \underset{(A)}{(NH_4)_2CO_3} \rightleftharpoons \underset{(B)}{2NH_3} + H_2O + CO_2$$
$$4NH_3 + Cu(aq) \rightarrow \underset{\substack{\text{(deep blue)} \\ \text{(C)}}}{\left[Cu(NH_3)_4\right]^{2+}}(aq)$$

1092. Aqueous solution of ammonia consists of
(a) H^+ (b) OH^-
(c) NH_4^+ (d) NH_4^+ and OH^-
(NEET-1991)

Ans. (d) : When ammonia dissolve in water, it form ammonium hydroxide.
$$H_2O + NH_3 \rightleftharpoons NH_4^+ + OH^-$$

1093. Which of the following oxides of nitrogen is paramagnetic?
(a) NO_2 (b) N_2O_3
(c) N_2O (d) N_2O_5
(NEET-1994)

Ans. (a) : In NO_2 there are free electron. So, it is paramagnetic in nature. It is an odd electron system containing 23 electrons.

1094. Which of the following is a nitric acid anhydride?
(a) NO (b) NO_2
(c) N_2O_5 (d) N_2O_5
(NEET-1988)

Ans. (c) : Dinitrogen pentoxide (N_2O_5) is a nitric acid anhydride. Acid anhydrides are the molecules that are capable of forming acidic solution in water.
Hydration of dinitrogen pentoxide –
$$N_2O_5 + H_2O \rightarrow \underset{\text{nitric acid}}{2HNO_3}$$

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1095. When copper is heated with conc. HNO_3 if produces

(a) $Cu(NO_3)_2$, NO and N_2O
(b) $Cu(NO_3)_2$, and N_2O
(c) $Cu(NO_3)_2$, NO and NO_2
(d) $Cu(NO_3)_2$, NO

(NEET-I 2016)

Ans. (c) : When copper is heated with conc. HNO_3 produces cupric nitrate $Cu(NO_3)_2$ and nitrogen dioxide NO_2.

$Cu+4HNO_3 \rightarrow Cu(NO_3)_2+2NO_2+2H_2O$

1096. The electronic configuration of an element is $1s^2$ $2s^2$ $2p^6$ $3s^2$ $3p^3$. What is the atomic number of the element, which is just below the above element in the periodic table?

(a) 36 (b) 49
(c) 33 (d) 34

NEET-1995

Ans. (c) : The element which present just below this element will have outermost electronic configuration is $1s^2$, $2s^2$ $2p^6$, $3s^2$ $3p^6$, $4s^2$, $3d^{10}$, $4p^3$, and hence , its atomic number is 33.

1097. If the atomic number of an element is 33, it will be placed in the periodic table in the

(a) first group (b) third group
(c) fifteenth group (d) seventh group

NEET-1993

Ans. (c) : Electronic configuration of element

Z (33) = $1s^2$, $2s^2$, $2p^6$, $3s^2$, $3p^6$, $3d^{10}$, $4s^2$, $4p^3$

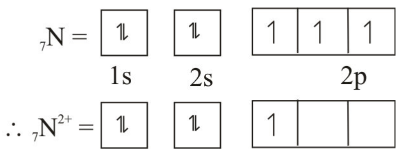
The element has its valence electrons in p orbitals. So, it is p-block elements. It's p-orbital also contains 3 electrons like nitrogen due to this it is placed in fifteenth group

1098. Number of unpaired electrons in N^{2+} is/are

(a) 2 (b) 0
(c) 1 (d) 3

NEET-1989

Ans. (c) : The electronic configuration of N^{2+}



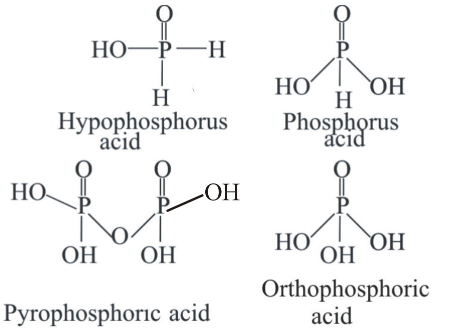
Hence, the number of unpaired electron in N^{2+} is 1.

1099. Which of the following acids contains P – O – P bond?

(a) Hypophosphorous acid
(b) Phosphorous acid
(c) Pyrophosphoric acid
(d) Orthophosphoric acid

Tripura JEE-2022

Ans. (c): The structures of the given acids are –



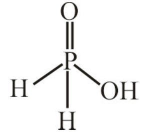
Thus, P–O–P bond is present in pyrophophoric acid.

1100. Find the basicity of the following acids: Hypophosphorous acid, metaphosphoric acid, phosphorous acid, orthophosphoric acid, pyrophosphoric acid.

(a) 1,1,2,3,3 (b) 1,2,2,3,4
(c) 1,1,2,3,4 (d) 1,2,3,3,2

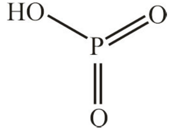
Tripura JEE-2021

Ans. (c) : Hypophosphorous acid



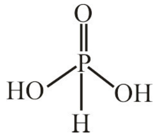
Basicity of acid =1

Metaphosphoric acid



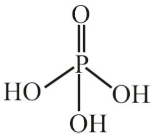
Basicity of acid =1

Phosphorous acid



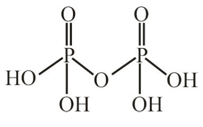
Basicity of acid =2

Orthophosphoric acid



Basicity of acid = 3

Pyrophosphoric acid



Basicity of acid = 4

So, the correct order is – 1,1,2,3,4

1101. A hydride of nitrogen which is acidic is

(a) NH_3 (b) N_3H
(c) N_2H_2 (d) N_2H_4

UP CPMT-2011

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Ans. (b) : N_3H is a hydride of nitrogen which is acidic as it can easily release H^+ ion.

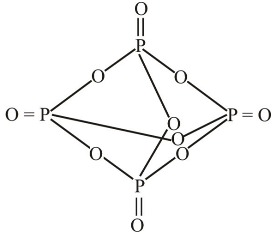
1102. The number of P – O bonds in P_4O_{10} is

(a) 16 (b) 12

(c) 8 (d) 4

UP CPMT-2010

Ans. (a): The structure of P_4O_{10} is



Number of P – O single bonds = 12

Number of P = O bonds = 4

Total number of P – O bonds = 16.

1103. Which of the following is not correct?

(a) Hydrolysis of NCl_3 gives NH_3 and HOCl

(b) NH_3 is less stable than PH_3

(c) NH_3 is a weak reducing reagent compared to PH_3

(d) Nitric oxide in solid state exhibits diamagnetic property

UP CPMT-2008

Ans. (b): Among V A group hydrides, the stability decreases in going down the group i.e, $NH_3 > PH_3 > AsH_3 > SbH_3 > BiH_3$

It is due to the increasing bond length down the group.

1104. On hydrolysis PCl_3 gives

(a) H_3PO_3 (b) PH_3

(c) H_3PO_4 (d) $POCl_3$

UP CPMT-2007

Ans. (a) : Hydrolysis of **PCl_3**: On hydrolysis of PCl_3, it gives phosphorous acid and HCl.

$$PCl_3+3H_2O \rightarrow H_3PO_3+3HCl$$

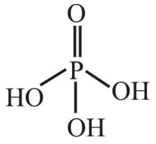
1105. Which is tribasic acid?

(a) H_3PO_2 (b) H_3PO_4

(c) $H_4P_2O_7$ (d) H_3PO_3

UP CPMT-2007

Ans. (b) : H_3PO_4 is tribasic acid



It is ionizes in three steps because three -OH group are present.

1106. Which of the following oxide of nitrogen is most thermally stable?

(a) N_2O_5 (b) N_2O

(c) NO (d) N_2O_3

UP CPMT-2006

Ans. (c) : Nitric oxide (NO) is decomposed at 900°C. So, it is the most thermally stable oxide of nitrogen.

$$2NO \xrightarrow{900^\circ C} N_2 + O_2$$

1107. Which of the following gas is used in artificial respiration ?

(a) O_2 (b) CO_2

(c) Helium (d) All of these

UP CPMT-2006

Ans. (d) : Oxygen mixed with CO_2 or helium is used for artificial respiration ($O_2 + CO_2$) or (O_2 + He).

Helium is used as it is less soluble in blood.

1108. PCl_5 is possible but NCl_5 does not exist

(a) in N, d–sub-shell is absent

(b) ionization energy of N is very high

(c) it does not like Cl

(d) None of the above

UP CPMT-2006

Ans. (a) : Nitrogen cannot form pentahalides because it cannot expand its octet due to non-availability of d-orbitals.

1109. Which phosphorus reacts with KOH solution to produce phosphene gas?

(a) Whit ephosphorus (b) Red Phosphorus

(c) Both (a) and (b) (d) None of the above

UP CPMT-2003

Ans. (a) : White phosphorus is most reactive form of phosphorus. Its molecular formula is P_4. Out of three forms of phosphorus–white, red and black, only white phosphorus react with aqueous alkali to form phosphine (PH_3).

$$\underset{\text{White phosphorus}}{P_4} + 3KOH + 3H_2O \longrightarrow \underset{\text{Potassium hypophosphite}}{3KH_2PO_2} + \underset{\text{Phosphine}}{PH_3}$$

1110. PCl_3 and cold water reacts to produce which of the following?

(a) H_3PO_3 (b) H_3PO_2

(c) $H_4P_2O_7$ (d) H_3PO_4

UP CPMT-2003

Ans. (a) : $$PCl_3 + 3H_2O \longrightarrow \underset{\substack{\text{phosphorus}\\\text{acid}\\\text{or}\\\text{ortho phosphorus}\\\text{acid}}}{H_3PO_3} + 3HCl$$

∴ PCl_3 gives ortho phosphorus acid on reaction with H_2O.

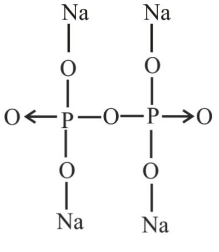
1111. Sodium pyrophosphate is represented by which of the following formula?

(a) $Na_2P_2O_4$ (b) $Na_2P_2O_5$

(c) $Na_4P_2O_7$ (d) $Na_2P_2O_5$

UP CPMT-2003

Ans. (c) : Sodium pyrophosphate is chemically $Na_4P_2O_7$ It is sodium salt of pyrophospheric acid ($H_4P_2O_7$).



Sodium pyrophosphate

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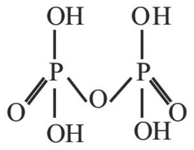
1112. In pyrophosphoric acid, the number of hydroxyl groups are

(a) 2 (b) 3

(c) 4 (d) 5

UP CPMT-2001

Ans. (c) :



$H_4P_2O_7$
Pyrophosphoric acid

∴ Pyrophosphoric acid has 4, –OH groups.

1113. NH_3 gas is dried over:

(a) CaO (b) HNO_3

(c) P_2O_5 (d) $CuSO_4$

UPTU/UPSEE-2005

Ans. (a) : Base + Acid → Salt +H_2O

NH_3 gas dried over CaO, because both are basic in nature and they do not react each other.

Note - CaO is used as a reactant and drying agent in the production of ammonia.

1114. Which of the following is the correct decreasing order of oxidation state of nitrogen?

(a) $HNO_3 > NO > NH_4Cl > N_2$

(b) $HNO_3 > NO > N_2 > NH_4Cl$

(c) $HNO_3 > NH_4Cl > NO > N_2$

(d) $NO > HNO_3 > NH_4Cl > N_2$

UPTU/UPSEE-2015

Ans. (b) : $HNO_3 \Rightarrow +1+x+3(-2)=0$

$\Rightarrow 1+x-6=0$

$\Rightarrow x=+5$

$NH_4Cl \Rightarrow x+4(+1)+(-1)=0$

$\Rightarrow x+4-1=0$

$\Rightarrow x=-3$

$NO \Rightarrow x+(-2)=0$

$\Rightarrow x=+2$

$N_2 \Rightarrow x=0$

$HNO_3 > NO > N_2 > NH_4Cl$

1115.

Iodide	**PI_3**	**AsI_3**	**SbI_3**
Bond angle	**102^o**	**$100^o2'$**	**99^o**

The bond angle is maximum in PI_3, which is

(a) due to small size of P

(b) due to more bp–bp repulsion in PI_3

(c) due to less electronegativity of P

(d) None of the above

UPTU/UPSEE-2014

Ans. (b) : Among P, As and Sb, P is the most electronegative element due to this there is more bp – bp repulsion.

1116. In the following Haber synthesis of NH_3, the equilibrium constant for NH_3 formation, on increase in temperature, is

$N_2(g)+3H_2(g) \rightleftharpoons 2NH_3(g)$+ heat energy

(a) decreased

(b) increased

(c) first decreased and then increased

(d) not altered

UPTU/UPSEE-2011

Ans. (a) : $N_2(g)+3H_2(g) \rightleftharpoons 2NH_3(g)$+ heat energy.

The given reaction is exothermic and equilibrium constant for an exothermic reaction decreases with rise in temperature.

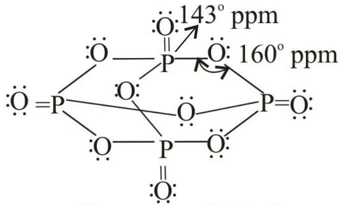
1117. Which one of the following represents the correct number of types of P–O bonds in P_4O_{10}?

(a) 1 (b) 2

(c) 3 (d) 4

UPTU/UPSEE-2011

Ans. (b) : In P_4O_{10} there of two type of bonding one is P – O and second is P = O.



[Structure of P_4O_{10}]

1118. The conjugated base of hydrazoic acid is

(a) HN_3^- (b) N_2^-

(c) N_3^- (d) N^{-3}

UPTU/UPSEE-2010

Ans. (c) : N_3H is also known as hydrazoic acid. It will release are H^+ and forms the conjugate base N_3^- the reaction is

$$\underset{\text{Acid}}{HN_3} \rightarrow H^+ + \underset{\text{Conjugate base}}{N_3^-}$$

The conjugate base of hydrazoic acid is N_3^- .

1119. Which is the strongest Lewis base?

(a) SbH_3 (b) AsH_3

(c) PH_3 (d) NH_3

UPTU/UPSEE-2010

Ans. (d) : NH_3 is the strongest Lewis base due to smallest size and high charge density on nitrogen atom. It can give up its lone pair of electron most easily.

1120. Among NH_3, HNO_3, NaN_3 and Mg_3N_2 the number of molecules having nitrogen in negative oxidation state is

(a) 1 (b) 2

(c) 3 (d) 4

UPTU/UPSEE-2008

Ans. (c) : Calculating the oxidation state of nitrogen in given molecules, oxidation state of N in NH_3 is

$x + 3 \times (+1) = 0$ or $x = -3$

oxidation state on N in HNO_3 is

$1 + x + 3 \times (-2) = 0$ or $x = +5$

oxidation state of N in NaN_3 is

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$+1+3x = 0$ or $x = -\frac{1}{3}$

Oxidation state of N in Mg_3N_2 is

$3\times2+2x=0$ or $x = -3$

This 3 molecules NH_3, NaH_3 and Mg_3N_2 have nitrogen in negative oxidation states.

1121. During the preparation of NH_3 in Haber's process, the promoter (s) used is/are-

(a) PtO_2 (b) Mo

(c) Mix of Al_2O_3 and K_2O (d) Fe and Mn

WB-JEE-30.04.2022

Ans. (b) : In Haber process of ammonia production the element used as catalytic promoter to increase the activity of iron catalyst is Mo

$$N_2+3H_2 \rightleftharpoons 2NH_3+24\text{ Kcal}$$

1122. Atoms in a P_4 molecule of white phosphorus are arranged regularly in the following way

(a) at the corners of a cube

(b) at the corners of an octahedron

(c) at the corners of a tetrahedron

(d) at the centre and corners of a tetrahedron

WB-JEE-2009

Ans. (c) : The easiest way to solve this question is by calculating the hybridization of the compound given above we generally consider the hybridization of the central element, but in this case, all the atoms will act the same i.e. hybridization of all four phosphorus will be the same.

1123. Of the following compounds the most acidic is

(a) As_2O_3 (b) P_2O_5

(c) Sb_2O_5 (d) Bi_2O_3

WB-JEE-2009

Ans. (b) : Generally, acidic nature of oxides increases along a period from left to right and decreases along a group from up to down.

Since As, P, Sb, and Bi all belong to V group and arranged in the fallowing manner.

P, As, Sb, Bi

$\therefore$ P_2O_5 it is the most acidic and Bi_2O_3 is the least acidic.

1124. P_4O_{10} is the anhydride of

(a) H_3PO_2 (b) H_3PO_3

(c) H_3PO_4 (d) $H_4P_2O_7$

WB-JEE-2010

Ans. (c) : H_3PO_4 is the anhydride of P_4O_{10}.

$$4H_3PO_4 \xrightarrow{\Delta} P_4O_{10} + 6H_2O$$

1125. NO_2 is not obtained on heating

(a) $AgNO_3$ (b) KNO_3

(c) $Cu(NO_3)_2$ (d) $Pb(NO_3)_2$

WB-JEE-2011, WB-JEE-2016

Ans. (b) : $2AgNO_3 \xrightarrow{\Delta} 2Ag + 2NO_2 + O_2$

$$2KNO_3 \xrightarrow{\Delta} 2KNO_2 + O_2$$

$$2Cu(NO_3)_2 \xrightarrow{\Delta} 2CuO + 4NO_2 + O_2$$

$$2Pb(NO_3)_2 \xrightarrow{\Delta} 2PbO + 4NO_2 + O_2$$

NO_2 is not obtained on heating KNO_3.

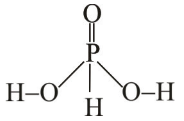
1126. The number of acidic protons in H_3PO_3 are

(a) 0 (b) 1

(c) 2 (d) 3

WB-JEE-2012

Ans. (c) : H_3PO_3 is dibasic acid i.e. two hydrogen atoms are ion sable. The structure of H_3PO_3



OH → acid proton

1127. Nitric acid can be obtained from ammonia via the formations of the intermediate compounds

(a) nitric oxide and nitrogen dioxide

(b) nitrogen and nitric oxide

(c) nitric oxide and dinitrogen pentoxide

(d) nitrogen and nitrous oxide

WB-JEE-2013

Ans. (a) : Nitric acid can be obtained from following steps -

$$\underset{\text{Ammonia}}{4NH_3} + 5O_2 \xrightarrow[700-800^\circ C]{\text{Pt gauge}} \underset{\text{Nitric oxide}}{4NO} + 6H_2O$$

$$2NO + O_2 \xrightarrow{50^\circ C} \underset{\text{Nitrogen dioxide}}{2NO_2}$$

$$4NO_2 + 2H_2O + O_2 \rightarrow \underset{\text{Nitric acid}}{4HNO_3}$$

1128. The hydrides of the first elements in groups 15-17, namely NH_3, H_2O and HF respectively show abnormally high values for melting and boiling points. This is due to

(a) small size of N, O and F

(b) the ability to form extensive intramolecular H-bonding

(c) the ability to form extensive intramolecular H-bonding

(d) effective van der Waals' interaction

WB-JEE-2014

Ans. (b) :

Atom	Electronegativity in Pauling scale
F	4.0
O	3.5
N	3.0

Hydrides of N, O and F because of the small size and high electronegativity of elements, have ability to form extensive intermolecular hydrogen bonding. Thus a large amount of energy is revered to break these bonds i.e. the melting and boiling points of hydrides of these elements are abnormally high.

1129. Sulphuryl chloride (SO_2Cl_2) reacts with white phosphorus (P_4) to give

(a) PCl_5, SO_2 (b) $OPCl_3$, $SOCl_2$

(c) PCl_5, SO_2, S_2Cl_2 (d) $OPCl_3$, SO_2, S_2Cl_2

WB-JEE-2015

Ans. (a) : When Sulphuryl chloride (SO_2Cl_2) reacts with white phosphorus (P_4), it forms phosphorous pentachloride (PCl_5) and sulphur dioxide (SO_2)

$$10SO_2Cl_2+P_4 \rightarrow 4PCl_5 +10SO_2$$

@apna_pdf

1130. An element X belongs to fourth period and fifteenth group of the periodic table. Which of the following statememt is true?

(a) It has completely filled s-orbital and a partially filled *d*-orbital
(b) It has completely filled s-and *p*-orbitals and a partially filled *d* -orbital
(c) It has completely filled s-and *p*-orbitals and a half filled *d*-orbital
(d) It has a half filled *p*-orbital and completely filled s-and *d* - orbitals

WB-JEE-2016

Ans. (d)

Period	**Group 15**
1	Nil
2	N(7)
3	P(15)
4	As (33)

Let us configure As (33), Now.

As(33) $\rightarrow 1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^{10}\ 4s^2\ 4p^3$

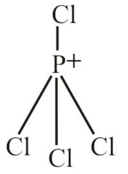
So, s and d-orbital are fully filled and p-orbital and half filled.

1131. In the solid state, PCl_5 exists as

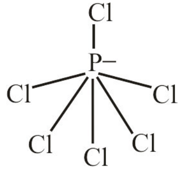
(a) $[PCl_4]^-$and $[PCl_6]^+$ ions
(b) covalent PCl_5 molecules only
(c) $[PCl_4]^+$and $[PCl_6]^-$ ions
(d) covalent P_2Cl_{10} molecules only

WB-JEE-2016

Ans. (c) : In the solid state, PCl_5 prefers to exist as oppositely charged ion like $[PCl_4]^+$ and$[PCl_6]^-$ as ionic. PCl_5 exist as solid in $[PCl_4]^+$and $[PCl_6]^-$ ions.



$[PCl_4]^+$
sp^3
Tetrahedral Shape



$[PCl_6]^-$
sp^3d^2
Octahedral Shape

1132. Very pure N_2 can be obtained by

(a) thermal decomposition of ammonium dichromate
(b) treating aqueous solution of NH_4Cl and $NaNO_2$
(c) liquefaction and fractional distillation of liquid air
(d) thermal decomposition of sodium azide

Karnataka-CET-2018

Ans. (d) : When sodium azide (NaN_3) undergoes thermal decomposition i.e. breakdown in the presence of heat, pure N_2 is obtained. Pure nitrogen is obtained by heating sodium are barium azide in vacuum.

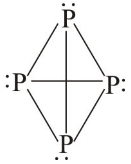
$$\underset{\text{Sodium azide}}{2NaN_3} \xrightarrow{\Delta} 2Na(s) + \underset{\text{pure nitrogen gas}}{3N_2(g)}$$

1133. White phosphorous P_4 has the following characteristics

(a) 6P– P single bonds
(b) 4P– P single bonds
(c) 4 lone pair of electrons
(d) P–P–P angle of 60^0

WB-JEE-2018

Ans. (a,c,d) : P_4 (white phosphorus) has large in size. It has less electro negativity. It forms only single bond. P_4 has 6, P-P single bond. Angle between P-P-P is 60^o.



1134. The $H-N-H$ angle in ammonia is 107.6^o, while the H–P–H angle in phosphine is 93.5^o. Relative to phosphine, the p-character of the lone-pair on ammonia is expected to be

(a) Less
(b) More
(c) Same
(d) Cannot be predicted

WB-JEE-2019

Ans. (a) : Relative to phosphine, the p-character of the lone-pair on ammonia is expected to be less because bond angle is decrease.

1135. Which is true regarding nitrogen?

(a) Less electronegative
(b) Has low ionisation enthalpy
(c) d-orbitals are available
(d) Ability to form pπ- pπ bonds with itself

Karnataka-CET-2016

Ans. (d) : Nitrogen having 1s electron in its inner core and they do not show repulsion between non paired electron and inner core because of this overlapping pi(π) bond is formed.

Nitrogen has ability to form pπ-pπ bonds itself due to their small size and high electronegativity.

1136. The statement that is not correct is

(a) Hypophosphorous acid reduces silver nitrate to silver
(b) In solid state PCl_6 exists as $[PCl_4]^+[PCl_6]^-$
(c) Pure phoshine in non-inflammable
(d) Phosphorous acid on heating disproportionates to give metaphosphoric acid and phosphine

Karnataka-CET-2014

Ans. (c) : Pure phosphine gas is stable in air and not inflammable at normal temperature but on heating up to 150^oC, it catches fire and produces phosphorus pentaoxide.

$$2PH_3 + 4O_2 \rightarrow P_2O_5 + 3H_2O$$

1137. Conjugate base of $H_2PO_4^-$ is

(a) HPO_4^-
(b) HPO_4^{2-}
(c) H_3PO_4
(d) PO_4^{3-}

Karnataka-CET-2013

Ans. (b) : When acids are acceptor of a proton then it leads to the formation of conjugate acid and when an acid loses a proton, the left over substance is known as conjugate base.

So,

$$H_2PO_4^- \rightarrow HPO_4^{-2} + H^+$$

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7. Oxygen Family

1138. Given below are two statements:

Statement I:

The boiling points of the following hydrides of group 16 elements increases in the order-

$H_2O < H_2S < H_2Se < H_2Te$

Statement II:

The boiling points of these hydrides increase with increase in molar mass

In the light of the above statements, choose the most appropriate answer from the options given below:

(a) Both Statement I and Statement II are incorrect
(b) Statement I is correct but Statement II is incorrect
(c) Statement I is incorrect but Statement II is correct
(d) Both Statement I and Statement II are correct

NEET-17.07.2022

Ans. (a): $H_2O > H_2Te > H_2Se > H_2S$

Among hydrides of group 16 elements, with the increase in molecular weight, Van der wall forces in crease so boiling point also increase.

However H_2O unexpectedly has highest boiling point due to presence of H- bonding.

1139. The correct order of melting points of hydrides of group 16 elements is:

(a) $H_2S < H_2Se < H_2Te < H_2O$
(b) $H_2 < H_2S < H_2Se < H_2Te$
(c) $H_2S < H_2Te < H_2Se < H_2O$
(d) $H_2Se < H_2Se < H_2Te < H_2O$

JEE Main-26.06.2022, Shift-I

Ans. (a) : Melting point of H_2O is higher than other hydrides due to intermolecular hydrogen bonding and melting point increases as we move down the group due to increasing Vander wall force

Hydride	Melting Point
H_2O	273 K
H_2S	188 K
H_2Se	208 K
H_2Te	222 K

So, the correct order is

$H_2S < H_2Se < H_2Te < H_2O$.

1140. Match List I with List II

List-I		**List-II**	
A.	CO_3^{2-}	**I.**	**Colourless gas which turns lead acetate paper black**
B.	S^{2-}	**II.**	**Colourless gas which turns acidified potassium dichromate solution green**
C.	SO_3^{2-}	**III.**	**Brown fumes which turns acidified KI solution containing starch blue.**
D.	NO_2^-	**IV.**	**Colourless gas evolved with brisk effervescence, which turns lime water milky.**

Choose the correct answer from the options given below:

(a) A-III, B-I, C-II, D-IV
(b) A-II, B-I, C-IV, D-III
(c) A-IV, B-I, C-III, D-II
(d) A-IV, B-I, C-II, D-III

JEE Main-27.06.2022, Shift-II

Ans. (d) : (a) CO_3^{2-} on action of dil. sulphuric acid, CO_2 gas is released which turns lime water milky.

(b) S^{2-}: Colourless gas which turns lead acetate paper black

(c) SO_3^{2-} colourless gas which turns acidified potassium dichromate solution green.

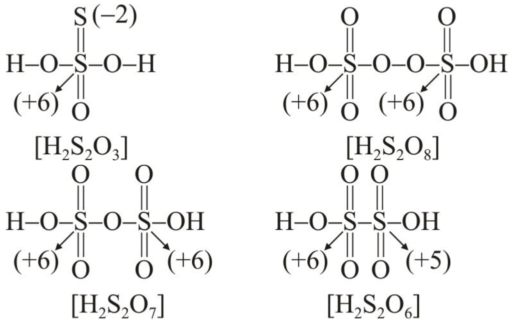
(d) NO_2^- on action of dil. H_2SO_4, NO_2 gas is evolved which turns KI solution blue.

1141. Which of the following oxoacids of sulphur contains "S" in two different oxidation states ?

(a) $H_2S_2O_3$ (b) $H_2S_2O_6$
(c) $H_2S_2O_7$ (d) $H_2S_2O_8$

JEE Main-28.06.2022, Shift-II

Ans. (a) :



1142. Which one of the following gases is placed second in respect of abundance in the Earth's atmosphere?

(a) Oxygen (b) Hydrogen
(c) Nitrogen (d) Carbon dioxide

NDA (II)-2017

Ans. (a) : Earth's atmosphere is composed of about 78% nitrogen, 21% oxygen, 0.9 % argon, and 0.1 other gases.

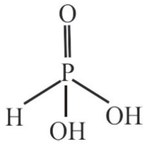
Oxygen with 21% is placed second in respect of abundance in the earth's atmospheres.

1143. The basicities of H_3PO_3 and $H_4P_2O_7$, respectively, are

(a) 1 and 4 (b) 2 and 4
(c) 3 and 4 (d) 2 and 3

AMU-2019

Ans. (b) :



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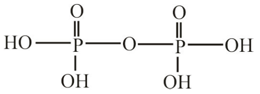
H_3PO_3 is dibasic acid. It has two P–OH bonds and one P–H bond.

Hence, its basicity is 2.

Note- To Calculate basicity, we count H atom directly attached to O atom.



As it is clearly shown in the figure, the acid $H_4P_2O_7$ contains 4 replaceable H-atoms.

Hence its basicity is = 4

1144. Which of the following form of sulphur can be prepared by pouring liquid sulphur into cold water?

(a) Monoclinic (b) Rhombic
(c) Plastic (d) Colloidal

AP-EAMCET (Med.)-1999

Ans. (c) : Plastic sulphur is obtained by pouring boiling sulphur in cold water when rubber like mass is obtained.

1145. Consider the following statements in respect of oxides of sulphur

1. In gas phase SO_2 molecules are V-shaped

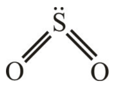
2. In gas phase SO_3 molecule has a planer structure.

3. γ-SO_3 is cyclic trimer and solid at 0°C. Which of the above statements are correct?

(a) 1 and 2 only (b) 2 and 3 only
(c) 1 and 3 only (d) 1, 2 and 3

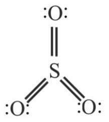
SCRA 2012

Ans. (d) :



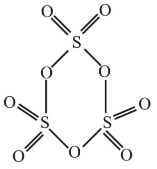
sp^2 hybrided
V-shape, Bent

SO_3



Trigonal planer

γ-SO_3



Cyclic trimer

Thus, all the three statements are correct

1146. Among the following the most reactive is:

(a) S_2O (b) SO_3
(c) SO_2 (d) SO_3

SCRA 2012

Ans. (d) : SO_3 is a highly reactive substance and strong oxidizing agent and it also acts as a fire hazard.

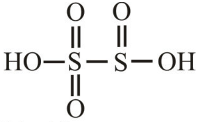
1147. Which oxy-acid of sulphur does not contain S S bond?

(a) $H_2S_2O_5$ (b) $H_2S_2O_4$
(c) $H_2S_2O_7$ (d) $H_2S_2O_6$

SCRA-2015

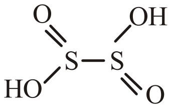
Ans. (c): Structure of oxy-acid of sulphur are –

(i) $H_2S_2O_5$



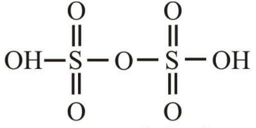
Disulfurous acid

(ii) $H_2S_2O_4$



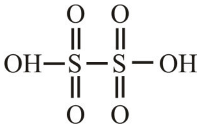
Dithionous acid

(iii) $H_2S_2O_7$



pyrosulphuric acid (oleum)

(iv) $H_2S_2O_6$



Dithionic acid

1148. The catalyst used in the manufacture of sulphuric acid by contact process is

(a) Al_2O_3 (b) Cr_2O_3
(c) V_2O_5 (d) MnO_2

J&K CET-2007, JCECE-2003
AP EAMCET- 1993

Ans. (c) : In Contact process V_2O_5 (Vanadium pentaoxide) catalyst is used in the manufacture of H_2SO_4.

$$2SO_2 + O_2 \xrightleftharpoons{V_2O_5} 2SO_3$$

1149. The crystalline form of sulphur that is stable at room temperature is

(a) Engel's sulphur (b) Rhombic sulphur
(c) Monoclinic sulphur (d) Plastic sulphur

AP EAMCET- 1994

Ans. (b) : Rhombic sulphur is present in prismatic crystalline form an is stable upto 95.5°C.

1150. With respect to both oxygen and ozone, which one of the following statements is not correct?

(a) Both have similar reactivity with water
(b) Oxygen is colorless and ozone is colored
(c) Oxygen valency is 2 in both
(d) Oxygen has 2 bonds and ozone has 3 bonds

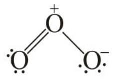
AP EAMCET- 1996

Ans. (c) : (a) Ozone and oxygen both have equal reactivity with water. Hence, statement is true.

(b) As we know oxygen is colorless whereas ozone is a pale blue gas and consists of three oxygen atoms.

(c) Oxygen gas and ozone have different valency which is given below–

$O_2 \equiv$:Ö = Ö: and $O_3 \equiv$
Valency = 2



Valency = 3,2,1

Hence, statement is false.

(d) It is clear that from the structure of oxygen and ozone, oxygen and ozone have 2 and 3 bonds respectively.

1151. Which of the following is the weakest acid in its aqueous solution?

(a) H_2Te (b) H_2Se
(c) H_2S (d) H_2Po

AP EAMCET- 1999

@apna_pdf

Ans. (c) : In VI group, on moving down a group the size of atom increase and thermal stability decrease and acidic nature increases. Hence, among the given hydrides H_2S is least acidic.

1152. Which one of the VI group elements has the highest catenation power?

(a) O (b) Se

(c) S (d) Te

AP EAMCET- 2000

Ans. (c) : On moving down the group catenating power of element decreases but oxygen has less catenation power because of high electronegative force. Therefore, the sulphur has the highest catenation power among VI group element.

1153. Mustard gas among the following is

(a) CCl_3NO_2

(b) $ClCH_2CH_2SCH_2CH_2Cl$

(c) CH_3SH

(d) H_2S

TS-EAMCET (Engg.), 05.08.2021 Shift-II

Ans. (b) : $ClCH_2CH_2SCH_2CH_2Cl$ or $C_4H_8Cl_2S$ is known as Mustard gas.

Mustard gas is colored oily liquid with a faint odor of garlic. Mustard gas is also known as dichlorodiethyl sulfide. This gas used in Second World War because it is toxic acid and it can be absorbed easily through skin.

1154. SF_6 is a kinetically inert substance because

(a) Fluorine is highly electronegative

(b) It is sterically protected

(c) Greater difference in electronegativities of S and F

(d) Larger size of S-atom

AP EAMCET (Engg.) 17.09.2020, Shift-II

Ans. (b) : In SF_6, sulphur is sp^3d^2 hybridised. Both geometry and shape of the molecule is octahedral. SF_6 is also a non-polar molecule (dipole moment, μ = 0), because S atom sterically protected six F atoms and not allowed to water molecule to attack at the S atom. So, SF_6 is also kinetically inert.

1155. Which of the following is used as a rocket fuel?

(a) Nitrolim+ O_3 (b) Water gas + O_3

(c) Cyanogen +O_2 (d) Cyanogen +O_3

AP EAMCET (Medical) -1998

Ans. (d): Combination of cyanogens and O_3 is utilized as a rocket fuel. Cyanogen is the chemical compound with formula CN_2 and colorless gas and also highly toxic.

1156. Which of the element of Oxygen family is most poisonous to human race?

(a) O (b) S

(c) Se (d) None

MPPET-2008

Ans. (c) : Selenium (se) element of oxygen family is most poisonous to human race.

The long term intake of excessive selenium may involve either organic or inorganic forms in food or water.

1157. The type of bonds present in sulphuric anhydride are

(a) 3σ and three $p\pi$ - $d\pi$

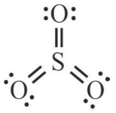
(b) 3σ, one $p\pi$-$d\pi$ and two $p\pi$ - $d\pi$

(c) 3σ and three $p\pi$ - $d\pi$

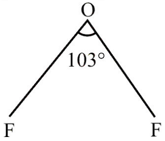
(d) 3σ and two $p\pi$ - $d\pi$

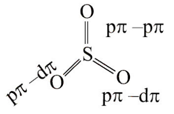
AP EAMCET (Engg.)-2009

Ans. (b): Sulphuric anhydride is SO_3 and structure is –



$\Rightarrow$ 3σ-bond deciding the shape of the molecule, $1p\pi$-$p\pi$ and $2p\pi$-$d\pi$ bonds are present.





1158. When some helium gas is added, at constant pressure, to an equilibrium mixture of $2SO_{2(g)} + O_{2(g)} \rightleftharpoons 2SO_{3(g)}$. Which of the following conditions will occur?

(a) The concentration of all three gases remain unchanged

(b) Concentration of Sulphur trioxide increases

(c) Concentration of Sulphur dioxide increases

(d) The number of moles of oxygen will decrease

AP EAPCET-6 Sep. 2021, Shift-II

Ans. (c): When on inert gas is added to the system in equilibrium at constant pressure, then the total volume will increase. Hence, the number of moles percent volume of various reactants and products will decrease. Therefore, the equilibrium shifts toward the direction in which there is increase in number of moles of gases.

1159. Which of the following is not given by SO_2 ?

(a) It converts acidified iodates to iodine

(b) It decolorize acidified $KMnO_4$ solution

(c) It decolorizes acidified potassium dichromate to form green colored solution

(d) It reacts with green colored ferrous sulphate to form yellowish brown ferric sulphate

AP EAPCET 24.08.2021, Shift-I

Ans. (d) : The first statement in option is true because sulphur dioxide acts as a reducing agent and it reduces the iodates.

$5SO_2+2KMNO_4+2H_2O\rightarrow 2H_2SO_3 + 2MNSO_4 + K_2SO_4$

SO_2 is also decolourises the $KMnO_4$ solution. So, the second statement is also true. Sulfur dioxide gas turns acidified potassium dichromate solution form orange to green and reduced chromium +4 to +3.

The fourth statement is not true because SO_2 reacts with ferrous sulphate to form the ferric oxide (Fe_2O_3).

1160. Sulphuric acid has high viscosity because of

(a) The presence of hydrogen bonds

(b) Its high boiling point

(c) Its high acid strength

(d) The presence of double bond.

COMEDK 2011

@apna_pdf

Ans. (a) : The Sulfuric acid has high viscosity because of presence of hydrogen bond. These hydrogen bonds helps sulphuric acid to form cluster.

1161. Which of the following is NOT TRUE for concentrated H_2SO_4?

(a) Sulphonating agent
(b) Oxidizing agent
(c) Dehydrating agent
(d) Deliquescent in nature

COMEDK-2012

Ans. (d) : The Conc. H_2SO_4 does not deliquescent in nature because its nature is hygroscopic and it absorbs moisture from nature without changing physical state.

1162. An element belonging to chalcogen group is

(a) carbon (b) phosphorus
(c) chlorine (d) sulphur

COMEDK-2015

Ans. (d) : Group 16 of the periodic table is sometimes known as group of chalcogens. Oxygen, sulphur, selenium, tellurium, polonium, and livermorium constitute group-16 of the periodic table.

1163. What is X in the following reaction?
$KHSO_4 + F_2 \rightarrow HF + X$

(a) K_2SO_4 (b) $K_2S_2O_4$
(c) $K_2S_2O_2$ (d) $K_2S_2O_8$

AP-EAMCET (Medical), 2006

Ans. (d) : For the reaction–

$$\underset{\substack{\text{Potassium}\\\text{hydrogen}\\\text{sulphate}}}{2KHSO_4} + F_2 \rightarrow 2HF + \underset{\substack{\text{Potassium}\\\text{persulphate}}}{K_2S_2O_8}$$

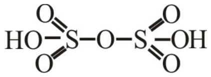
In this reaction- F_2 oxidized the potassium hydrogen sulphate in to potassium per sulphate.

1164. Which of the following oxy-acid of sulphur does not contain S-S bond?

(a) Pyrosulphuric acid (b) Dithionic acid
(c) Dithionous acid (d) Pyrosulphurous acid

AP-EAMCET (Medical), 2006

Ans. (a) : The molecular formula of pyrosulphuric acid is $H_2S_2O_7$. The structure of pyrosulphuric acid is given as:



Thus, structure is not attaining the S-S bond.

1165. For the preparation of sodium thiosulphate by Springs reaction the reactants used are:

(a) $Na_2S + Na_2SO_3 + Cl_2$ (b) $Na_2S + SO_2$
(c) $Na_2SO_3 + S$ (d) $Na_2S + Na_2SO_3 + I_2$

AP-EAMCET (Medical), 2003

Ans. (d) : Springs reaction for the preparation of sodium thiosulphate is given below:

$$\underset{\substack{\text{Sodium}\\\text{sulphide}}}{Na_2S} + \underset{\substack{\text{Sodium}\\\text{sulphite}}}{Na_2SO_3} + I_2 \longrightarrow \underset{\substack{\text{Sodium}\\\text{thiosulphate}}}{Na_2S_2O_3} + 2NaI$$

1166. In a balanced equation:

$$H_2SO_4 + xHI \longrightarrow H_2S + yI_2 + zH_2O$$

The values of x, y, z are

(a) x = 3, y = 5, z = 2 (b) x = 4, y = 8, z = 5
(c) x = 8, y = 4, z = 4 (d) x = 5, y = 3, z = 4

AP-EAMCET (Medical), 2003

Ans. (c) : The given equation is:

$$H_2SO_4 + xHI \longrightarrow H_2S + yI_2 + zH_2O$$

By the oxidation number method, we calculate the change in oxidation number of sulphur and then balance I_2 and H_2O.

$$\underset{\uparrow 8e^-}{\overset{+1\ \ +6}{H_2SO_4}} + \underset{1e^- \times 8}{\overset{+1\,-1}{HI}} \longrightarrow \overset{+1\ \ -2}{H_2\,S} + \overset{0}{I_2} + H_2O$$

$$\therefore H_2SO_4 + 8HI \longrightarrow H_2S + 4I_2 + 4H_2O$$

So, the value of x , y and z will be 8, 4 and 4 respectively.

1167. O_2^{2-} is the symbol of…… ion.

(a) Oxide (b) Super oxide
(c) Peroxide (d) Monoxide

AP-EAMCET (Medical), 2003

Ans. (c) : Oxide ion is the dianion of oxygen, O^{2-} ion. Superoxide ion is the ion with chemical formula O_2^-.

- The peroxide ion is the ion with the chemical formula O_2^{2-} and it has a single oxygen-oxygen covalent bond and oxidation state of –1.

$$:\ddot{\underset{..}{O}}-\ddot{\underset{..}{O}}:$$

- A monoxide is any oxide containing only one atom of oxygen for example, a well-known monoxide is carbon monoxide, CO.

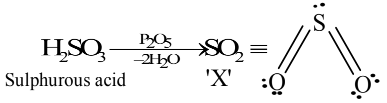
O_2^{2-} — $:\ddot{O}-\ddot{O}:$ Peroxide

1168. X, Y are anhydrides of sulphurous acid and sulphuric acid, respectively. The hybridisation state and the shape of X and Y are

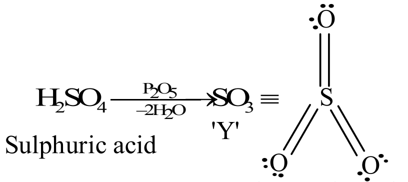
	X	Y
(a)	sp^2 ,angular	sp^3, tetrahedral
(b)	sp^2, angular	sp^2, angular
(c)	sp^2, angular	sp^2, planar triangular
(d)	sp^3, planar	sp^3, planar

AP-EAMCET (Medical), 2008

Ans. (c) : The anhydride of sulphurous acid is sulphur dioxide, which can understand by following reaction-



(angular shape)
Hybridisation = lonepair + bondpair
= 1 + 2 = 3 (sp^2)



(planer trigonal)
Hybridisation = 0 + 3 = (sp^2)

Hence, both X (SO_2) and Y (SO_3) have sp^2 hybridisation.

@apna_pdf

1169. What is the product formed when ozone reacts with mercury?

(a) HgO (b) Hg_2O_2

(c) Hg_2O (d) HgO_2

AP-EAMCET (Medical), 2001

Ans. (c) : When Mercury (Hg) is oxidized by O_3

$2Hg + O_3 \rightarrow Hg_2O + O_2$

Thus, Hg_2O is formed.

The phenomenon of mercury sticking to glass is called tailing mercury.

1170. Which one of the following compounds undergoes hydrolysis during distillation to yield hydrogen peroxide?

(a) $H_2S_2O_8$ (b) $H_2S_2O_6$

(c) HNO_3 (d) $H_4P_2O_7$

AP-EAMCET (Medical), 2002

Ans. (a) : Peroxydisulfuric acid is the inorganic compound with the chemical formula $H_2S_2O_8$ also called Marshalls acid. Peroxydisulfuric acid ($H_2S_2O_8$) reacts with water during distillation to form hydrogen peroxide.

Molar mass – 194.14 g /mol

Solubility in water = soluble

Melting point – 65°C

$$H_2S_2O_8 + 2H_2O \longrightarrow 2H_2SO_4 + H_2O_2$$

1171. Fluorine oxidises HSO_4^- to :

(a) $S_2O_3^{2-}$ (b) $S_2O_8^{2-}$

(c) $S_4O_6^{2-}$ (d) SO_2

AP-EAMCET (Medical), 2002

Ans. (b) : As we know that F_2 is the strongest oxidizing agent. Fluorine oxidises HSO_4^- to –

$$2H\overset{+6}{S}O_4^- + F_2 \longrightarrow 2HF + S_2O_8^{2-}$$

1172. Which element is not considered as 'Chalcogens'?

(a) Polonium (b) Sulphur

(c) Oxygen (d) Selenium

GUJCET-2008

Ans. (a) : Oxygen, Sulphur, Selenium, Tellurium, constitute group 16 of the periodic table. This is sometimes known as group of Chalcogens. Polonium is a radioactive element and forms a less number of compounds and therefore it is not considered as Chalcogens.

1173. Match the following

Column - 1 **Type of sulphur**	**Column - 2** **Property**
(A) α – Sulphur	**(I) Soluble in CS_2**
(B) S_2	**(II) Soluble in H_2O**
(C) β – Sulphur	**(III) Puckered ring**
	(IV) Paramagnetic
	(V) Chair form

The correct match is

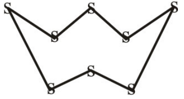
	A	B	C
(a)	I, III	IV	I,III
(b)	I, II, III	IV	I, II
(c)	II, III	II	II,V
(d)	I, IV,V	II	I, IV,V

TS-EAMCET 09.08.2021, Shift-I

Ans. (a) : α- Sulphur- It is S_8 puckered ring structure.

-It is readily soluble in Carbon Disulphide (CS_2).

-It is also called a crown shape.



(Puckered ring structure)

β-sulphur– β suphur is less dense than α- sulphur.

- it also contain puckered S_8 ring.

- it is also soluble in CS_2.

- Below 95.3°c it converts is to α sulphur.

S_2 (Disulphide)– it is paramagnetic in nature.

1174. Commercial name of Peroxydisulphuric acid is

(a) Marshall's acid

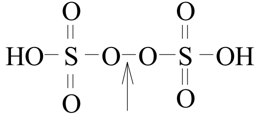
(b) Caro's acid

(c) Oleum

(d) Fuming sulphuric acid

TS EAMCET 06.08.2021

Ans. (a): The structure of peroxydisulphuric acid is–



$$HO-\overset{\overset{O}{\|}}{\underset{\underset{O}{\|}}{S}}-O-O-\overset{\overset{O}{\|}}{\underset{\underset{O}{\|}}{S}}-OH$$

(one peroxide bond)

Peroxysulphuric Acid ($H_2S_2O_8$)

Peroxydisulphuric acid ($H_2S_2O_8$) is an inorganic compound. It is also known as Marshall's Acid, after its inventor Professor Hugh Marshall. It is a sulphur oxoacid.

1175. Assertion (A) : SF_6 is highly stable

Reason (R) : SF_6 is a gas

The correct option among the following is

(a) (A) is true, (R) is true and (R) is the correct explanation for (A)

(b) (A) is true, (R) is true but (R) is not the correct explanation for (A)

(c) (A) is true but (R) is false

(d) (A) is false but (R) is true

TS EAMCET 04.08.2021, Shift-I

Ans. (b) : SF_6 is a gas and It is highly stable and extremely stable and chemically inert for steric resons. In SF_6, the six F atom protected the sulphur atom from attack by reagents to such an extent that even thermodynamically most favorable reaction.

1176. The reaction of sulphur in alkaline medium is given below:

$$S_{8(s)} + aOH^-_{(aq)} \rightarrow bS^{2-}_{(aq)} + cS_2O^{2-}_{3(aq)} + dH_2O_{(f)}$$

The values of 'a' is ________. (Integer answer)

JEE Main 24.02.2021, Shift-I

@apna_pdf

Ans. : Write the half reaction–

$$16e^- + S_8 \longrightarrow 8S^{2-}$$

$$\underline{S_8 + 12H_2O \longrightarrow 4S_2O_3{}^{2-} + 24H^+ + 16e^-}$$

$$2S_8 + 12H_2O \longrightarrow 8S^{2-} + 4S_2O_3^{2-} + 24H^+$$

Now, balancing in basic medium add an equal number of OH^- that of H^+ –

$$2S_8 + 12H_2O + 24OH^- \longrightarrow 8S^{2-} + 4S_2O_8^{2-} + 24H_2O$$

$$2S_8 + 24OH^- \longrightarrow 8S^{2-} + 4S_2O_8^{2-} + 12H_2O$$

$$S_8 + 12OH^- \longrightarrow 4S^{2-} + 2S_2O_8^{2-} + 6H_2O$$

So, a = 12.

1177. Assertion: SO_2 is more covalent than SeO_2
Reason: Covalent radius of Se is more than S

(a) If both Assertion and Reason are correct and the Reason is the correct explanation of Assertion.
(b) If both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.
(c) If Assertion is correct but Reason is incorrect.
(d) If both the Assertion and Reason are incorrect.

[AIIMS-27 May, 2018 (E)]

Ans. (b): SO_2 is more covalent than SeO_2 because in SO_2, S has +6 oxidation state while in SeO_2, Se has +4 oxidation state.

Covalent radius of Se is more than S.

Therefore, both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.

1178. Assertion: O_3 has higher boiling point than O_2.
Reason: O_3 is allotrope of oxygen

(a) If both Assertion and Reason are correct and the Reason is the correct explanation of Assertion.
(b) If both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.
(c) If Assertion is correct but Reason is incorrect.
(d) If both the Assertion and Reason are incorrect.

[AIIMS-26 May, 2018(M)]

Ans. (b): O_3 has high molar mass than O_2 so, it has higher boiling point than that of O_2.

Both A and R are true but R is not correct expiation of A.

1179. Assertion : Both rhombic and monoclinic sulphur exist as S_8 but oxygen exists as O_2.
Reason : Oxygen forms $p\pi - p\pi$ multiple bond due to small size and small bond length but $p\pi - p\pi$ bonding is not possible in sulphur.

(a) If both Assertion and Reason are correct and the Reason is the correct explanation of Assertion.
(b) If both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.
(c) If Assertion is correct but Reason is incorrect.
(d) If both the Assertion and Reason are incorrect.

[AIIMS-2017]

Ans. (a): Assertion and Reason are correct and Reason is the right explanation for assertion.

Both rhombic and monoclinic sulphur exist as S_8 but oxygen exists as O_2. The formation of $P\pi - P\pi$ bond is the main reason for the existence of oxygen in O_2 structure, but formation of $P\pi - P\pi$ bond is not possible in sulphur. Sizes of oxygen and sulphur determine the formation of $P\pi - P\pi$ bond. Oxygen is in small size it can be able to forms multiple bond of $P\pi - P\pi$ and the size of sulphur is bigger than the oxygen. So, it can not be able to form the $P\pi - P\pi$ bond.

1180. Assertion: SF_6 cannot be hydrolysed but SF_6 can be.
Reason: Six F atoms in SF_6 prevent the attack of H_2O on sulphur atom of SF_6.

(a) If both Assertion and Reason are correct and the Reason is the correct explanation of Assertion.
(b) If both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.
(c) If Assertion is correct but Reason is incorrect.
(d) If both the Assertion and Reason are incorrect.

[AIIMS-2016]

Ans. (a): Both assertion and reason are correct and reason is the correct explanation for assertion.

SF_6 cannot be hydrolysed because it is sterically protected by the six F atoms. So it is difficult were OH^- atom to attack central atoms. However in SF_4, due to lesser surrounding F-atom, it's comparatively easy to attack central atom and hence SF_4 get hydrolysed but not SF_6.

1181. Assertion: Sulphuric acid is more viscous than water.
Reason: Concentrated sulphuric acid has a great affinity for water.

(a) If both Assertion and Reason are correct and the Reason is the correct explanation of Assertion.
(b) If both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.
(c) If Assertion is correct but Reason is incorrect.
(d) If both the Assertion and Reason are incorrect.

[AIIMS-2009]

Ans. (b): Assertion and reason are true but reason is not the correct explanation of assertion.

Concentrated sulphuric acid is more viscous than water because of the presence of extensive intermolecular hydrogen bonding in sulphuric acid.

1182. Assertion: The S – S – S bond angle in S_8 molecule is 105°.
Reason: S_8 has a V-shape.

(a) If both Assertion and Reason are correct and the Reason is the correct explanation of Assertion.
(b) If both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.

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(c) If Assertion is correct but Reason is incorrect.
(d) If both the Assertion and Reason are incorrect.

[AIIMS-2008, 2009]

Ans. (c): Atoms in S_8 molecule undergoes SP^3 hybridisation and consists of two lone pairs of electrons on each and exists as staggered 8 atom rings.

S_8 has puckered ring structure.

1183. Assertion: Reaction of SO_2 and H_2S in the presence of Fe_2O_3 catalyst gives elemental sulphur.

Reason: SO_2 is a reducing agent.

(a) If both Assertion and Reason are correct and the Reason is a correct explanation of the Assertion.
(b) If both Assertion and Reason are correct but Reason is not a correct explanation of the Assertion.
(c) If the Assertion is correct but Reason is incorrect.
(d) If both the Assertion and Reason are incorrect.
(e) If the Assertion is incorrect but the Reason is correct.

[AIIMS-2005]

Ans. (c) : Reaction of SO_2 and H_2S in the presence of Fe_2O_3 is as follows :

$$2H_2S + SO_2 \rightarrow 2H_2O + 3S\downarrow$$

In the reaction SO_2 is oxidising agent and H_2S is reducing agent. So, assertion is true but the reason is false.

1184. Assertion: Dinegative anion of oxygen (O^{2-}) is quite common but dinegative anion of sulphur (S^{2-}) is less common.

Reason: Covalency of oxygen is two.

(a) If both Assertion and Reason are correct and the Reason is a correct explanation of the Assertion.
(b) If both Assertion and Reason are correct but Reason is not a correct explanation of the Assertion.
(c) If the Assertion is correct but Reason is incorrect.
(d) If both the Assertion and Reason are incorrect.
(e) If the Assertion is incorrect but the Reason is correct.

[AIIMS-2002]

Ans. (b): Fluorine is the most electronegative element on the earth. The second most electronegative element is oxygen by which it can easily gain electrons to form dinegative anion (O^{2-}),while sulphur is not so electronegative element as oxygen.

The covalency of an atom is the number of electrons it shares with other atoms when forming chemical bonds. So covalency of oxygen is two as it forms a double bonds (as H_2O).

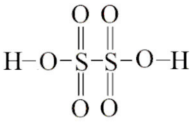
1185. Which of the following are peroxyacids of sulphur?

(a) H_2SO_5 and $H_2S_2O_8$ (b) H_2SO_5 and $H_2S_2O_7$
(c) $H_2S_2O_7$ and $H_2S_2O_8$ (d) $H_2S_2O_6$ and $H_2S_2O_7$

[AIIMS-2017]

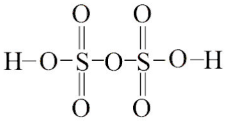
Ans. (a): Peroxyacids have peroxy linkage which means there should be a bond between oxygen and oxygen (O – O) in a compound.

H_2SO_5, $H_2S_2O_8$ have peroxy linkage and thus are peroxy acids.



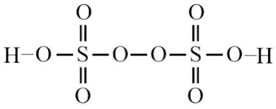
$$H-O-\overset{O}{\underset{O}{\overset{\|}{\underset{\|}{S}}}}-\overset{O}{\underset{O}{\overset{\|}{\underset{\|}{S}}}}-O-H$$

dithionic acid
($H_2S_2O_6$)



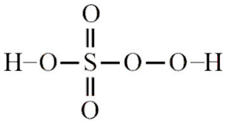
$$H-O-\overset{O}{\underset{O}{\overset{\|}{\underset{\|}{S}}}}-O-\overset{O}{\underset{O}{\overset{\|}{\underset{\|}{S}}}}-O-H$$

Oleum
pyrosulphuric acid
($H_2S_2O_7$)



$$H-O-\overset{O}{\underset{O}{\overset{\|}{\underset{\|}{S}}}}-O-O-\overset{O}{\underset{O}{\overset{\|}{\underset{\|}{S}}}}-O-H$$

Peroxodisulphuric acid ($H_2S_2O_8$)



$$H-O-\overset{O}{\underset{O}{\overset{\|}{\underset{\|}{S}}}}-O-O-H$$

Peroxomonosulphuric acid (H_2SO_5)

1186. Oxygen is more electronegative than sulphur, yet H_2S is acidic while H_2O is neutral. This is because

(a) Water is a highly associated.
(b) H–S bond is weaker than H–O bond.
(c) H_2S is a gas while H_2O is a liquid.
(d) The molecular weight of H_2S is more than that of H_2O.

[AIIMS-2012]

Ans. (b): H–S bond is weaker than H–O bond due to large size of S (Sulphur). Moreover, due to high electronegativity of oxygen it forms hydrogen bond in H_2O.

1187. Which one of the following is the correct decreasing order of boiling point?

(a) $H_2Te > H_2O > H_2Se > H_2S$
(b) $H_2O > H_2S > H_2Se > H_2Te$
(c) $H_2Te > H_2Se > H_2S > H_2O$
(d) $H_2O > H_2Te > H_2Se > H_2S$

[AIIMS-2010]

Ans. (d): Van der waal's forces increases due to increase in molecular weight of hydrides of group 16 elements. So, boiling point also increases. But H_2O unexpectedly has highest boiling point due to presence of hydrogen bonding.

So, correct decreasing order of boiling point is

$H_2O > H_2Te > H_2Se > H_2S$

1188. S^{2-} and SO_3^{2-} can be distinguished by using

(a) $(CH_3COO)_2$ Pb (b) $Na_2[Fe(CN)_5NO]$
(c) both (a) and (b) (d) None of these

[AIIMS-2008]

Ans. (c): Both the reagents can be used to distinguish between S^{2-} and SO_3^{2-}

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Test with $(CH_3COO)_2Pb$:

$$S^{2-} + (CH_3COO)_2Pb \rightarrow \underset{\text{(black ppt)}}{PbS\downarrow} + 2CH_3COO^-$$

$$SO_3^{2-} + (CH_3COO)_2Pb \rightarrow \underset{\text{(white ppt)}}{PbSO_4\downarrow} + 2CH_3COO^-$$

Test with $Na_2[Fe(CN)_5NO]$:

$$S^{2-} + Na_2[Fe(CN)_5NO] \rightarrow \underset{\text{(Violet)}}{Na_4[Fe(CN)_5NOS]}$$

$$SO_3^{2-} + Na_2[Fe(CN)_5NO] \rightarrow \underset{\text{(Purple)}}{Na_4[Fe(CN)_5NO.SO_3]}$$

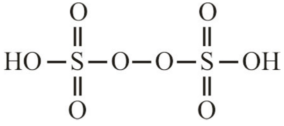
1189. Peroxydisulphuric acid has the following bond:

(a) $O \leftarrow O = O$ (b) $\leftarrow O = O \rightarrow$

(c) $> O \rightarrow O <$ (d) $-O-O-$

[AIIMS-2008]

Ans. (d): The structure of Peroxydisulphuric acid ($H_2S_2O_8$) is



$$HO-\overset{\overset{O}{\|}}{\underset{\underset{O}{\|}}{S}}-O-O-\overset{\overset{O}{\|}}{\underset{\underset{O}{\|}}{S}}-OH$$

Peroxide linkage

Thus, Peroxydisulphuric acid contains peroxide i.e. –O–O– bond.

1190. The element which is the most abundant in the earth crust is

(a) O (b) S

(c) Al (d) H

[AIIMS-2007]

Ans. (a) : The most abundant element in the earth's crust is oxygen (46.1 % by weight) followed by silica and aluminium.

1191. The incorrect statement among the following is:

(a) C_{60} is an allotropic form of carbon.

(b) O_3 is an allotropic form of oxygen.

(c) S_8 is the only allotropic form of sulphur.

(d) Red phosphorus is more stable in air than white phosphorus.

[AIIMS-2006]

Ans. (c):

- C_{60} is an allotropic form of carbon which is true.
- O_3 is an allotropic form of oxygen which is also true.
- But sulphur has different allotropes such as monoclinic sulphur, plastic sulphur, orthorhombic sulphur etc. Thus, S_8 is not the only allotrope of sulphur.
- And red phosphorus is more stable than white phosphorus in air, this is also true.

1192. Hypo on treatment with iodine produces :

(a) H_2S (b) Na_2SO_4

(c) Na_2SO_3 (d) $Na_2S_4O_6$

[AIIMS-2000]

Ans. (d): Sodium thiosulphate is an important inorganic salt with several medical uses. It also called sodium hyposulfite or 'hypo'.

Hypo ($Na_2S_2SO_3$) on treatment with iodine produces sodium tetrathionate such as;

$$\underset{\text{Sodiumthiosulphate}}{2Na_2S_2O_3} + I_2 \rightarrow \underset{\text{Sodiumtetrathionate.}}{Na_2S_4O_6} + 2NaI$$

1193. H_2S does produce metallic sulphide with :

(a) $CuCl_2$ (b) $COCl_2$

(c) $CdCl_2$ (d) $ZnCl_2$

[AIIMS-1997]

Ans. (b): H_2S is the group reagent for II and IV group of basic redicals (cations). So with $CoCl_2$ (no metal here), no metallic sulphide will be produced.

1194. Which gas cannot be collected over water ?

(a) O_2 (b) PH_3

(c) N_2 (d) SO_2

[AIIMS-1997]

Ans. (d): Insoluble gases don't dissolve in water and thus can be collected over it. For example, Nitrogen, Oxygen, carbon dioxide etc. Soluble gases dissolve easily in water and thus can't be separated from it.

Here, sulphur dioxide (SO_2) cannot be collected over water because it reacts with water forming H_2SO_3 as;

$SO_2 + H_2O \rightarrow H_2SO_3$

1195. The sodium extract of an organic compound on acidification with acetic acid and addition of lead acetate solution gives a black precipitate. The organic compound contains

(a) nitrogen (b) halogen

(c) sulphur (d) phosphorus

VITEEE-2014

Ans. (c) :

$$Na_2S + (CH_3COO)_2Pb \rightarrow \underset{\text{(Black ppt)}}{Pbs} + 2CH_3COONa$$

The organic compounds containing sulphur when react with sodium metal give Na_2S. The Na_2S when react with lead acetate forms black ppt of PbS.

1196. Out of $H_2S_2O_3$, $H_2S_2O_4$, H_2SO_5, and $H_2S_2O_8$ peroxy acids are

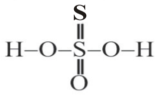
(a) $H_2S_2O_3$, $H_2S_2O_8$ (b) H_2SO_5, $H_2S_2O_8$

(c) $H_2S_2O_4$, H_2SO_5 (d) $H_2S_2O_3$, $H_2S_2O_4$

VITEEE-2013

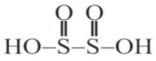
Ans. (b) : Peroxy acids have peroxy linkage(–O–O–)

(i) $H_2S_2O_3$



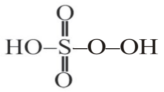
$$H-O-\overset{\overset{S}{\|}}{\underset{\underset{O}{\|}}{S}}-O-H$$

(ii) $H_2S_2O_4$



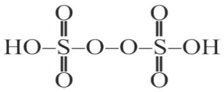
$$HO-\overset{\overset{O}{\|}}{S}-\overset{\overset{O}{\|}}{S}-OH$$

(iii) H_2SO_5



$$HO-\overset{\overset{O}{\|}}{\underset{\underset{O}{\|}}{S}}-O-OH$$

(iv) $H_2S_2O_8$



$$HO-\overset{\overset{O}{\|}}{\underset{\underset{O}{\|}}{S}}-O-O-\overset{\overset{O}{\|}}{\underset{\underset{O}{\|}}{S}}-OH$$

Here, in option (b) H_2SO_5 and $H_2S_2O_8$ have peroxy linkage. Thus, it is clear that H_2SO_5 and $H_2S_2O_8$ are peroxy acids.

1197. Which pair of oxyacids of phosphorus contains 'P–H' bonds?

(a) H_3PO_4, H_3PO_3 (b) $H_3PO_5, H_4P_2O_7$

(c) H_3PO_3, H_3PO_2 (d) H_3PO_2, HPO_3

VITEEE- 2009

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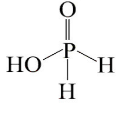
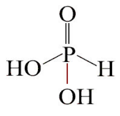
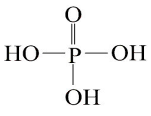
Ans. (b) :



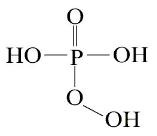
H_3PO_2



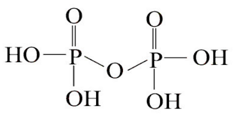
H_3PO_3



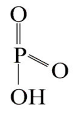
H_3PO_4



H_3PO_5



$H_4P_2O_7$



HPO_3

The structure of H_3PO_2, H_3PO_3, H_3PO_4, H_3PO_5, $H_4P_2O_7$ and HPO_3 is shown above.

From these structure we can conclude that H_3PO_2 and H_3PO_3 Contains P – H bonds.

H_3PO_2 contain two P – H bonds and H_3PO_3 contain one P–H bond.

1198. Which of the following statements regarding sulphur is not correct?

(a) At about 1000 K, it mainly consists of S_2 molecules

(b) The oxidation state of sulphur is never less than +4 in its compounds

(c) S_2 molecule is paramagnetic

(d) Rhombic sulphur is readily soluble in CS_2

AP-EAMCET – 2016

Ans. (b) : Sulphur crystal containing cyclic S_8 rings packed in a manner which leads to the formation of rhombic crystal. S_2 molecule is a paramagnetic. It is fairly soluble in CS_2, sparingly soluble in alcohol and ether. Whereas, totally insoluble in water. The oxidation state of sulphur in its compound is never less then +4 e.g. H_2SO_3, H_2SO_5, $H_2S_2O_8$, $H_2S_2O_6$ etc.

1199. Which of the following reactions does not involve liberation of oxygen?

(a) $XeF_4 + H_2O \rightarrow$ (b) $XeF_4 + O_2F_2 \rightarrow$

(c) $XeF_2 + H_2O \rightarrow$ (d) $XeF_6 + H_2O \rightarrow$

AP-EAMCET – 2016

Ans. (d) :

(i) $6XeF_4 + 12H_2O \rightarrow 4Xe + 2XeO_3 + 24HF + 3O_2$

(ii) $XeF_4 + O_2F_2 \rightarrow XeF_6 + O_2$

(iii) $2XeF_2 + 2H_2O \rightarrow 2Xe + 4HF + O_2$

(iv) $XeF_6 + 3H_2O \rightarrow XeO_3 + 6HF$

Hence, Xenonhexafluoride on reaction with water does not give the oxygen as a product.

1200. Which one of the following statements is not correct?

(a) O_3 is used as a germicide

(b) In O_3, $O-O$ bond length is identical with that of molecular oxygen

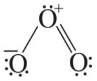
(c) O_3 is an oxidizing agent

(d) The shape of O_3 molecule is angular

AP-EAMCET – 2016
WB-JEE-2010, 2008

Ans. (b) : Ozone (O_3) is a polar molecule with a dipole moment of 0.53D. In O_3, O–O bond length is 1.278Å whereas O_2 bond length is 1.21Å. Thus, the bond length are not equal. Hence, given statement is false.

- Ozone is an unstable, colorless gas. It is powerful oxidizer and a potent germicide. Hence, statement is true.
- Ozone acts as a powerful oxidizing agent because it decomposes readily on heating to form a molecule of oxygen along with nascent oxygen. Nascent oxygen is a free radical which is very reactive in nature. Thus, it acts as a powerful oxidizing agent. Hence, statement is true.
- Ozone has sp^2 hybridisation with bent shaped.



Hence, statement is true.

1201. What is the formula of calgon ?

(a) $(NaPO_3)_6$ (b) $Mg_3(PO_4)_2$

(c) Na_3PO_4 (d) $MgSO_4$

AP-EAMCET (Engg.)-2004

Ans. (a) : The molecular formula of calgon is $(NaPO_3)_6$. It contains the sodium, phosphorus and oxygen elements. It's chemical name is sodium hexametaphosphate. It is used for removal of hardness of water.

1202. The oxidation numbers of sulphur in S_8, SO_2 and H_2S respectively are

(a) 0, +6, – 2 (b) 0, +4, – 2

(c) 0, +1, + 2 (d) 0, +1, – 2

AP- EAMCET(Medical) -2010

Ans. (b): The given species are S_8, SO_2 and H_2S. In the molecular form, the oxidation state is always zero. So, the S_8 has the 0 oxidation state.

For SO_2 —	For H_2S —
$+x + 2(-2) = 0$	$2(+1) + x = 0$
or $x = +4$	or $x = -2$

1203. Which one of the following is most acidic?

(a) H_2O (b) H_2S

(c) H_2Te (d) H_2Se

AP-EAMCET- (Engg.) - 2010

Ans. (c) : On going up to down in group, size of atom increase and bond length also increase. Thus the bond dissociation energy decreases. Since H_2Te gives a proton (H^+) more readily. Hence, it is most acidic among the given.

$$H_2Te + H_2O \longrightarrow H_3O^+ + HTe^-$$

1204. $Na_2S_2O_3$ reacts with moist Cl_2 to form Na_2SO_4, HCl and X. Which one of the following is X?

(a) H_2S (b) SO_2

(c) SO_3 (d) S

AP-EAMCET (Engg.) 2013

Ans. (d) :

$$Na_2S_2O_3 + Cl_2 + H_2O \longrightarrow Na_2SO_4 + 2HCl + S(X)$$

$Na_2S_2O_3$ (sodium thiosulphate) is oxidised by moist Cl_2 to form sulphur precipitates.

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1205. The first four elements in group 16 are collectively known as

(a) halogens (b) chalcogens

(c) noble gases (d) carbon family.

SRMJEEE – 2010

Ans. (b) : The first four elements in group -16 are collectively known as chalcogens and elements are oxygen (O), Sulphur (S), Selenium (Se), and Tellurium (Te).

1206. The anhydride of H_2SO_4 is

(a) SO_2 (b) $H_2S_2O_7$

(c) H_2SO_3 (d) SO_3

SRMJEEE – 2011

Ans. (d) : The sulphuric acid (H_2SO_4) decomposes to give sulphur trioxide (SO_3) and H_2O. Thus SO_3 is regarded as anhydride of sulphuric acid.

$$H_2SO_4 \xrightarrow[-H_2O]{} SO_3 + H_2O$$

1207. The number of cations produced by Mohr's salt in solution is

(a) 1 (b) 2

(c) 3 (d) 4

SRMJEEE-2015

Ans. (c) : The formula of Mohr's salt is $Fe\ SO_4.(NH_4)_2SO_4.\ 6H_2O$

$FeSO_4.\ (NH_4)_2SO_4.\ 6H_2O \rightarrow Fe^{2+} + 2NH_4^+ + 2SO_4^{2-} + 6H_2O$

Therefore, three cation ($2NH_4^+$ and Fe^{2+}) are produced by Mohr's salt in the solution.

1208. Basicity of dithionic acid is

(a) two (b) one

(c) three (d) four.

AMU-2019

Ans. (a) : Dithionic acid with chemical formula $H_2S_2O_6$, is a chemical compound known only in solution. The basicity of dithionic acid is two.

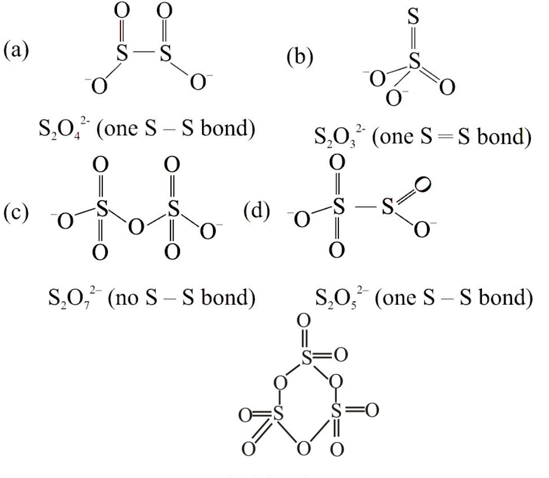
1209. The number of S–S bonds in sulphur trioxide trimer (S_3O_9) is

(a) 3 (b) 2

(c) 1 (d) 0

AMU-2019

Ans. (d) : Zero


(a)
$S_2O_4^{2-}$ (one S – S bond)
(b)
$S_2O_3^{2-}$ (one S = S bond)
(c)
$S_2O_7^{2-}$ (no S – S bond)
(d)
$S_2O_5^{2-}$ (one S – S bond)

(s-s) bond = zero

1210. Arrange H_2O, H_2S and H_2Se in order of increasing acidity.

(a) $H_2O < H_2S < H_2Se$ (b) $H_2S < H_2O < H_2Se$

(c) $H_2Se < H_2S < H_2O$ (d) $H_2O < H_2Se < H_2S$

AMU-2017

Ans. (a) : Because of decrease in bond dissociation enthalpy, acidity of hydrides increases down the group. Increasing order of acidity is ;

$H_2O < H_2S < H_2Se$

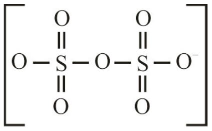
1211. The species having no S – S bond is

(a) $S_2O_4^{2-}$ (b) $S_2O_3^{2-}$

(c) $S_2O_7^{2-}$ (d) $S_2O_5^{2-}$

AMU-2015

Ans. (c) : $S_2O_7^{2-}$ species having no S–S bond



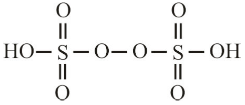
1212. Which of the following gas -O-O- linkage?

(a) $H_2S_2O_6$ (b) $H_2S_2O_8$

(c) $H_2S_2O_3$ (d) $H_2S_4O_6$

WB JEE-2016, AMU-2011

Ans. (b) : $H_2S_2O_8$ is a peroxy acid and has –O–O– linkage.



Peroxodisulphuric acid.

1213. Which of the following statement is incorrect?

(a) H_2S is less acidic than H_2Se

(b) H_2S is less acidic than H_2Te

(c) H_2Te is less acidic than H_2Se

(d) H_2Se is less acidic than H_2Te

AIIMS 2011

Ans. (c) : The acidity of the hydrides of the elements of the group increases with increasing size of the central atom. Hence, for the group 16 hydrides, the acidic character increases as $H_2O<H_2S<H_2Se<H_2Te$.

1214. The acidity of hydrides of O, S, Se and Te varies in the order

(a) $H_2O> H_2S> H_2Se> H_2Te$

(b) $H_2O< H_2S< H_2Se< H_2Te$

(c) $H_2S> H_2O> H_2Se> H_2Te$

(d) $H_2Se> H_2S> H_2O> H_2Te$

AMU-2005

Ans. (b) : The acidic nature increases from H_2O to H_2Te. The increase in acidic character of hydrides on moving down the group may be explained in terms of bond length of H–M bond. Larger is bond-length, lesser is bond energy and thus easier is ionisation of H–M bond or easier in proton donor nature.

$H_2O < H_2S < H_2Se < H_2Te$

1215. Hypo phosphorus acid, H_3PO_2 is :

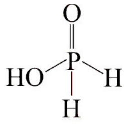
(a) a monobasic acid (b) a tribasic acid

(c) a dibasic acid (d) not acidic at all

BCECE-2006

@apna_pdf

Ans. (a) : Hypo phosphorus acid (H_3PO_2) gives basicity according to number of (–OH) group attached to phosphorous in its structure. Thus, H-atoms gives reducing character.



H_3PO_2

As only one (–OH) group is attached to phosphorous atom.

It is a monobasic acid.

1216. In presence of moisture, SO_2 can :

(a) act as oxidant (b) act as reductant

(c) gain electron (d) not act as reductant

BCECE-2006

Ans. (b) : In the presence of moisture, SO_2 act as a reducing agent by losing electrons . It reduces hydrogen peroxide into water.

$$SO_2 + 2H_2O \rightarrow H_2SO_4 + 2H$$

$$H_2O_2 + 2H \rightarrow 2H_2O$$

The bleaching action of SO_2 is due to its reducing property, presence of moisture and SO_2 given bleaching

$$SO_2 + 2H_2O \rightarrow H_2SO_4 + 2[H]$$

$$\text{Colouring matter} + 2H \xrightleftharpoons{\text{air}} \text{colourless compound.}$$

Note – sulphur dioxide acts as bleaching agent in presence of moisture, it is due to liberation of Nascent hydrongen.

1217. Fuming sulphuric acid is :

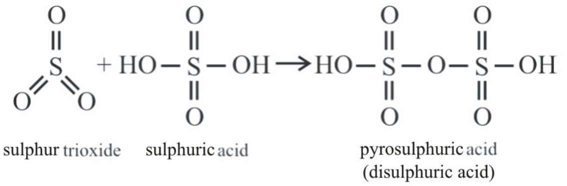
(a) $H_2SO_4 + SO_3$ (b) $H_2SO_4 + SO_2$

(c) H_2SO_4 (d) $H_2SO_4 + SO_4$

BCECE-2004

Ans. (a) : Fuming sulphuric acid is also called 'oleum', is produced by adding sulphur trioxide, SO_3 to sulfuric acid. It mostly contains disulphuric acid (also called pyrosulphuric acid).

$$H_2S_2O_7(H_2SO_4 + SO_3) \rightarrow \text{Fuming sulphuric acid}$$



1218. S – S bond is not present in :

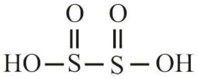
(a) $H_2S_2O_4$ (b) $H_2S_2O_6$

(c) $H_2S_2O_8$ (d) none of these

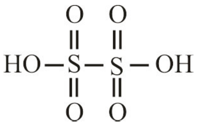
BCECE-2004

Ans. (c)

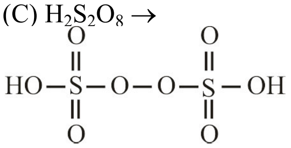
(A) $H_2S_2O_4 \rightarrow$



(B) $H_2S_2O_6 \rightarrow$



(C) $H_2S_2O_8 \rightarrow$



Thus, except $H_2S_2O_8$, all contains S–S bond.

1219. Ozone is used for purifying water because

(a) it dissociates and release oxygen

(b) do not leave any foul smell like chlorine

(c) kills bacteria, cyst, fungi and acts as a biocide

(d) All of the above

BCECE-2008

Ans. (d) : Ozone is used to purify water because ozone kills, bacteria, cysts, fungi, mold, parasites, viruses, contaminates etc.

O_3 → O_2 + [O] → Weak oxygen
↓ ↓
Ozone Oxygen

• We are getting oxygen to breath as a product, and it does not give any foul smell like chlorine.

• Weak oxygen is the strong oxidizing agent.

[O] + Carbon-compound→ kills bacteria by oxidization
↓
Like, bacteria, fungi, etc.

Hence, the option (d) is correct.

1220. An element is oxidized by fluorine and not by chlorine. Identify the element.

(a) Sodium (b) Aluminum

(c) Oxygen (d) Sulphur

BCECE-2013

Ans. (c) : Fluorine is more electronegative element than oxygen and oxygen is more electronegative than chlorine.

Hence, fluorine can oxidise oxygen whereas, chlorine reduced oxygen.

1221. The oxoacid of sulphur which contains two sulphur atoms in different oxidation states is –

(a) pyrosulphurous acid

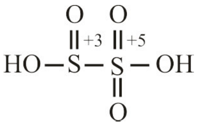
(b) hyposulphurous acid

(c) pyrosulphuric acid

(d) persulphuric acid

BCECE-2014

Ans. (a) : The oxidation states of two S atoms in pyrosulphurous acid or disulphurous acid ($H_2S_2O_5$) are different i.e. +3 and +5 state.



Pyrosulphurous acid

Note – The salts of disulphurous acid are called disulphites or metabisulphites.

1222. Sulphur (s) when react with HNO_3 (conc.) mainly gives

(a) H_2SO_4, NO_2 and H_2O (b) H_2S, N_2O_5 and SO_2

(c) H_2SO_3, NO_2 and SO_2 (d) SO_2, NO_2 and H_2O

BCECE-2017

@apna_pdf

Ans. (a) : When sulphur reacts with concentrated nitric acid (HNO_3), sulphuric acid (H_2SO_4), nitrogen dioxide (NO_2) and water are formed as the products.
The reaction is as follows:-

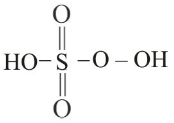
$$S + 6HNO_3 \rightarrow H_2SO_4 + 6NO_2 + 2H_2O$$

1223. Caro's acid is

(a) H_2SO_3	(b) $H_2S_2O_5$
(c) H_2SO_5	(d) $H_2S_2O_8$

[BITSAT-2005]

Ans. (c) : Caro's acid is peroxy monosulphurio acid (H_2SO_5).



$$HO-\overset{\overset{\large O}{\|}}{\underset{\underset{\large O}{\|}}{S}}-O-OH$$

Hybrid state of S = sp^3
Oxidation state of S = + 6

1224. Bleaching action of SO_2 is due to its

(a) oxidising property	(b) acidic property
(c) reducing property	(d) basic property

[BITSAT-2007]

Ans. (c) : Sulphur dioxide is a good reductant. In the presence of water, SO_2 is able to decolorise substances. Specifically it is a useful reduction bleach for papers and delicate materials such as clothes.

$$SO_2 + H_2O \rightleftharpoons H_2SO_3 \rightleftharpoons 2H^+ + SO_3^-$$
$$SO_3^- + O \rightarrow SO_4^{2-}$$
$$SO_4^{2-} + dye \rightarrow reduced\,dye$$

This bleaching effect normally does not last very long. Oxygen in the atmosphere reoxidises the reduced dyes, restoring the colour.

1225. Which of the following behaves as both oxidising and reducing agents?

(a) H_2SO_4	(b) SO_2
(c) H_2S	(d) HNO_3

[BITSAT-2006]

Ans. (b) : SO_2 has an O.N. of +4 which is neither highest (i.e. +6) nor lowest (i.e. t –2) therefore, it can act both as an oxidizing as well as a reducing agent.
Other H_2O_2, MnO_2 also act as both oxidizing and reducing agent.

1226. Which of the following is not a member of chalcogens?

(a) O	(b) S
(c) Se	(d) Po

[BITSAT-2018]

Ans. (d) : Group 16 of the periodic table is known as chalcogens. This group also called oxygen family.

- It consists of the elements oxygen (O), sulphur (S), selenium (Se), tellurium (Te), and the radioactive element polonium (Po).
- But polonium (Po) is a radioactive element and it is one of the rarest element in the group. It is also harmful due to its radioactivity. Thus we can say that polonium is not considered as a chalcogen.

Electronic configuration of chalcogen –

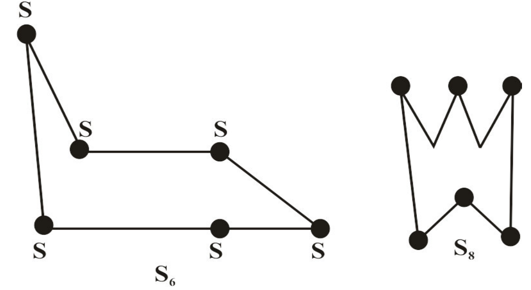
- Oxygen (O) – [He] $2s^2 2p^4$
- Sulphur (S) – [Ne] $3s^2 3p^4$
- Selenium (Se) – [Ar] $3d^{10} 4s^2 4p^4$
- Tellurium (Te) – [Kr] $4d^{10} 5s^2 5p^4$
- Polonium (Po) – [Xe] $4f^{14} 5d^{10} 6s^2 6p^4$

1227. Identify the incorrect statement:

(a) The S–S–S bond angles in the S_8 and S_6 rings are the same.
(b) Rhombic and monoclinic sulphur have S_8 molecules.
(c) S_2 is paramagnetic like oxygen
(d) S_8 ring has a crown shape.

[BITSAT-2021]

Ans. (a) : The S_6 molecule has a chair-form hexagon ring with the same bond length as that in S_8, but with somewhat smaller bond angles i.e. bond lengths are same but bond angles are different.



1228. Point out in which of the following properties oxygen differs from the rest of the members of its family (Group-VIA)?

(a) High value of ionisation energies
(b) Oxidation states (2,4,6)
(c) Polymorphism
(d) Formation of hydrides

CG PET -2007

Ans. (b) : Oxygen does not show + 4 and + 6 oxidation state.

Oxygen shows –2, –1, $-\frac{1}{2}$, 0, + 1 and + 2 oxidation state.

1229. In the formation of SO_3 according to following equilibrium $2SO_2 + O_2 \rightleftharpoons 2SO_3 + Heat$, which conditions favour the formation of SO_3?

(a) Low pressure
(b) Low concentration of oxygen
(c) Low temperature and used of catalyst
(d) High temperature without using catalyst

CG PET -2004

Ans. (c) : The given reaction is exothermic as heat is released during the reaction. For an exothermic reaction, on decreasing the temperature equilibrium will shift in forward direction. Hence, low temperature will be favoured for formation of SO_3.
According to the Le Chatelier's principle, on increasing pressure, equilibrium will shift in the direction where lesser number of gaseous moles are present. Hence, on increasing pressure equilibrium will shift in forward direction for the given system. Hence, high pressure is favourable for greater yield of SO_3.

@apna_pdf

1230. The formula of phosphate of a metal, M is MNH_4PO_4. The formula of its sulphate will be

(a) MSO_4 (b) $M(SO_4)_2$

(c) M_2SO_4 (d) $M_2(SO_4)_3$

CG PET -2004

Ans. (a) : The oxidation state of metal (M) in MNH_4PO_4 is +2 so the molecular formula of its sulphate will be MSO_4.

1231. Match List-I with List-II and select the correct answer using the codes give below

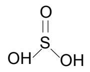
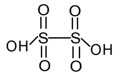
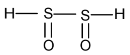
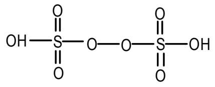
ListI (Oxyacid of sulphur)		List II (Oxidation state of sulphur)	
A.	H_2SO_3	1.	+1
B.	$H_2S_2O_6$	2.	+6
C.	$H_2S_2O_2$	3.	+4
D.	$H_2S_2O_8$	4.	+5

Codes

	A	B	C	D
(a)	4	3	2	1
(b)	2	1	3	4
(c)	4	3	2	1
(d)	3	4	1	2

CG PET -2017

Ans. (d) : The correct match for the given List I and II is as follows

Oxyacid	Structural representation	Oxidation state
H_2SO_3		+4
$H_2S_2O_6$		+5
$H_2S_2O_2$		+1
$H_2S_2O_8$		+6

1232. Which one of the following is used for water softening?

(a) $Ca_3 (PO_4)_2$ (b) Na_3PO_4

(c) $Na_2 [Na_4(PO_3)_6]$ (d) Na_2HPO_4

S. C. R. A - 2014

Ans. (c) : Sodium hexametaphosphate ($Na_2 [Na_4(PO_3)_6]$) commercially called 'calgon' is used for water softening.

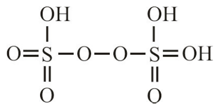
1233. In which of the following oxoacid of Sulphur, S-O-O-S bond is present?

(a) $H_2S_2O_7$ (b) $H_2S_2O_8$

(c) $H_2S_2O_4$ (d) $H_2S_2O_3$

GUJCET-2020

Ans. (b) :



$H_2S_2O_8$ (Marshall's acid/peroxy disulphuric acid)

1234. In manufacturing of sulphuric acid in presence of platinum catalyst, which metal impurity acts as catalytic poison?

(a) Fe (b) Cr

(c) Cu (d) V

GUJCET-2018

Ans. (b) : In the manufacturing of sulphuric acid in presence of platinum catalyst, arsenic metal impurity (in the form of As_2O_3) acts as a catalytic poison

Cr → behaves like negative catalyst poison.

1235. Which type of colloid is the dissolution of sulphur (S_8)?

(a) Macromolecular colloid

(b) Micelle

(c) Multimolecular colloid

(d) Associated colloid

GUJCET-2016

Ans. (c) : By dissolution, a large number of atoms or smaller molecules of a substance aggregate together to form species having a size in the colloidal range (1–1000nm). The species thus formed are called Multimolecular colloids.

1236. What is the catalyst used in the manufacture of sulphuric acid by contact process?

(a) Nickel powder (b) Platinised asbestos

(c) Anhydrous Al_2O_3 (d) Aluminium powder

AP EAMCET- 2000

Ans. (b) : Platinised asbestos is used in the manufacture of sulphuric acid. The contact process is a method to produce sulfuric acid in the high concentrations needed for industrial processes. Platinum is originally used as the catalyst for this reaction.

$$2SO_2 + O_2 \xrightleftharpoons[400-500^\circ C, 1-5atm]{\text{Platinised}} 2SO_3$$

1237. The correct order of electron gain enthalpy is

(a) S > Se > Te > O (b) Te > Se > S > O

(c) O > S > Se > Te (d) S > O > Se > Te

(JEE Main 2021, 26 Feb Shift-II)

Ans. (a) : Because of the small size leading to repulsion of the incoming electron second period elements (here oxygen) have low electron gain enthalpy than other element of the column. S has the highest enthalpy. Correct order of electron gain enthalpy is S > Se > Te > O

1238. Given below are two statement-

Statement-I α and β- forms of sulphur can change reversibly between themselves with slow heating or slow cooling.

Statement-II At room temperature, the stable crystalline form of sulphur is monoclinic sulphur.

In the light of the above statements, choose the correct answer from the options given below.

(a) Both statement I and II are true.

(b) Both statements I and II are false.

(c) Statement I is true but statement II is false

(d) Statement I is false but statement II is true.

(JEE Main 2021, 25 Feb Shift-II)

@apna_pdf

Ans. (c) : $\alpha-\text{sulphur} \underset{<369K}{\overset{>369K}{\rightleftharpoons}} \beta-\text{sulphur}$

At room temperature α-sulphur (Rhombic) is most stable form.

1239. Among the following allotropic forms of sulphur, the number of allotropic forms, which will show paramagnetism is..................

(a) α-sulphur
(b) β-sulphur
(c) S_2-form

(JEE Main 2021, 24 Feb Shift-II)

Ans. (a) : Only S_2 – From of sulphur is paramagnetic in nature, because S_2 is like O_2 i.e. paramagnetic as per molecular orbital theory. It contains unpaired electron.

α-sulphur and β-sulphur are diamagnetic as they do not have unpaired electron.

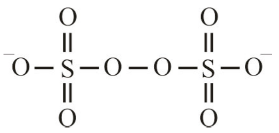
1240. The number of bonds between sulphur and oxygen atoms in $S_2O_8^{2-}$ and the sulphur atoms in rhombic sulphur, respectively, are rhombic sulphur, respectively, are

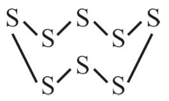
(a) 4 and 6
(b) 8 and 8
(c) 4 and 8
(d) 8 and 6

(JEE Main 2020, 8 Jan Shift-I)

Ans. (b) : We have to count S–O single bonds as well as S=O in $S_2O_8^{2-}$, as each double bond also has one sigma bond.

The structure of $S_2O_8^{2-}$ and S_8 is shown below,





1241. The acidic, basic and amphoteric oxides, respectively, are

(a) Cl_2O, CaO, P_4O_{10}
(b) N_2O_3, Li_2O, Al_2O_3
(c) Na_2O, SO_3, Al_2O_3
(d) MgO, Cl_2O, Al_2O_3

(JEE Main 2020, 9 Jan Shift-I)

Ans. (b) : Acidic oxides are mostly oxides of non-metals and they dissolve in water to form acids.

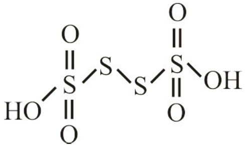
- Non-metal oxides are acidic in natures N_2O_3. Basic oxides are always oxides of metals.
- They combine with water to form bases which are usually called metal hydroxides.
- Alkali metal oxides are basic in nature- Li_2O an amphoteric oxide is an oxide that can act as either an acid or base in a reaction to produce a salt and water. Al_2O_3 is amphoteric oxide.

1242. The oxoacid of sulphur that does not contain bond between sulphur atoms is

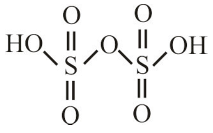
(a) $H_2S_2O_3$
(b) $H_2S_2O_4$
(c) $H_2S_2O_7$
(d) $H_2S_4O_6$

(JEE Main 2019, 10 April Shift-I)

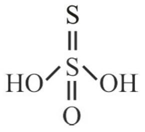
Ans. (c) : $H_2S_2O_7$ does not contain bond between sulphur atoms.



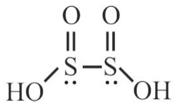
(I) $H_2S_4O_6$



(II) $H_2S_2O_7$



(III) $H_2S_2O_3$



(IV) $H_2S_2O_4$

1243. When the first electron gain enthalpy $(\Delta_{e_g}H)$ of oxygen is –141 kJ/mol, its second electron gain enthalpy is

(a) a positive value
(b) a more negative value than the first
(c) almost the same as that of the first
(d) negative, but less negative than the first

(JEE Main 2019, 9 Jan Shift-II)

Ans. (a) : As given, the first electron gain enthalpy of oxygen can be shown as,

$$O(g)+e^- \rightarrow O^-(g); \Delta e_g H_1 = -141 kJ/mol$$

The expression of second electron gain enthalpy of oxygen will be,

$$O^-(g)+e^- \rightarrow O^{2-}(g); \Delta e_g H_2 = +ve$$

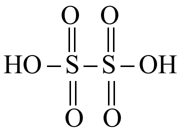
$\Delta e_g H_2$ of oxygen is positive, i.e. endothermic, because a strong electrostatic repulsion will be observed between highly negative O and the incoming electron (e^-). A very high amount energy will be consumed (endothermic) by the system to overcome the electrostatic repulsion.

1244. Which of the following has S-S bond?

(a) $H_2S_2O_6$
(b) $H_2S_2O_7$
(c) $H_2S_2O_8$
(d) Mustard gas

AP EAMCET- 2004

Ans. (a) : $H_2S_2O_6$ (Dithionic acid) contains S-S bond.



$$HO-\underset{\underset{O}{\|}}{\overset{\overset{O}{\|}}{S}}-\underset{\underset{O}{\|}}{\overset{\overset{O}{\|}}{S}}-OH$$

1245. Which of the following statements regarding sulphur is incorrect?

(a) S_2 molecule is paramagnetic
(b) The vapour at 200^0C consists mostly of S_8 rings
(c) At 600^0C, the gas mainly consists of S_2 molecules
(d) The oxidation state of sulphur is never less than +4 in its compounds

(AIEEE 2011)

Ans. (d) : Sulphur exhibit +2, +4, +6, oxidation states but +4 and +6 are more common.

@apna_pdf

1246. Which one of the following is an amphoteric oxide?

(a) ZnO (b) Na_2O

(c) SO_2 (d) B_2O_3

(AIEEE 2003)

Ans. (a) : Oxides made by metals which can act as a basic / acidic oxide.

ZnO – Amphoteric, Na_2O-basic, SO_2-acidic, B_2O_3-acidic

1247. Number of paramagnetic oxides among the following given oxides is Li_2O, Na_2O_2, KO_2, MgO and K_2O

(a) 1 (b) 2

(c) 3 (d) 0

(JEE Main 2021, 1 Sep Shift-II)

Ans. (a) : $Li_2O \rightarrow 2Li^+O^{2-}$

$MgO \rightarrow Mg^{2+}O^{2-}$

$K_2O \rightarrow 2K^+\,O^{2-}$,

$Na_2O_2 \rightarrow 2Na^+\,O_2^{2-}$

$KO_2 \rightarrow K^+\,O^{2-}$

O^{2-} = complete octet, diamagnetic

$O^{2-} \Rightarrow \sigma_{1s}^2\sigma_{1s}^{*2}\sigma_{2s}^2\sigma_{2s}^{*2}\sigma_{2px}^2\pi_{2py}^2 \simeq \pi_{2pz}^2\pi_{2py}^{*2} \simeq \pi_{2pz}^{*2}$ (dia)

$O_2^- \Rightarrow \sigma_{1s}^2\sigma_{1s}^{*2}\sigma_{2s}^2\sigma_{2s}^{*2}\sigma_{2px}^2\pi_{2py}^2 \simeq \pi_{2pz}^2\pi_{2py}^{*2} \simeq \pi_{2pz}^{*1}$ (para)

1248. Consider the sulphides HgS, PbS, CuS, Sb_2S_3, As_2S_3 and CdS.

Number of these sulphides soluble in 50% HNO_3 is

(JEE Main 2021, 31 Aug Shift-I)

Ans. (d) HgS → Aqua Regia

$PbS \rightarrow Pb(NO_3)_2 + H_2S$

$CuS \rightarrow Cu(NO_3)_2 + H_2S$

$Sb_2S_3 \rightarrow$ 50% HNO_3

$As_2S_3 \rightarrow As(NO_3)_3 + 3S + NO + H_2O$

$CdS \rightarrow Cd(NO_3)_2 + H_2S$

PbS, CuS, As_2S_3 and CdS are soluble in 50% HNO_3, HgS, Sb_2S_3 are insoluble in 50% HNO_3.

So the correct answer is option (d).

1249. In polythionic acid, $H_2S_xO_6$(X = 3 to 5) the oxidation state(s) of sulphur is/are

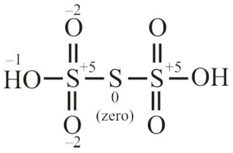
(a) only + 5 (b) only + 6

(c) +3 and +5 (d) 0 and +5

(JEE Main 2021, 27 Aug Shift-I)

Ans. (d) : When, x = 3

$H_2S_3O_6 \rightarrow$ 0 and +5



$HO-S(=O)_2-S-S(=O)_2-OH$

$\boxed{O.S.}\downarrow$

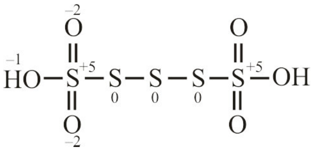
$H = +1$

$O = -2$

$-\overset{-2}{O}\overset{+1}{H} = -1$

When,

x = 5 $H_2S_5O_6 \rightarrow$ 0 and +5



$HO-S(=O)_2-S-S-S-S(=O)_2-OH$

1250. The product obtained from the electrolytic oxidation of acidified sulphate solutions, is

(a) HSO_4^- (b) HO_3SOOSO_3H

(c) HO_2SOSO_2H (d) HO_3SOSO_3H

(JEE Main 2021, 27 July Shift-I)

Ans. (b) : $2H_2SO_4 \rightarrow H_2S_2O_8 + 2H^+ + 2e^-$

$2H_2O \rightarrow O_2 + 4H^+ + 4e^-$

Cathode –

$e^- + H^+ \rightarrow \frac{1}{2}H_2$

Main product to electrolysis of conc. H_2SO_4 is HO_3SOOSO_3H or ($H_2S_2O_8$).

1251. Chalcogen group elements are

(a) Se, Tb and Pu (b) Se, Te and Po

(c) S, Te and Pm (d) 0, Ti and Po

(JEE Main 2021, 26 Aug Shift-II)

Ans. (b) : Group 16 of the periodic table is known as chalcogens. This group also called oxygen family.

- It consists of the elements oxygen (O), sulphur (S), selenium (Se), tellurium (Te), and the radioactive element polonium (Po).

1252. Which of the following oxyacids of sulphur has S-O-S linkage in its structure?

(a) Peroxodisulphuric acid

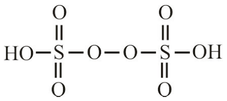
(b) Sulphuric acid

(c) Pyrosulphuric acid

(d) Sulphurous acid

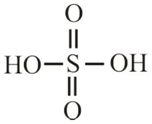
J & K CET-(2016)

Ans. (c) :



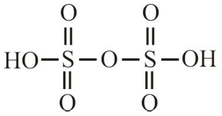
$HO-S(=O)_2-O-O-S(=O)_2-OH$

(a) Peroxodisulphuric acid ($H_2S_2O_8$)



$HO-S(=O)_2-OH$

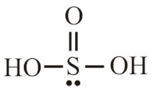
(b) Sulphuric acid (H_2SO_4)



$HO-S(=O)_2-O-S(=O)_2-OH$

(c) Pyrosulphuric acid ($H_2S_2O_7$)

(contains S–O–S linkage)



$HO-\ddot{S}(=O)-OH$

(d) Sulphurous acid (H_2SO_3)

1253. The catalyst for the oxidation of SO_2 to SO_3 and the manufacture of sulphuric acid by contact process is

(a) MoO_2 (b) V_2O_5

(c) CrO_3 (d) MnO_4

J & K CET-(2019)

@apna_pdf

Ans. (b) : $2SO_2 + O_2 \xrightleftharpoons{V_2O_5} 2SO_3$

SO_2 is oxidised by air in presence of V_2O_5 to SO_3.

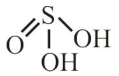
1254. The oxyacid of sulphur that contains a lone pair of electrons on sulphur is

(a) Sulphurous acid
(b) Sulphuric acid
(c) Peroxodisulphuric acid
(d) Pyrosulphuric acid

J & K CET-(2011)

Ans. (a) : Sulfurous acid H_2SO_3 is the oxyacid of sulphur that contains a lone pair of electrons in which 4 electrons are involved in bonding remaining 2 electrons are remained as a lone pair

∵ Sulphur has six valence electrons.



1255. Which one statement about sulphur dioxide gas is incorrect?

(a) It has an angular shape.
(b) It decolourises acidified potassium permanganate solution.
(c) Two S–O bonds are equal.
(d) It is a dehydrating agent

J & K CET-(2010)

Ans. (d) : Sulphur dioxide has angular shape because of the presence of one lone pair of electrons.

It reduces the acidified permanganate to Mn^{2+} thus, decolourises the acidified $KMnO_4$ solution.

$$5SO_2 + 2\underset{\text{coloured}}{MnO_4^-} + 2H_2O \rightarrow 5SO_4^{2-}$$

SO_2 is not a denydrating agent.

1256. Which one of the following is non-reducing?

(a) H_2S (b) H_2Te
(c) H_2Se (d) H_2O

J & K CET-(2009)

Ans. (d) : As the size of central metal atoms increases, H–X–H (Here, X = O, S, Se, Te) bond strength decreases and thus, the reducing power increases. The order of reducing power is $H_2O < H_2S < H_2Se < H_2Te$.

1257. The following is not an example of oxyacids of sulphur

(a) H_2SO_3 (b) $H_2S_2O_3$
(c) H_2SO_4 (d) SO_3

J & K CET-(2007)

Ans. (d) : Oxyacids are the compounds which contains hydrogen and oxygen along with main element.

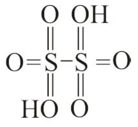
So, H_2SO_3, $H_2S_2O_3$, H_2SO_4 are the oxyacids of sulphur while SO_3 is the oxide of sulphur.

1258. The molecular formula of dithionic acid is

(a) $H_2S_2O_4$ (b) $H_2S_2O_6$
(c) $H_2S_2O_5$ (d) $H_2S_2O_7$

J & K CET-(2006)

Ans. (b) : The molecular formula of dithionic acid is



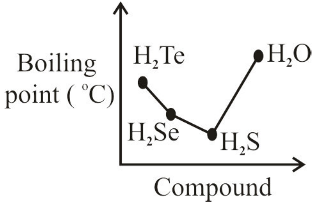
$(H_2S_2O_6)$

1259. Which of the following oxides of group 16 has the highest boiling point?

(a) H_2O (b) H_2S
(c) H_2Se (d) H_2Te

J & K CET-(2013)

Ans. (a) : Water has an abnormally high boiling point as it undergoes hydrogen bonding.



1260. The mass of carbon anode consumed (giving only carbondioxide) in the production of 270 kg of aluminium metal from bauxite by the Hall process is (Atomic mass Al = 27)

(a) 180 kg (b) 270 kg
(c) 540 kg (d) 90 kg

JCECE - 2012

Ans. (d) : In Hall and Heroult process

$$2Al_2O_3 \longrightarrow 4Al + 3O_2$$

$$4C + 3O_2 \longrightarrow 2CO_2 + 2CO\uparrow$$

Only for removal of CO_2, following equation is possible

$$2Al_2O_3 + \underset{3\times12=36}{3C} \longrightarrow \underset{4\times27=108}{4Al} + 3CO_2$$

∵ For 108 kg of Al, 36kg of C is required in above reaction

∴ For 270 kg of Al require amount of C

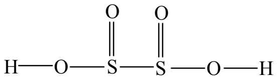
$$= \frac{36}{108} \times 270 = 90\text{kg}$$

1261. Sulphur in +3 oxidation state is present in

(a) Dithionous acid (b) Sulphurous acid
(c) Thionous acid (d) Phyrosulphuric acid

JCECE - 2015

Ans. (a) : Dithionous acid ($H_2S_2O_4$) has sulphur in +3 oxidation state.



Dithionous acid

Let oxidation state of sulphur is x.

$2 \times 1 + 4 \times (-2) + 2x = 0$

$2 - 8 + 2x = 0$

$2x = +6$

$x = +3$

1262. When a sulphur sol is evaporated, sulphur is obtained. On mixing with water, sulphur sol is not formed. The sol is

(a) Reversible (b) Hydrophobic
(c) Hydrophilic (d) Lyophilic

JCECE - 2017

Ans. (b): Sulphur solution being hydrophobic, is formed by the oxidation of H_2S gas as follows

$$2H_2S + O_2 \rightarrow 2H_2O + 2S$$

Direct addition of water does not form solution due to its hydrophobic nature.

@apna_pdf

1263. …………. is polyatomic molecule.

(a) Calcium (b) Oxygen
(c) Sulphur (d) Barium

JCECE - 2018

Ans. (c) : Polyatomic molecules are groups of three or more atoms held together by covalent bonds.

Sulphur is a polyatomic molecules as it exists in nature as S_6 and S_8.

1264. In which of the following compounds, sulphur show maximum oxidation number?

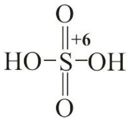
(a) H_2SO_4
(b) SO_3
(c) $H_2S_2O_7$
(d) All have same oxidation number for sulphur

JIPMER-2017

Ans. (d) : (i) Oxidation number of S in H_2SO_4 :

$x + 2 - 8 = 0$

$\therefore x = +6$

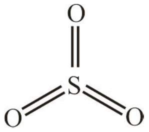


$$HO-\underset{\underset{O}{\|}}{\overset{\overset{O}{\|^{+6}}}{S}}-OH$$

(ii) Oxidation number of S in SO_3 :

$x - 6 = 0$

$\therefore x = +6$

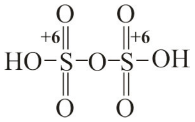


(iii) Oxidation number of S in $H_2S_2O_7$:

$= 2 + 2x - 14 = 0$

$2x = +12$

$\therefore x = +6$



$$HO-\underset{\underset{O}{\|}}{\overset{\overset{O}{{}^{+6}\|}}{S}}-O-\underset{\underset{O}{\|}}{\overset{\overset{O}{\|^{+6}}}{S}}-OH$$

[Where, x = Oxidation number of sulphur (S)]

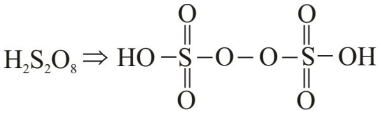
1265. Which of the following represents the correct order of decreasing number of S=O bonds?

(a) $H_2SO_4 > H_2SO_3 > H_2S_2O_8$
(b) $H_2S_2O_8 > H_2SO_3 > H_2SO_4$
(c) $H_2S_2O_8 > H_2SO_4 > H_2SO_3$
(d) $H_2SO_3 > H_2S_2O_8 > H_2SO_4$

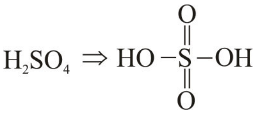
JIPMER-2015

Ans. (c) : Correct order of decreasing number of S = O bonds.

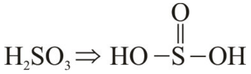
$H_2S_2O_8 > H_2SO_4 > H_2SO_3$



$$H_2S_2O_8 \Rightarrow HO-\underset{\underset{O}{\|}}{\overset{\overset{O}{\|}}{S}}-O-O-\underset{\underset{O}{\|}}{\overset{\overset{O}{\|}}{S}}-OH$$



$$H_2SO_4 \Rightarrow HO-\underset{\underset{O}{\|}}{\overset{\overset{O}{\|}}{S}}-OH$$



$$H_2SO_3 \Rightarrow HO-\overset{\overset{O}{\|}}{S}-OH$$

The number of S = O bond present in $H_2S_2O_8$, H_2SO_4 and H_2SO_3 are 4, 2 and 1 respectively.

1266. Oxidation state of oxygen in F_2O is

(a) + 1 (b) – 1
(c) + 2 (d) – 2

JIPMER-2009

Ans. (c) : In F_2O, as fluorine is more electronegative than oxygen, fluorine will have a negative charge and oxygen will have a positive charge. The oxidation state of fluorine is –1

Let the oxidation state of oxygen in F_2O is x.

$F_2O = 2(-1) + x = 0$

$-2 + x = 0$

$\boxed{x = +2}$

1267. Among the following, the correct formula of Marshall's acid is

(a) $H_2S_2O_6$ (b) $H_2S_2O_8$
(c) H_2SO_4 (d) H_2SO_5

JIPMER-2018

Ans. (b) : Peroxydisulfuric acid is the inorganic compound with the chemical formula $H_2S_2O_8$. Also called Marshall's acid.

1268. Sulphur sol contains

(a) Discrete S-atoms
(b) Discrete S molecules
(c) Large aggregates of S molecules
(d) Water dispersed in solid sulphur

Karnataka-CET-2016

Ans. (c) : A sulphur sol contains particles of various sizes composed of about a thousand molecules of sulphur.

Sulphur is a solution, contains large aggregates of sulphur molecules (S_8-molecules) so that they become in range of colloidal state.

1269. Excess of PCl_5 reacts with concentrated H_2SO_4 giving

(a) Chlorosulphonic acid (b) Sulphurous acid
(c) Sulphuryl chloride (d) Thionyl chloride

Karnataka-CET-2013

Ans.(c): $H_2SO_4 + 2PCl_5 \rightarrow SO_2Cl + 2POCl_3 + HCl$

Sulphuric acid sulphure echloride

PCl_5 reacts with cone H_2SO_4 to give sulphuryl chloride by replacing its hydroxyl groups with chlorine atoms.

1270. When sulphur dioxide is passed in an acidified $K_2Cr_2O_7$ solution, the oxidation state of sulphur is changed from

(a) +4 to 0 (b) +4 to +2
(c) +4 to +6 (d) +6 to +4

KARNATAKA-CET, 2008

Ans. (c) : When SO_2 is passed in an acidified $K_2Cr_2O_7$ solution,

$K_2Cr_2O_7 + H_2SO_4 + 3SO_2 \rightarrow K_2SO_4 + Cr_2(SO_4)_3 + H_2O$

Hence, oxidation state of sulphur changes from +4 to +6.

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1271. Concentrated sulphuric acid can be reduced by

(a) NaCl (b) NaF
(c) NaOH (d) $NaNO_{3+}$
(e) NaBr

Kerala-CEE-2009

Ans. (e) : Concentrated sulphuric acid, being a strong acid, oxidises bromides and iodides but not chlorides and fluorides because fluoride and chloride are more electronegative. Hence, it can be reduced only by NaBr among the given options.

$$H_2\overset{+6}{S}O_4 + Na\overset{-1}{Br} \rightarrow NaH\overset{+6}{S}O_4 + H\overset{-1}{Br}$$

$$2H\overset{-1}{Br} + \underbrace{H_2\overset{+6}{S}O_4 \rightarrow 2H_2O + \overset{0}{Br_2} + \overset{+4}{S}O_2}_{\text{Reduction}}$$

1272. Which one of the following group 16, elements does not exist in -2 oxidation state?

(a) S (b) Se
(c) O (d) Po
(e) Te

Kerala-CEE-2016

Ans. (d) : In the group 16, most metallic elements does not show –2 oxidation state as its electronegativity is very low.

Hence, Po (Polonium) (Z = 84) does not show –2 oxidation state because on going down the group, electro positive nature increases.

1273. Which of the following does not exist?

(I) $HO_3S–S–SO_3H$ (II) HO–Te–OH
(III) $HS–S_2–SH$ (IV) HS–Po–OH
(a) Only II (b) Only III
(c) II and IV (d) I, III and IV

Manipal-2020

Ans. (c) : $H_2S_3O_6$ is an example of polythionic acid and it is an trithionic acid .H_2S_4 is an hydro sulfane

1274. Oxygen has an oxidation state of + 2 in :

(a) H_2O_2 (b) H_2O
(c) F_2O (d) SO_2

Manipal-2017

Ans. (c) : Oxidation state of oxygen is always -2 except in peroxides, superoxides and when it reacts with fluorine.

In F_2O, oxidation state of 'F' is –1, So oxidation state of oxygen is +2.

In SO_2 and H_2O, oxidation state of oxygen is –2

In H_2O_2 oxidation state of H is +1, So oxidation state of oxygen is –1.

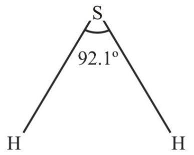
1275. What is the H—S—H bond angle in H_2S?

(a) 104.5° (b) 92.1°
(c) 91° (d) 90°

MHT CET-02.05.2019, SHIFT-III

Ans. (b) : As the electronegativity of the central atom decreases the lone pair of electrons lie further from it and therefore lp – lp repulsion decrease.

The H–S–H bond angle in H_2S is 92.1°. This is a smaller angle then tetrahedral angle. Because sulphur is less electronegative, it has less repulsion.



1276. The oxidation state of sulphur in $H_2S_2O_7$ is

(a) +4 (b) +6
(c) +5 (d) +7

MHT CET-02.05.2019, SHIFT-II

Ans. (b) : Let the oxidation number of sulphur be x. The oxidation number of H and O are +1 and – 2 respectively

$$\therefore\ 2(+1) + 2x + 7(-2) = 0$$
$$2 + 2x - 14 = 0$$
$$2x = +14 - 2$$
$$2x = +12$$
$$\boxed{x = +6}$$

The oxidation number of the sulphur atoms in $H_2S_2O_7$ is +6.

1277. In ozone molecule the formal charge on the central oxygen atom is

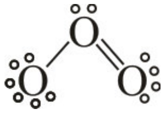
(a) –1 (b) +2
(c) 0 (d) +1

MHT CET-02.05.2019, SHIFT-II

Ans. (d) : The formal charge over an atom of a polyatomic molecule or ion is the difference between the valence electron of that atom in the elemental state and the number of electrons assigned to that atom in Lewis structure.

The formal charge on the central oxygen atom in O_3 molecule is +1

F.C = [Total no. of valence e^- in free state] – [Total no. of non-bonding pair e^- (lone pair)] $-\frac{1}{2}$[Total no. of bonding e–]



$$F.C = 6 - 2 - \frac{1}{2}(6)$$
$$F.C = 4 - 3$$
$$F.C = +1$$

1278. The oxidation number of sulphur in S_8 molecule is

(a) 6 (b) 0
(c) 2 (d) 3

MHT CET-02.05.2019, SHIFT-II

Ans. (b) : Oxidation number of sulphur is zero in S_8 ,as in any monotonic molecule. As oxidation number is defined by breaking a bond and giving the bond pair of electrons to the more electronegative element. Therefore, as S_8 as has a crown shape with each scan having bonds with two other 'S', if you break any bond elements on both sides are same i.e. sulphur having same electronegativity. So, electrons cannot be assigned to any of them.

Therefore, 'S' has zero oxidation number.

@apna_pdf

1279. In preparation of sulphuric acid from sulphur dioxide in lead chamber process. What substance is used as a catalyst?

(a) Manganese dioxide (b) Vanadium pentoxide
(c) Nitric oxide (d) Raney nickel

MHT CET-2017

Ans. (c) : In the preparation of sulphuric acid (H_2SO_4) by lead chamber process, mixture containing SO_2 and NO is treated with steam (H_2O). In this reaction nitric oxide (NO) acts as a catalyst.

$2SO_2 + O_2 + 2H_2O + NO \rightarrow 2H_2SO_4 + NO$

1280. Which is the most stable allotrope of sulphur?

(a) Octahedral sulphur (b) Monoclinic sulphur
(c) Plastic sulphur (d) Colloidal sulphur

MHT CET-2016

Ans. (a) : The two most commonly allotropes of sulphur are Rhombic and Monoclinic forms. Out of there rhombic allotrope (yellow in color) of sulphur is the most stable allotrope of sulphur.

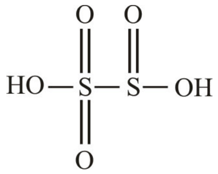
Rhombic sulphur is also called octahedral sulphur.

1281. Which oxoacid of sulphur contains S—S bond in its structure?

(a) Disulphurous acid
(b) Disulphuric acid
(c) Perdisulphuric acid
(d) Hydrosulphurous acid

MHT CET-2015

Ans. (a) : Disulphurous acid ($H_2S_2O_5$) contains S-S in its structure.



1282. Which oxyacid of sulphur contains S—S single bond?

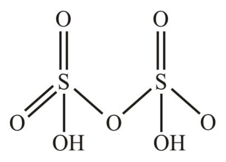
(a) Oleum (b) Marshall's acid
(c) Dithionic acid (d) Thiosulphuric acid

MHT CET-2014

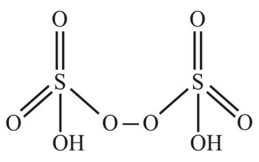
Ans. (c) : Oxyacid is a compound that contains oxygen, hydrogen and one other element. Here, we are provided with oxyacids of sulphur, these contain oxygen, hydrogen and sulphur atoms.

Thus, in dithinoic acid S–S single bond is present.

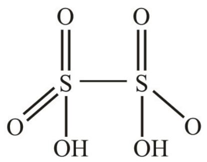
(a) Oleum ($H_2S_2O_7$)



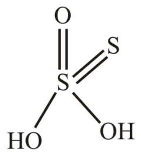
(b) Marshall's acid ($H_2S_2O_8$)



(c) Dithionic Acid ($H_2S_2O_6$)



(d) Thiosulphuric acid ($H_2S_2O_3$)



1283. Ozone is present as a chief constituent in which region of the atmosphere?

(a) Troposphere (b) Stratosphere
(c) Mesosphere (d) Thermosphere

MHT CET-2014

Ans. (b) : Ozone layer also called Ozonosphere, region of the upper atmosphere. Approximately 90% of the atmosphere's ozone occurs in the stratosphere, the region extending from 10 – 18 km to approximately 50 km above Earth's surface.

Ozone is a three oxygen molecule that are abundant in the stratosphere it absorbs energy from incoming ultraviolet radiation from the sun.

1284. Which among the following group 16 elements exists in more than two allotropic states?

(a) Polonium (b) Tellurium
(c) Selenium (d) Oxygen

MHT CET-2014

Ans. (c) : :

Sr. No	Element	Allotropes
(a)	Polonium	α and β- polonium
(b)	Tellurium	None
(c)	Selenium	Trigonal, rhombohedral, three deep red monodinic forms (α, β and λ amorphous red, black victrous selenium).
(d)	Oxygen	Dioxygen and Ozone

1285. Which of the statements given below is incorrect?

(a) O_3 molecule is bent
(b) ONF is isoelectronic with O_2N^-
(c) OF_2 is an oxide of fluorine
(d) Cl_2O_2 is an anhydride of perchloric acid

(NEET-2015)

Ans. (c) : FO is incorrect because it is a Fluoride of oxygen because electronegativity of fluorine is more than that of oxygen.

- The structure of O_3 is bent due to cone pair
- No. of electrons in ONF = 24
  No. of electrons in O_2N^- = 24

Both are isoelectronic.

- Cl_2O_7 is an anhydride of perchloric acid

$$2HClO_4 \xrightarrow[-H_2O]{\Delta} Cl_2O_7$$

1286. Sulphur trioxide can be obtained by which of the following reaction?

(a) $CaSO_4 + C \xrightarrow{\Delta}$ (b) $Fe_2(SO_4)_3 \xrightarrow{\Delta}$
(c) $S + H_2SO_4 \xrightarrow{\Delta}$ (d) $H_2SO_4 + PCl_4 \xrightarrow{\Delta}$

(NEET-2012)

Ans. (b) :

(a) $2CaSO_4 + C \xrightarrow{\Delta} 2CaO + 2SO_2 + CO_2$

(b) $Fe_2(SO_4)_3 \xrightarrow{\Delta} Fe_2O_3 + 3SO_3$

(c) $S + H_2SO_4 \xrightarrow{\Delta} SO_2 + H_2O$

(d) $H_2SO_4 + PCl_4 \xrightarrow{\Delta} POCl_3 + HSO_3Cl + HCl$

Sulphur trioxide is obtained by heating $Fe_2(SO_4)_3$

@apna_pdf

1287. Which one of the following pairs of reactants does not form oxygen, when they react with each other?

(a) F_2, NaOH solution (hot, conc.)
(b) F_2, H_2O
(c) Cl_2, NaOH solution (cold, dilute)
(d) $CaOCl_2$, H_2SO_4 (dilute, small amount)

AP EAMCET- 2005

Ans. (c) : Chlorine react with cold and dilute NaOH to give sodium hypochlorite.

$$Cl_2 + 2NaOH \rightarrow NaCl + NaClO + H_2O$$

• F_2 on reaction with under cold and dilute NaOH to give the following product–

$10F_2 + 20NaOH \rightarrow 20NaF + 10H_2O + 5O_2$

It is not form the oxygen.

• $2F_2(g) + 2H_2O(l) \rightarrow 4HF(aq) + O_2(g)$

• $2CaOCl_2 + H_2SO_4 \rightarrow CaCl_2 + CaSO_4 + 2HClO$
$HClO \rightarrow HCl + O$

1288. Identify the correct formula of Oleum from the following :

(a) $H_2S_2O_7$
(b) H_2SO_3
(c) H_2SO_4
(d) $H_2S_2O_8$

(Odisha NEET 2020)

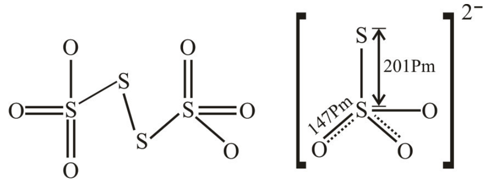
Ans. (a) : Formula of Oleum is $H_2S_2O_7$ is also called as Pyrosulfuric acid. Oleum or fuming sulfuric acid is a solution of various compositions of sulfur trioxide in sulfuric acid or sometimes more specifically to disulfuric acid.

1289. In which pair of ions both the species contain S–S bond?

(a) $S_4O_6^{2-}, S_2O_3^{2-}$
(b) $S_2O_7^{2-}, S_2O_8^{2-}$
(c) $S_4O_6^{2-}, S_2O_7^{2-}$
(d) $S_2O_3^{2-}, S_2O_3^{2-}$

(NEET 2017)

Ans. (a) : $S_4O_6^{2-}$ and $S_2O_3^{2-}$ both the species have S–S bond.

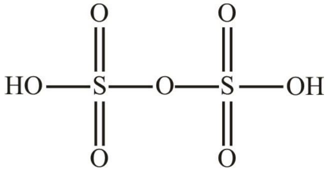


1290. Oleum is

(a) castor oil
(b) oil of vitriol
(c) fuming H_2SO_4
(d) none of these

(NEET-1991)

Ans. (c) : Oleum is a cloudy, gray, fuming, oil, corrosive liquid, with a sharp, penetrating odor. Its composition is that H_2SO_4 with dissolved SO_3.



1291. Match List I (substances) with List II (processes) employed in the manufacture of the substances and select the correct option.

	List I (Substances)		List II (Processes)
A.	Sulphuric Acid	I.	Haber's process
B.	Steel	II.	Bassemer's process
C.	Sodium hydroxide	III.	Leblanc process
D.	Ammonia	IV.	Contact process

(a) A - (i), B- (iv), C- (ii), D- (iii)
(b) A - (i), B- (ii), C- (iii), D- (iv)
(c) A - (iv), B- (iii), C- (ii), D- (i)
(d) A - (iv), B- (ii), C- (iii), D- (i)

(NEET-Mains 2010)

Ans. (d) :

(a) Sulphuric acid is manufactured by using the contact process.

(b) Steel is prepared by Bessemer's process.

(c) Sodium hydroxide is prepared by the Leblanc process.

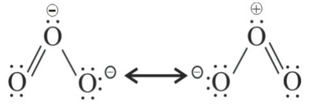
(d) Ammonia is manufactured by Haber's process

1292. The angular shape of ozone molecule (O_2) consists of

(a) 1σ and 1π bond
(b) 2σ and 1π bond
(c) 1σ and 1π bonds
(d) 2σ and 2π bond

(NEET-2008)

Ans. (b) : In case of double bond, there is one sigma and one π – bonds. Therefore, the angular shape of the ozone molecule (O_3) consists of 2 sigma and 1 pi bonds



1293. The gases respectively absorbed by alkaline pyrogallol and oil of cinnamon are

(a) O_3, CH_4
(b) O_2, O_3
(c) SO_2, CH_4
(d) N_2O, O_3

(NEET-1989)

Ans. (b) : Ozone, O_3 is absorbed by oil of cinnamon and oxygen. O_2 is absorbed by alkaline pyrogallol.

Oil of cinnamon contains unsaturation and so addition reaction is shown with O_3 therefore it absorbs O_3.

Pyragollol is also known pyrogallic acid, or 1, 2, 3-trihydroxybenzene an organic compound belonging to the phenol family which gets oxidized in presence of O_2 and therefore, it absorbs O_2.

1294. Which is the correct thermal stability order for H_2E (E = O, S, Se, Te and Po)?

(a) $H_2Se < H_2Te < H_2Po < H_2S$
(b) $H_2S < H_2O < H_2Se < H_2Te < H_2PO$
(c) $H_2O < H_2S < H_2Se < H_2Te < H_2PO$
(d) $H_2PO < H_2Te < H_2Se < H_2S < H_2O$

(NEET 2019)

Ans. (d) : The correct order of stability is as follows -

$H_2P_O < H_2T_e < H_2S_e < H_2S < H_2O$

On moving down the group thermal stability order for H_2E decreases because. H–E bond energy decreases.

1295. Acidity of diprotic acids in aqueous solutions increases in the order

(a) $H_2S < H_2Se < H_2Te$
(b) $H_2Se < H_2S < H_2Te$

@apna_pdf

(c) $H_2Te < H_2S < H_2Se$
(d) $H_2Se < H_2Te < H_2S$

(NEET-2014)

Ans. (a) : The strength of the bond between hydrogen and the central atom decreases and the acidic strength of hydrides increases as the size of the central atom increases which weakens the M-H bond. Order of increasing size is S < Se < Te and we also know that

$$\text{Acidic nature } \alpha \ \frac{1}{\text{Bond dissociation enthalpy}}$$

S to Te size increases, bond dissociation enthalpy decreases and acidic nature increases.

Therefore, the correct order would be-

$$H_2S < H_2S_e < H_2T_e$$

1296. Which of the following bonds has the highest energy?

(a) S–S
(b) O–O
(c) Se–Se
(d) Te–Te

(NEET-1996)

Ans. (a) : S–S contains the highest bond energy, which is due to lower size and less electron- electron repulsion.

1297. Which of the following does not give oxygen on heating?

(a) $K_2Cr_2O_7$
(b) $(NH_4)_2Cr_2O_7$
(c) $KClO_3$
(d) $Zn(ClO_3)_2$

(NEET 2013)

Ans. (b) :

- $\mathbf{(NH_4)_2Cr_2O_7} \xrightarrow{\Delta} N_2 + Cr_2O_3 + 4H_2O$
- $\mathbf{4K_2Cr_2O_7} \xrightarrow{\Delta} 4K_2CrO_4 + 2Cr_2O_3 + 3O_2$
- $\mathbf{2KClO_3} \xrightarrow{\Delta} 2KCl + 3O_2$
- $\mathbf{Zn(ClO_3)_2} \xrightarrow{\Delta} ZnCl_2 + 3O_2$

1298. Which would quickly absorb oxygen?

(a) Alkaline solution of pyrogallol
(b) Conc. H_2SO_4
(c) Lime water
(d) Alkaline solution of $CuSO_4$

(NEET-1991)

Ans. (a) : When pyrogallol is present in alkaline solution. It absorbs oxygen from the air and turns brown from colourless solution. It can be used to calculate the amount of oxygen in air.

The common name for Pyrogallol is 1, 2, 3–trihydroxybenzene.

1299. Oxygen will directly react with each of the following elements except

(a) P
(b) Cl
(c) Na
(d) S

(NEET-1989)

Ans. (b) : Out of 'P', Na, S and Cl, chlorine does not react directly but Na, P and S react with oxygen directly.

- $P_4 + 5O_2 \rightarrow P_4O_{10}$
- $S + O_2 \rightarrow SO_2$
- $4Na + O_2 \rightarrow 2Na_2O$

1300. It is possible to obtain oxygen from air by fractional distillation because

(a) oxygen is in a different group of the periodic table from nitrogen
(b) oxygen is more reactive than nitrogen
(c) oxygen has higher boiling point than nitrogen
(d) oxygen has a lower density than nitrogen

(NEET-1989)

Ans. (c) : It is possible to obtain oxygen from air by fractional distillation because oxygen has higher boiling point than Nitrogen. During this process, dinitrogen with less boiling point (78 K) distills as vapours while dioxygen with higher boiling point (90 k) remains in the liquid state and can be separated.

1301. Gas that cannot be collected over water is

(a) N_2
(b) SO_2
(c) O_2
(d) PH_3

UP CPMT-2013

Ans. (b) : The gas that will react with water cannot be collected over water.

Insoluble gases don't dissolve in water and thus can be collected over it for example N_2, O_2,CO_2 etc.

Reaction sulphur dioxide with water:-

$$SO_2 + H_2O \longrightarrow H_2SO_3$$

Therefore, sulphur dioxide cannot be collected over the water.

1302. The oxidation states of sulphur in the anions SO_3^{2-} , $S_2O_4^{2-}$ and $S_2O_6^{2-}$ follow the order

(a) $S_2O_4^{2-} < S_2O_6^{2-} < SO_3^{2-}$
(b) $S_2O_6^{2-} < S_2O_4^{2-} < SO_3^{2-}$
(c) $S_2O_4^{2-} < SO_3^{2-} < S_2O_6^{2-}$
(d) $SO_3^{2-} < S_2O_4^{2-} < S_2O_6^{2-}$

UP CPMT-2011

Ans. (c) : In SO_3^{2-}, $x + (-2 \times 3) = -2$

$$x - 6 = -2$$
$$x = -2 + 6$$
$$x = +4$$

In $S_2O_4^{2-}$, $2x + (-2 \times 4) = -2$

$$2x = +8 - 2$$
$$2x = +6 \rightarrow x = +3$$

In $S_2O_6^{2-}$, $2x + (-2 \times 6) = -2$

$$2x = +12 - 2$$
$$2x = +10$$
$$x = +5$$

Thus, increasing order of oxidation state of S is

$$S_2O_4^{2-} < SO_3^{2-} < S_2O_6^{2-}$$

1303. Peroxide bond is absent in

(a) $(S_2O_7)^{2-}$
(b) $(S_2O_8)^{2-}$
(c) CrO_5
(d) BaO_2

UP CPMT-2009

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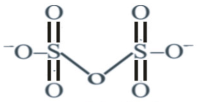
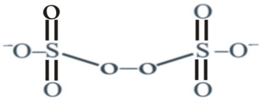
Ans. (a):

(a) $(S_2O_7)^{2-}$ ⇒



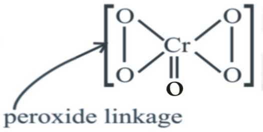
(no peroxide linkage)

(b) $(S_2O_8)^{2-}$ ⇒



(Peroxide linkage)

(c) CrO_5 ⇒



(d) $BaO_2 \Rightarrow [{}^-O-O^-]Ba^{2+}$

(Peroxide linkage)

1304. H_2S is not a/an
(a) reducing agent (b) acidic
(c) oxidising agent (d) None of these

UP CPMT-2007

Ans. (c) : (a) H_2S works as a reducing agent, because it can reduce PbO into PbS.

$$PbO + H_2S \rightarrow PbS + H_2O$$

(b) It is acidic in nature. In calcogens, the acidic nature of hydride increases from H_2O to H_2Te.
(c) It is not oxidising agent.

1305. Difference between S and S^{2-} as S^{2-} has
(a) larger radii and large size
(b) smaller radii and large size
(c) larger radii and small size
(d) smaller radii and small size

UP CPMT-2007

Ans. (a) : Size or radii of anion is always larger than its atom.
Difference between S and S^{2-} implies larger radii and larger size of S^{2-} because the radii of the anion are always larger than the atomic radii of its parent atom. In an anion as electron or electrons are added to the neutral atom the nuclear charge acts on more electrons so that each electron is held less tightly and there by the electron could expands.

1306. Ozone is used for purifying water because
(a) it dissociates and release oxygen
(b) do not leave any foul smell like chlorine
(c) kills bacteria, cyst, fungi and acts as a biocide
(d) All of the above

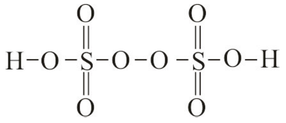
UP CPMT-2007

Ans. (c) : Ozone is a powerful oxidising agent and when it is dissolved in water, produces broad spectrum biocide that destroys all bacteria, viruses and cysts. It is one of the effective ways of eliminating microorganism in the water. Ozone is most effective oxidant (secondary to F_2). Ozone is very good biocide. Ozone also absorbs UV radiation.

1307. Oxidation number of sulphur in $H_2S_2O_8$ is
(a) +6 (b) +8
(c) +21 (d) +7

UP CPMT-2005
JCECE - 2003

Ans. (a) : The structure of $H_2S_2O_8$ –



$$H-O-\overset{\overset{O}{\|}}{\underset{\underset{O}{\|}}{S}}-O-O-\overset{\overset{O}{\|}}{\underset{\underset{O}{\|}}{S}}-O-H$$

∵ Sum of oxidation state of all elements is zero.
$+1 \times 2 + 2x + (-1 \times 2) + (-2 \times 6) = 0$
or $2 + 2x - 2 - 12 = 0$
or $2x = 12$
∴ $x = +6$

1308. Which of the following sulphides is yellow in colour?
(a) CuS (b) CdS
(c) ZnS (d) CoS

UP CPMT-2004

Ans. (b) : (a) CuS-black (b) CdS-Yellow
(c) ZnS-white (d) CoS-black

1309. Industrial name of $H_2S_2O_7$ is
(a) Caro's acid (b) Marshall's acid
(c) oleum (d) All of these

UP CPMT-2004

Ans. (c) : (i) Marshall's acid is $H_2S_2O_8$ (peroxydisulphuric acid)
(ii) Caro's acid is H_2SO_5 (peroxydisulphuric acid)
(iii) Oleum is $H_2S_2O_7$. On dilution, it gives sulphuric acid (H_2SO_4)

$$\underset{\text{Oleum}}{H_2S_2O_7} + H_2O \longrightarrow \underset{\text{sulphuric acid}}{2H_2SO_4}$$

1310. The oxidation number of sulphur in $Na_2S_2O_3$
(a) +1 (b) +2
(c) +3 (d) –3

UP CPMT-2002

Ans. (b) : $Na_2S_2O_3$
Let the oxidation state of S be x then
$2(+1) + 2x + 3(-2) = 0$
$2x - 4 = 0$
$x = +2$

1311. If a species has 16 protons, 18 electrons and 16 neutrons, the symbol (with charge) of species is
(a) S^- (b) Si^{2-}
(c) P^{3-} (d) S^{2-}

UPTU/UPSEE-2010

Ans. (d) : The species has 16 protons and 16 neutrons which means its mass number is 32. Hence, the element we are talking about is sulphur which is represented by the symbol 'S'. As we can see that the number of protons is less than electron. It means that the species will have a negative charge over it and also there are two excess electrons hence the magnitude of the negative charge would be 2.
The species will be shown by S^{-2}.

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1312. On adding 1 g arsenic to 80 g benzene, the freezing point of benzene is lowered by 0.19^0 C. The formula of arsenic is

(a) As (b) As_2

(c) As_3 (d) As_4

UPTU/UPSEE-2008

Ans. (d) : Given–

$\Delta T_f = 0.19^oC$

$K_f = 5.08$ kg / mol

w = 1g

W = 80 g

$$\Delta T_f = \frac{1000\ K_f w}{mW}, \text{ where}$$

K_f = molar depression constant

M = Molality

W = Weight of benzene

w = Weight of arsenic

then, $$m = \frac{1000 \times K_f \times w}{\Delta T_f k \times W}$$

$$= \frac{1000 \times 5.08 \times 1}{0.19 \times 80} = 334.21$$

Atomic weight of As = 74.92

The number of Atoms = $\frac{334.21}{74.92} = 4.4608 \approx 4$

Hence, the formula of arsenic is As_4.

1313. Which one of the following is not true at room temperature and pressure?

(a) P_4O_{10} is a white solid.

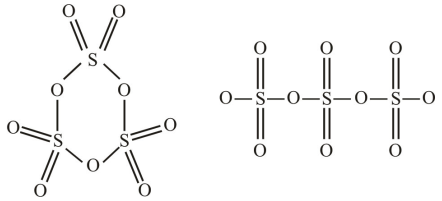
(b) SO_2 is a colourless gas.

(c) SO_3 is a colourless gas.

(d) NO_2 is a brown gas.

WB-JEE-2011

Ans. (c) : At room temperature SO_3 is a solid and exists as either α -SO_3, β - SO_3 or γ - SO_3 which contain similar chains cross linked into sheets



1314. 'Sulphan' is

(a) a mixture of SO_3 and H_2SO_5

(b) 100% conc. H_2SO_4

(c) a mixture of gypsum and conc. H_2SO_4

(d) 100% oleum (a mixture of 100% SO_3 in 100% H_2SO_4)

WB-JEE-2013

Ans. (d) : Sulphan is 100% oleum. In other words sulphan or oleum is a mixture of concentrated sulphuric acid that has been saturated with excess sulphur trioxide.

This is a corrosive dense liquid and is a strong dehydrating agent. When it is poured on glucose or sugar, it draws out practically all the water from the same.

1315. Electrolysis of X gives Y at anode. Vaccum distillation of Y gives H_2O_2. The number of peroxy (O-O) bonds present in X and Y respectively, are

(a) 1, 1 (b) 1, 2

(c) 0, 1 (d) 0, 0

AP EAMCET- 2006

Ans. (c) : Hydrogen peroxide can be obtained by the electrolysis of sulphuric acid followed by Vacuum distillation. The first product of electrolysis is perdisulphuric acid ($H_2S_2O_8$) which reacts with water during distillation to form H_2O_2.

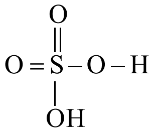
$$2H_2SO_4 \rightarrow 2H^+ + 2HSO_4^-$$

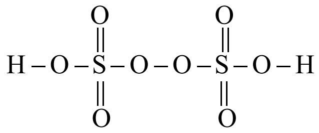
At anode–

$$2HSO_4^- \rightarrow \underset{Y}{H_2S_2O_8} + 2e^-$$

$$\underset{\text{'Y'}}{H_2S_2O_8} + 2H_2O \rightarrow \underset{\text{'X'}}{2H_2SO_4} + H_2O_2$$

X, Y are H_2SO_4 and $H_2S_2O_8$ respectively.





∴ No. of O–O bond = 0 ∴ No. of O–O bond = 1

Hence, correct option is (c).

1316. Which of the following is not correct?

(a) $3O_2 \underset{\text{discharge}}{\overset{\text{Silent electric}}{\rightleftharpoons}} 2O_3; \Delta H = -284.5kJ$

(b) Ozone undergoes addition reaction with unsaturated carbon compounds

(c) Sodium thiosulphate reacts with I_2 to form sodium tetrathionate and sodium iodide

(d) Ozone oxidises lead sulphide to lead sulphate

AP EAMCET- 2006

Ans. (a) : The formation of ozone from oxygen is an endothermic reaction, not exothermic reaction.

$$3O_2 \xrightarrow[\text{discharge}]{\text{Electric}} 2O_3 \quad \Delta H = -284.5kJ$$

So, statement,

$$3O_2 \underset{\text{discharge}}{\overset{\text{Silent electric}}{\rightleftharpoons}} 2O_3 \quad \Delta H = -284.5kJ$$

is not correct.

- Ozone undergoes addition reaction with unsaturated carbon compounds, this reaction is called the **ozonolysis** of alkene & alkyne.

$$CH_3CH = CH_2 \xrightarrow[\text{(ii)Zn-}H_2O]{\text{(i)}O_3} CH_3CHO + HCHO$$

Hence, statement is true.

- $\underset{\text{Sodiumthio sulphate}}{2Na_2S_2O_3} + I_2 \rightarrow 2NaI + \underset{\text{Sodiumtetra thionate}}{Na_2S_4O_6}$

Hence, statement is true.

- $\underset{\text{Lead sulphide}}{PbS(s)} + 4O_3(g) \rightarrow \underset{\text{Lead sulphate}}{PbSO_4(s)} + 4O_2(g)$

Hence, statement is true.

1317. Which of the following statements are correct for alkali metal compounds?

(i) Superoxides are paramagnetic in nature

(ii) The basic strengths of hydroxides increases down the group

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(iii) The conductivity of chlorides in their aqueous solutions decreases down the group

(iv) The basic nature of carbonates in aqueous solutions is due to cationic hydrolysis

(a) (i), (ii) and (iii) only (b) (i) and (ii) only
(c) (ii), (iii) and (iv) only (d) (iii) and (iv) only

AP EAMCET- 2008

Ans. (b) :
(i) Alkalis are base which dissolves in water therefore, the alkali metal superoxides contain O_2^- ion, which has an unpaired electron. Hence, it show paramagnetic in nature.
(ii) The hydroxides are basic in nature. The basic strength of hydroxides increases down the group.
(iii) The conductivity of chlorides in their aqueous solution increase down the group.
(iv) The basic nature of carbonate in a aqueous solution is due to anionic hydrolysis.

1318. Which one of the following is not used as a catalyst in the reaction of SO_2 with O_2 (for the formation of SO_3)?

(a) V_2O_5 supported (b) Platonized asbestos
(c) Platinum gauze (d) Charcoal

S. C. R. A - 2014

Ans. (d) : Sulphurdioxide reacts with chlorine in the presence of charcoal to give sulphonyl chloride SO_2Cl_2.

$$SO_2(g) + Cl_2(g) \xrightarrow{\text{charcoal}} SO_2Cl_2$$

$$2SO_2(g) + O_2(g) \xrightarrow{V_2O_5} 2SO_3(g)$$

1319. Among the following allotropic forms of sulphur, which does not contain S_8 rings?

(a) Monoclinic sulphur
(b) Engel's sulphur
(c) Rhombic sulphur
(d) γ -monoclinic sulphur

S. C. R. A - 2014

Ans. (b) : Both rhombic and monoclinic sulphur have S_8 molecules as well as $\gamma -$monoclinic sulphur. Engel's sulphur contains S_6-ring. It is also called cyclo-S_6. Cyclo-S_6 is orange-red and forms rhombohedral crystals.

8. Halogen Family

1320. The property of halogens which is not correctly matched is

(a) $I > Br > Cl > F$ (density)
(b) $F > Cl > Br > I$ (electron gain enthalpy)
(c) $F > Cl > Br > I$ (ionization enthalpy)
(d) $F > Cl > Br > I$ (electronegativity)

Karnataka CET-17.06.2022, Shift-II

Ans. (b) : The electron gain enthalpy of Cl is maximum.
So, the trend is : Cl>F>Br>I.

1321. Polar stratospheric clouds facilitate the formation of:

(a) $ClONO_2$ (b) HOCl
(c) ClO (d) CH_4

JEE Main-26.06.2022, Shift-I

Ans. (b) : In summer season Nitrogen dioxide and methane react with chlorine monoxide and chlorine atom forming, chlorine sinks, preventing much ozone depletion, where as in winter season, special type of clouds are formed over antalica, these polar stratospheric cloud provide surface on which chlorine nitrate formed gels hydrated to form hypochloro acid.

$$ClO(g) + NO_2(g) \longrightarrow ClONO_2(g)$$

$$ClONO_2(g) + H_2O(g) \longrightarrow HOCl(g) + HNO_3(g)$$

Both reaction takes place in stratosphere.

1322. Given below are two statements: one is labelled as Assertion A and the other is labelled as Reason R.
Assertion A: Fluorine forms one oxoacid.
Reason R: Fluorine has smallest size amongst all halogens and is highly electronegative. In the light of the above statements, choose the most appropriate answer from the option given below.

(a) Both A and R are correct and R is the correct explanation of A.
(b) Both A and R are correct but R is NOT the correct explanation of A.
(c) A is correct but R is correct
(d) A is not correct but R is not correct.

JEE Main-27.06.2022, Shift-II

Ans. (a) : Fluorine forms only one oxoacid because of smaller size & high electronegativity.
Both the assertion and reason are correct and Reason is the correct explanation.

1323. HIO_3 On heating at 170°C give:

(a) I_2 (b) I_2O_5
(c) I_2O_4 (d) HIO_4

CG PET-22.05.2022

Ans. (b) : 2 moles of HIO_3 on heating at 170°C, we get

$$2HIO_3 \xrightarrow{\Delta} I_2O_5 + H_2O$$

1324. Which one of the following will NOT produce carbon dioxide on reacting with an aqueous solution of hydro-chloric acid ?

(a) Limestone (b) Quick Lime
(c) Chalk (d) Marble

NDA (I)-2019

Ans : (b) Quick lime on reaction with HCl does not produce carbon dioxide.

$$\underset{\substack{\text{Quick}\\\text{lime}}}{CaO} + 2HCl \rightarrow CaCl_2 + H_2O$$

1325. Which one of the following is not a monoatomic element ?

(a) Copper (b) Helium
(c) Iodine (d) Barium

NDA (II)-2019

@apna_pdf

Ans : (c) Iodine is not a monoatomic element. It exist in the form of diatomic, I_2. Except Iodine, all the given elements exist in monoatomic.

1326. Which of the following is more stable?
(a) HF (b) HI
(c) HCl (d) HBr

AP-EAMCET (Med.)-1999

Ans. (a) : HF is more stable than the HCl, HBr and HI
$HF > HCl > HBr > HI$

1327. Which of the following statements about the halogen is correct?
(a) They are all diatomic and forms univalent ions
(b) They are all diatomic and forms divalent ions
(c) They are all capable of exhibiting several oxidation states
(d) They can mutually displace each other from the solution of their compound with metals

AP EAMCET- 1991

Ans. (a) : All the halogen are diatomic and form a univalent ions. All halogens perform as both oxidizing and reducing agents and are capable of exhibiting more than one stable oxidation state. Like, F^-, Cl^-, Br^-, I^- etc.

1328. The deep color produced when iodine is dissolved in solution of potassium iodide is caused by the presence of
(a) I_2 (b) KI
(c) I_2^- (d) I_3^-

AP EAMCET- 1993

Ans. (d) : $I_2 + KF \rightarrow KF_3$
$$KI_3 \rightleftharpoons K^+ + I_3^-$$
The deep color produced when iodine is dissolved in a solution of potassium iodide is caused by the presence of I_3^-.

1329. The element which can displace three other halogens from their compounds is
(a) Cl (b) Br
(c) I (d) F

AP EAMCET- 1996, 98

Ans. (d) : In the electrochemical series, F is at the lower position among the halogen. Therefore, it can displace three other halogens from their compounds.

1330. What is the correct order of occurrence (% by weight) in air of Ne, Ar and Kr?
(a) Ne > Ar > Kr (b) Ar > Ne > Kr
(c) Ar > Kr > Ne (d) Ne > Kr > Ar

JHARKHAND CECE

Ans. (b) : All the noble gases are present in earth's atmosphere helium and radon.
The correct order of occurrence (% by weight) in air is-
Ar > Ne > Kr.

1331. Which one of the following reactions does not occur?
(a) $F_2 + 2Cl^- \longrightarrow 2F^- + Cl_2$
(b) $Cl_2 + 2F^- \longrightarrow 2Cl^- + F_2$
(c) $Br_2 + 2I^- \longrightarrow 2Br^- + I_2$
(d) $Cl_2 + 2Br^- \longrightarrow 2Cl^- + Br_2$

AP EAMCET- 2008

Ans. (b) : When we increase in atomic number then the reduction potential of halogens decrease. So, the oxidizing power also decreases.
Therefore, halogen with lower atomic number will oxidize the halide ion of higher atomic number.
Hence, the reaction $Cl_2 + 2F^- \rightarrow 2Cl^- + F_2$ is not feasible.

1332. Bromine can be liberated from KBr solution by reaction with the following:
(a) Iodine solution (b) Chlorine water
(c) Sodium chloride (d) Potassium chloride

MPPET - 2012

Ans. (b) : Bromine can be liberated from KBr solution by the action of Chlorine water.
$$2KBr + Cl_2 \rightarrow 2KCl + Br_2$$
Chlorine can oxidize bromine. Hence, option (b) is correct.

1333. The most basic element is
(a) Fluorine (b) Iodine
(c) Chlorine (d) Bromine

MPPET- 2009

Ans. (b) : When we go from top to bottom in halogen family basic character increases so, iodine is most basic element. The basic order is $F_2 < Cl_2 < Br_2 < I_2$.

1334. In the manufacturing of I_2 from the solution of chile salt petre, left after the crystallization of $NaNO_3$' IO_3^- is generally reduced to I^- with
(a) $NaHSO_3$
(b) adding finely divided zine
(c) Passing SO_2
(d) adding $SNCl_2$

S. C. R. A - 2014

Ans. (a) : Chile salt petre, a source of $NaNO_3$, also contain $NaIO_3$. The $NaIO_3$ is source of I_2 produced as shown in the following equations.
Step-I: $IO_3^- + 3HSO_3^- \rightarrow I^- + 3H^- + 3SO_4^{2-}$
Step-II: $5I^- + IO_3^- + 6H^- \rightarrow 3I_2(s) + 3H_2O$
$NaHSO_3$ required in step-I and what additional volume of chile salt petre must be added in step-II to bring out complete conversion of I^- to I_2.

1335. Tincture of iodine contains
(a) KI (b) KIO_3
(c) HI (d) CHI_3

SCRA-2010

Ans. (a) : Tincture of iodine or iodine tincture also known as weak iodine solution and it is called an antiseptic with dark brown colour and smell of alcohol. Tincture of iodine is a mixture of iodine, sodium or potassium iodide.

1336. Which of this order for the property mentioned is not correct?
(a) $Cl_2 > Br_2 > F_2 > I_2$ [Bond dissociation enthalpy]
(b) HI>HBr>HCl>HF [Acidic strength]
(c) HOI>HOBr>HOCl [Acidic strength]
(d) $HClO_4 > HClO_3 > HClO_2 > HClO$ [Acidic strength]

AP EAPCET-6 Sep. 2021, Shift-II

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Ans. (c):
Acidity depends upon factors such as–
1. % s character
2. Electro negativity
3. No. of O atoms attached
4. Highest oxidation state

Here, $\boxed{HOI<HOBr<HOCl}$

Electro negativity of Cl is more so, HOCl will be more acidic.

1337. Which of the following facts related to halogens is not correctly matched?
(a) A halogen in the liquid state at room temperature – Bromine
(b) Strongest oxidizing agent – Fluorine
(c) Halogen having the highest $\Delta H_{\text{bond dissociation}}$ – fluorine
(d) Halogen which has least –ve $\Delta H_{e.g}$ –iodine

AP EAPCET-6 Sep. 2021, Shift-II

Ans. (c): Halogens have the following major properties–
1. They have very high electronegativities among them Fluorine has the highest value 4.0
2. They have seven valence electrons. So it can act as strong oxidizing agents.
3. They are highly reactive especially with alkali metals and alkaline earth metals.
4. Bromine only nonmetal which in liquid at room temperature.

1338. Which of the following sequences is the correct order of the size of species ?
(a) $I > I^+ > I^-$
(b) $I^- > I^+ > I^{-1}$
(c) $I^+ > I^- > I^{-1}$
(d) $I^- > I > I^+$

AP EAPCET 24.08.2021, Shift-I

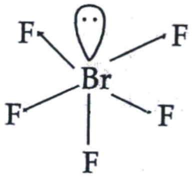
Ans. (d) : As we increase the negative degree in isolated gaseous atom then size of the anion will be increases due to the extra addition of electron in outer orbital of the shell. Hence, the order will be –

$I^- > I > I^+$

1339. Hybridized state of bromine in bromine pentafluoride is
(a) sp^3d
(b) d^2sp^3
(c) dsp^3
(d) sp^3d^2

COMEDK-2015

Ans. (d) : The hybridisation of BrF_5 is Sp^3d^2



(Square pyramidal shape)

1340. The decreasing order of stability of oxides of halogen is
(a) fluorine>chlorine>iodine>bromine
(b) fluorine>chlorine>bromine>iodine
(c) iodine>bromine>chlorine>fluorine
(d) iodine>chlorine>bromine>fluorine.

COMEDK-2015

Ans. (d) : Iodine oxygen bond is stable due to the greater polarity of bond and stability of chlorine oxygen bond is due to multiple bond formation with orbital of chlorine atom now, be lier in better I and Cl, so it lacks both characteristics So, the stability order of oxide is given as
I > Cl > Br > F.

1341. Which halogen element gives Halous acid type of oxoacid?
(a) F
(b) Br
(c) Cl
(d) I

GUJCET-2021

Ans. (c) : Chlorine element gives halous acid type of oxoacids because they contain the halogen atom in tripositive oxidation state. Chlorine forms fours type of oxoacids.
(i) HOCl (hypochlorous acid)
(ii) HOClO (Chlorous acid)
(iii) $HOClO_2$ (Chloric acid)
(iv) $HOClO_3$ (Perchloric acid)
Note:- The strongest acid out of all the acids is the Perchloric acid.

1342. Among the following, the number of halide(s) which is/are inert to hydrolysis is ____.
(a) BF_3
(b) $SiCl_4$
(c) PCl_5
(d) SF_6

JEE Main-25-02-2021, Shift-I

Ans. (d) : SF_6 is inert to hydrolysis due to the presence of sterically protected sulphur atom by six fluorine atoms which does not permit the reactions like hydrolysis to take place.

1343. The correct order of bond dissociation enthalpy of halogens is :
(a) $F_2 > Cl_2 > Br_2 > I_2$
(b) $I_2 > Br_2 > Cl_2 > F_2$
(c) $Cl_2 > Br_2 > F_2 > I_2$
(d) $Cl_2 > F_2 > Br_2 > I_2$

JEE Main-25.02.2021, Shift-II

Ans. (c) : Bond dissociation enthalpy is the energy needed to break one mole of the bond to give separate atoms-everything being in the gas state. A halogen molecule having large size of atoms should have low bond dissociation energy. Bond dissociation energy of halogen family decreases down the group as the size of atom increases. But fluorine is exception because the size of fluorine atom is small which produces inter electronic repulsions. So, order of bond dissociation energy will be : $Cl_2 > Br_2 > F_2 > I_2$

1344. Assertion: Halogens do not occur in free state
Reason: Halogens are highly reactive
(a) If both Assertion and Reason are true and the Reason is a correct explanation of the Assertion.
(b) If both Assertion and Reason are true but Reason is not a correct explanation of the Assertion.
(c) If Assertion is true but the Reason is false
(d) If both Assertion ad Reason are false

AIIMS-1994

Ans. (a): It is fact that halogen are highly reactive as they have seven electrons in their outermost orbit and they want to stabilize by acquiring an electron.

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Therefore, they do not occur in free state.
Hence, both assertion and reason are true and reason is the correct explanation of assertion.

1345. Assertion: Amongst the halogens, fluorine can oxidise the elements to the highest oxidation state.

Reason: Due to small size of fluoride ions, it is difficult to oxidise fluoride ions to fluorine. Hence reverse reaction takes place more easily.

(a) If both Assertion and Reason are true and the Reason is a correct explanation of the Assertion
(b) If both Assertion and Reason are true but Reason is not a correct explanation of the Assertion
(c) If Assertion is true but the Reason is false
(d) If both Assertion and Reason are false

AIIMS-1996

Ans. (b): Assertion is true but reason is false because fluorine can oxidise the other element to the highest oxidation state because of being highly electronegative nature. Fluorine is stronger oxidising agent than other halogens due to the highest electronegativity.

1346. Which of the following reacts most slowly with nitric acid?

(a) Phosphorus
(b) Chlorine
(c) Sulphur
(d) Iodine

AIIMS-26 May 2019 (Morning)

Ans. (b): Chlorine reacts most slowly with nitric acid (HNO_3) among all the given elements because both nitric acid and chlorine are strong oxidising agent.

1347. Assertion: F_2 and Cl_2 when passed through water, F_2 is more reactive.

Reason: F_2 is most electronegative.

(a) If both Assertion and Reason are correct and the Reason is the correct explanation of Assertion.
(b) If both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.
(c) If Assertion is correct but Reason is incorrect.
(d) If both the Assertion and Reason are incorrect.

[AIIMS-27 May, 2018 (M)]

Ans. (b) : F_2 is more reactive because of higher electrode potential value.

1348. Assertion: Fe^{3+} does not give brown ring test.

Reason: Because NO_3^- is first converted into NO_2^-.

(a) If both Assertion and Reason are correct and the Reason is the correct explanation of Assertion.
(b) If both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.
(c) If Assertion is correct but Reason is incorrect.
(d) If both the Assertion and Reason are incorrect.

[AIIMS-26 May, 2018(M)]

Ans. (c): In brown ring test, Fe^{2+} ion oxidises to Fe^{3+} ion and NO_3^- ion reduces to NO.
Brown ring test is valid for Fe^{2+} ion.

1349. Assertion: $HClO_4$ is a stronger acid than $HClO_3$.

Reason: Oxidation state of Cl in $HClO_4$ is +VII and in $HClO_3$ +V.

(a) If both Assertion and Reason are correct and the Reason is the correct explanation of Assertion.
(b) If both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.
(c) If Assertion is correct but Reason is incorrect.
(d) If both the Assertion and Reason are incorrect.

[AIIMS-2004, 2017]

Ans. (b): Both assertion and reason are true but reason is not the correct explanation of assertion. In general, the strengths of acids that have general formula $(HO)_m ZO_n$ can be related to the value of n. As the value of n increases, acidic character also increases. The negative atoms draw electrons away from the Z-atom and make it more positive.

1350. Assertion: HOF bond angle in HFO is higher than HOCl bond angle in HClO.

Reason: Oxygen is more electronegative than halogens.

(a) If both Assertion and Reason are correct and the Reason is the correct explanation of Assertion.
(b) If both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.
(c) If Assertion is correct but Reason is incorrect.
(d) If both the Assertion and Reason are incorrect.

[AIIMS-2014]

Ans. (d): HOCl bond angle is greater than HOF bond angle. This is due to very small size of fluorine or, due to op–bp repulsion.
Oxygen is more electronegative than all halogens except fluorine (most electronegative). Thus, Assertion as well as Reason is incorrect.

1351. Assertion: White phosphorus is more reactive than red phosphorus.

Reason: Red phosphorus consists of P_4 tetrahedral units liked to one another to form linear chains.

(a) If both Assertion and Reason are correct and the Reason is the correct explanation of Assertion.
(b) If both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.
(c) If Assertion is correct but Reason is incorrect.
(d) If both the Assertion and Reason are incorrect.

[AIIMS-2012]

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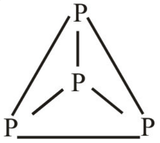
Ans. (b): White phosphorous is more reactive than red phosphorous because red phosphorous has more stability due to its structure.

Red phosphorus atoms from a network of more number of atoms and are less reactive and not much flammable. White phosphorous (P_4) has a tetrahedral structure that is thermodynamically unstable so that it combusts in air.



1352. Assertion: F is more electronegative than Cl.
Reason: F has high electron affinity than Cl.

(a) If both Assertion and Reason are correct and the Reason is a correct explanation of the Assertion.
(b) If both Assertion and Reason are correct but Reason is not a correct explanation of the Assertion.
(c) If the Assertion is correct but Reason is incorrect.
(d) If both the Assertion and Reason are incorrect.
(e) If the Assertion is incorrect but the Reason is correct.

[AIIMS-2007]

Ans. (c): Chlorine has high electron affinity than fluorine the less negative electron gain enthalpy of fluorine as compared to chlorine is due to very small size of the fluorine atom.

1353. Assertion: Ozone is an allotrope of oxygen.
Reason: Oxygen is bluish colour liquid and in singlet state it is paramagnetic.

(a) If both Assertion and Reason are correct and the Reason is a correct explanation of the Assertion.
(b) If both Assertion and Reason are correct but Reason is not a correct explanation of the Assertion.
(c) If the Assertion is correct but Reason is incorrect.
(d) If both the Assertion and Reason are incorrect.
(e) If the Assertion is incorrect but the Reason is correct.

[AIIMS-2007]

Ans. (c): Ozone (O_3) is a triatomic molecule consisting of three oxygen atoms. It is an allotrope of oxygen that is much less stable than the diatomic O_2.

Liquid O_2 is a clear substance with a light sky blue coloration.

In singlet oxygen, all the electron spins are paired and hence it is not paramagnetic in nature.

1354. Assertion: All halogens are colored.
Reason: The halogens absorb visible light.

(a) If both Assertion and Reason are correct and the Reason is a correct explanation of the Assertion.
(b) If both Assertion and Reason are correct but Reason is not a correct explanation of the Assertion.
(c) If the Assertion is correct but Reason is incorrect.
(d) If both the Assertion and Reason are incorrect.
(e) If the Assertion is incorrect but the Reason is correct.

[AIIMS-2002]

Ans. (a): All the halogens are coloured. The colour deepens with the rise of atomic number from fluorine to iodine. The colour is due to the absorption of energy from visible light by their molecules or excitation of outer electrons to higher energy levels.

F	Cl	Br	I
Light Yellow	Yellow Green	Reddish Brown	Deep Violet

1355. Assertion: The fluorine has lower reactivity.
Reason: F–F bond has low bond dissociation energy.

(a) If both Assertion and Reason are correct and the Reason is a correct explanation of the Assertion.
(b) If both Assertion and Reason are correct but Reason is not a correct explanation of the Assertion.
(c) If the Assertion is correct but Reason is incorrect.
(d) If both the Assertion and Reason are incorrect.
(e) If the Assertion is incorrect but the Reason is correct.

[AIIMS-2002]

Ans. (e): Fluorine is most reactive among halogens because of low bond dissociation of F–F. The low energy is due to high repulsion between non bonding electrons is the small atoms of fluorine.

So, Assertion is incorrect but the reason is correct

1356. Assertion: Fluorine exists only in–1 oxidation state.
Reason: Fluorine has $2s^22p^5$ configuration.

(a) If both Assertion and Reason are correct and the Reason is a correct explanation of the Assertion.
(b) If both Assertion and Reason are correct but Reason is not a correct explanation of the Assertion.
(c) If the Assertion is correct but Reason is incorrect.
(d) If both the Assertion and Reason are incorrect.
(e) If the Assertion is incorrect but the Reason is correct.

[AIIMS-2001]

Ans. (a): The atomic number of flourine is '9' with electronic configuration [He] $2s^22p^5$.

p (orbital) can hold 6 electrons and has valency for only 1 electrons.

Hence, it can accept only 1 electron

So, oxidation state is (–1).

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1357. Assertion: Iodine is more soluble in water than in carbon tetrachloride.
Reason: Iodine is a polar compound.
(a) If both Assertion and Reason are correct and the Reason is a correct explanation of the Assertion.
(b) If both Assertion and Reason are correct but Reason is not a correct explanation of the Assertion.
(c) If the Assertion is correct but Reason is incorrect.
(d) If both the Assertion and Reason are incorrect.
(e) If the Assertion is incorrect but the Reason is correct.

[AIIMS-1999]

Ans. (d): Iodine is less soluble in water than in carbon tetrachloride. Iodine is a non-polar compound. Iodine, being a non-polar compound is more soluble in CCl_4 (non-polar compound) than in water because "like dissolve like". So, both assertion and reason are false.

1358. One mole of fluorine is reacted with two moles of hot and concentrated KOH. The products formed are KF, H_2O and O_2. The molar ratio of KF, H_2O and O_2 respectively is
(a) 1 : 1 : 2 (b) 2 : 1 : 0.5
(c) 1 : 2 : 1 (d) 2 : 1 : 2

[AIIMS-27 May, 2018(E)]

Ans. (b): $F_2 + 2KOH \rightarrow 2KF + H_2O + \frac{1}{2}O_2$

$\therefore$ Molar ratio of KF : H_2 : O_2 from balanced chemical equation is 2:1:1/2

1359. In ClF_2^- and ClF_4^- find out the number of lone pair and shape.
(a) 3-Linear, 2-Square planar
(b) 3-Square planar, 2-Linear
(c) 0-Linear, 2-Square planar
(d) 2-Linear, 2-Square planar

[AIIMS-27 May, 2018(M)]

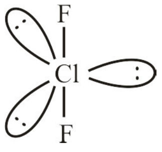
Ans. (a): $Cl \rightarrow 3s^2\ 3p^5$

It has 7 valance e^-

In ClF_2^-,

It has 5σ - bonds and sp^3d hybridization

$\therefore$ 3 L.P's



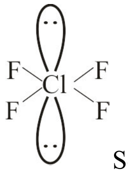
Linear geometry

3-Linear

In ClF_4^-,

It has 6σ - bonds and sp^3d^2 hybridization

$\therefore$ 2 L.P's



Square planar geometry

2-square planar

1360. Which of the following pair of molecules does not have identical structure?
(a) I_3^-, BeF_2 (b) HClO, SO_2
(c) BF_3, ICl_3 (d) BrF_4^-, XeF_4

[AIIMS-26 May, 2018(E)]

Ans. (c): $BF_3 \rightarrow$ Trigonal Planar
$ICl_3 \rightarrow$ T – shape

1361. Which of the following fluorides does not exist?
(a) NF_5 (b) PF_5
(c) AsF_5 (d) SbF_5

[AIIMS-2017]

Ans. (a): Nitrogen does not have empty 2d orbitals. Hence, it is unable to form more than 4 bonds. Hence, NF_5 does not exist but all other pentafluorids of 15 group elements exist as they have vacant d-orbitals.

1362. What is X and Y in the given reactions ?
$2X_2(g) + 2H_2O(l) \rightarrow 4H^+(aq) + O_2(g)$
$Y_2(g) + H_2O(l) \rightarrow HY\ (aq) + HOY\ (aq)$
(a) X = Cl, Y = F (b) X = Cl, Y = Br
(c) X = F, Y = Cl (d) X = I, Y = F

[AIIMS-2016]

Ans. (c): $2F_2(g) + 2H_2O\ (l) \rightarrow 4\ H^+\ (aq) + O_2(g)$
$Cl_2(g) + H_2O(l) \rightarrow HCl\ (aq) + HOCl$

1363. Regarding F^- and Cl^- which of the following statements is/are correct?
(i) Cl^- can give up an electron more easily than F^-
(ii) Cl^- is a better reducing agent than F^-
(iii) Cl^- is smaller in size than F^-
(iv) F^- can be oxidized more readily than Cl^-
(a) (i) and (ii) (b) (i), (ii) and (iv)
(c) (iii) and (iv) (d) Only (i)

[AIIMS-2015]

Ans. (d): The electronegative of F^- ion is high, so it accept an electron and Cl^- ion can give an electron more easily. Also the size of F^- is smaller than chloride ion (Cl^-).

1364. When Br_2 is treated with aqueous solutions of NaF, NaCl and NaI separately
(a) F_2, Cl_2 and I_2 are liberated.
(b) only F_2 and Cl_2 are liberated.
(c) only I_2 is liberated.
(d) only Cl_2 is liberated.

[AIIMS-2014]

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Ans. (c): Within a group the element above can displace the element below in a redox reaction.

When bromine gas is passed through solutions of NaF, NaCl, NaI, bromine cannot displace fluorine and chlorine compound but it can displace iodine compound.

$2NaI + Br_2 \rightarrow 2\ NaBr + I_2$

Iodine gas is released.

Hence, option 'c' is correct.

1365. When chlorine reacts with cold and dilute solution of sodium hydroxide, the products obtained are

(a) $Cl^- + ClO^-$
(b) $Cl^- + ClO_2^-$
(c) $Cl^- + ClO_3^-$
(d) $Cl^- + ClO_4^-$

[AIIMS-2013]

Ans. (a): When chlorine reacts with cold and dilute sodium hydroxide, the following reaction takes place.

$2NaOH + Cl_2 \rightarrow NaCl + NaClO + H_2O$

Hence, the products are Cl^- and ClO^-

When chlorine reacts with concentrated sodium hydoxide, the following reaction takes places.

$NaOH + Cl_2 \rightarrow 5\ NaCl + NaClO_3 + 3H_2O$

Hence, the products are Cl^- and ClO_3^-

1366. When chlorine water is added to a solution of KBr, the solution immediately turns orange red, because

(a) chlorine is reduced to chloride ion
(b) of the formation of BrCl
(c) bromide ion is oxidized to bromine
(d) of the formation of Br_3^-

[AIIMS-2009]

Ans. (b): When chlorine water is added to solution of KBr chlorine displaces bromine as –

$Cl_2 + 2\ KBr \rightarrow 2KCl + Br_2$

Now, Br_2 which is formed above reacts with chlorine as

$Cl_2 + Br_2 \rightarrow 2BrCl$

The formation of BrCl turns the solution orange red.

1367. Which one of the following halides is the most stable?

(a) CCl_4
(b) CBr_4
(c) CF_4
(d) CI_4

[AIIMS-2010]

Ans. (c): Stability of carbon tetrahalides decreases with increase in the size of halogen atom. So, CF_4 is the most stable halide among the given options.

1368. Iodine exists in which form in iodised salt

(a) I_2
(b) $NaIO_3$
(c) ICl
(d) IO_4^-

[AIIMS-2009]

Ans. (b): Iodised salt is table salt mixed with a minimum amount of one of the four iodine containing salts of hydroiodic acid or iodic acid : potassium iodate or potassium iodine and sodium iodate or sodium iodide.

1369. Which two of the following salts are used for preaparing iodised salt?
(i) KIO_3 (ii) KI (iii) I_2 (iv) HI

(a) (i) and (ii)
(b) (i) and (iii)
(c) (ii) and (iv)
(d) (iii) and (iv)

[AIIMS-2006]

Ans. (a): Iodised salt is table salt mixed with a small amount of various salts of the element iodine. KIO_3 and KI are used for preparing iodised salt. Potassium iodate and potassium iodine is used in the iodized salt to prevent the iodine deficiency.

1370. Strongest reducing agent is :

(a) F^-
(b) Cl^-
(c) Br^-
(d) I^-

JEE Main 2018

Ans. (d) : Reducing agent - It is a compound or element which oxidizes itself (loses e^-) and reduces some other species.

F > Cl > Br > I → O.P decrease

Iodine has a large size→ nuclear charge is less, and thus, it can easily lose an e^- and can oxidize itself.

1371. Which of the following represents the correct order for oxidizing power of the given species -
ClO_4^-, BrO_4^- and IO_4^-

(a) $ClO_4^- > BrO_4^- > IO_4^-$
(b) $BrO_4^- > IO_4^- > ClO_4^-$
(c) $IO_4^- > BrO_4^- > ClO_4^-$
(d) $BrO_4^- > ClO_4^- > IO_4^-$

AP-EAMCET 25-08-2021 Shift - I

Ans. (c) : Oxidizing power of species is -

$IO_4^- > BrO_4^- > ClO_4^-$

1372. The element which can displace three other halogens from their compounds is:

(a) Cl
(b) Br
(c) I
(d) F

AP EAMCET (Medical) -1998

Ans. (d): Fluorine of the halogen which has tendency to displace all the three halogens from their compounds because fluorine is the strongest electronegative element in the periodic table and has strong tendency to take electrons and get reduced so, behaves as strongest oxidising agent.

1373. Bond energy of Cl_2, Br_2 and I_2 follow the order

(a) $Cl_2 > Br_2 > I_2$
(b) $Br_2 > Cl_2 > I_2$
(c) $I_2 > Br_2 > Cl_2$
(d) $I_2 > Cl_2 > Br_2$

AP EAMCET (Engg.) - 2012

Ans. (a) : The bond energies of chlorine, bromine, and Iodine decreases down the group as the size of the atom increases. The bond energy of fluorine, is however, lower than those of chlorine and bromine because of interelectronic repulsions present in the small atom of fluorine.

Bond energy order is $Cl_2 > Br_2 > F_2 > I_2$

@apna_pdf

1374. Which one of the following statements is not correct?

(a) The pH of 1.0×10^{-8} M HCl is less than 7
(b) The ionic product of water at 25°C is 1.0×10^{-14} mol^2L^{-2}
(c) Cl^- is a Lewis acid
(d) Bronsted Lowry theory cannot explain the acidic character of $AlCl_3$

AP EAMCET (Engg.) - 2012

Ans. (c) : Cl^- is not a Lewis acid. It is a Lewis base. Lewis acid is a chemical species that reacts with a Lewis base to form a Lewis adduct. A Lewis base then is any species that donates a pair of electrons to a Lewis acid to from a Lewis adduct.

For example OH^- and NH_3 are Lewis bases, because they can donate a lone pair of electrons.

1375. Fex_2 and Fey_3 are known when x and y are:

(a) x = F, Cl, Br, I and y = F, Cl, Br, I
(b) x = F, Cl, Br, I and y = F, Cl, Br
(c) x = F, Cl, Br and y = F, Cl, Br, I
(d) x = Cl, Br, I and y = F, Cl, Br, I

JEE Main 16.03.2021, Shift-II

Ans. (b) : FeI_3 is unstable whereas FeI_2 is stable in nature.

$$\underset{\text{(unstable)}}{2FeI_3} \longrightarrow \underset{\text{(stable)}}{2FeI_2} + I_2$$

As we know, in 17 group elements, iodine show the strong reducing nature.

$$2Fe^{3+} + 2I^- \longrightarrow 2Fe^{2+} + I_2$$

Rest of all halides of Fe^{2+} & Fe^{3+} are stable.

1376. The correct order of increasing electron affinity of halogens is

(a) F < Cl < Br < I
(b) I < Br < F < Cl
(c) I < Br < Cl < F
(d) Br < I < F < Cl

MPPET-2008

Ans. (b) : The electron affinity of chlorine is greater and less in iodine. The correct order is I < Br < F < Cl

1377. Strongest conjugate base among the following is

(a) $C\ell^-$
(b) F^-
(c) Br^-
(d) I^-

AP EAMCET (Engg.) 18.09.2020, Shift-I

Ans. (b) : We know, an weaker acid produces stronger conjugate base.

	Acid	**Conjugate base**	
Acidic strength ↓ Increases	HF	F^-	Increases ↑ Basic strength of conjugate base
	$HC\ell$	$C\ell^-$	
	HBr	Br^-	
	HI	I^-	

So, here F^- is the strongest conjugate base.

1378. Bond dissociation energies of HF, HCI, HBr follow the order ....

(a) HCI > HBr > HF
(b) HF > HBr > HCI
(c) HF > HCI > HBr
(d) HBr > HCI > HF

AP EAMCET (Engg.) 2001

Ans. (c) : There is a large difference between electronegativity of H and F, so the bond is stronger. As we go down the group, the difference between electronegativity decreases and therefore, bond dissociation energy also decreases.

The order of bond dissociation energies are H–F > H – Cl > H – Br

Also smaller the bond length greater is the bond dissociation energy.

1379. For electron affinity of halogens which of the following is correct?

(a) Br > F
(b) F > Cl
(c) Br > Cl
(d) F > I

[AIIMS-2004]

Ans. (d): Electron affinity is defined as the amount of energy released when an electron is added to the outermost shell of neutral gaseous atom to form an anion. Electron affinity decrease in a group from top to bottom due to increase in size so the expected order of EA for halogen is F > Cl > Br > I.

But fluorine atom is very small in size than other given halogens. Therefore, it release less energy than Cl. So, Cl atom has high electron affinity and the order is –

Cl > F > Br > I

1380. The strongest oxidising agent is :

(a) F_2
(b) Cl_2
(c) I_2
(d) Br_2

[AIIMS-2001]

Ans. (a): F_2 is the strongest oxidizing agent in the whole periodic table. The order of oxidizing power depends on the reduction potential which depends on factors like hydration enthalpy of atomization and electron affinity fluorine has higher electron affinity and also higher hydration on its ion, therefore, fluorine is strongest oxidizing agent.

Here, are the standard reduction potentials of all the halogens.

$F_2 \to 2.87$
$Cl_2 \to 1.36$
$Br_2 \to 1.07$
$I_2 \to 0.54$
$F_2 > Cl_2 > Br_2 > I_2$

1381. Which of the following is not the characteristic of interhalogen compounds?

(a) They are covalent.
(b) More reactive than halogens.
(c) Have low B.P. and high volatile.
(d) Quite unstable but not explosive.

[AIIMS-1999]

Ans. (c): Interhalogen compounds are formed when halogen group elements react with each other.

Inter halogen compounds are covalent in nature. More reactive than halogen because of low bond energy due to dissimilar size of atom in molecule.

1382. Iodide of Millon's base is :

(a) HIO_3
(b) K_2HgI_4
(c) $NH_2HgO.HgI$
(d) $Hg(NH_2)I$

[AIIMS-1999]

@apna_pdf

Ans. (c): When NH_4^+ ions are treated with Nessler's reagent (alkaline solution of K_2HgI_4) a brown ppt. of $NH_2 - Hg - O - HgI$. Or $Hg_2NI.\ H_2O$ (iodide of millon's base) is formed.

$2K_2HgI_4 + NH_2 + 2KOH \rightarrow NH_2.HgO.HgI + 7KI + 2H_2O$ iodine of millon's base.

1383. Chlorine acts as a bleaching agent only in presence of :

(a) Sunlight (b) Moisture

(c) Dry air (d) Pure oxygen

[AIIMS-1998]

Ans. (b): Chlorine acts as bleaching agent only in presence of moisture.

$$Cl_2 + H_2O \rightarrow 2HCl + O$$

1384. The correct order of acid strength of oxyacids is:

(a) $HClO > HClO_2 > HClO_3 > HClO_4$

(b) $HClO_2 > HClO_3 > HClO > HClO_4$

(c) $HClO_4 > HClO_3 > HClO_2 > HClO$

(d) $HClO_3 > HClO_4 > HClO > HClO_2$

[AIIMS-1998]

Ans. (c): The acidic strength of oxyacids depends upon the stability of conjugate base. More stable the conjugate base of an acid is the strongest acid.

Conjugate bases stabilizes by resonance ClO^- does not show resonance thus the stability order of conjugate base due to resonance is.

$ClO_4^- > ClO_3^- > ClO_2^- > ClO^-$

Hence, the acidic strength of given

$HClO_4 > HClO_3 > HClO_2 > HClO$

1385. The correct order of increasing oxidising power is :

(a) $Cl_2 < Br_2 < F_2 < I_2$ (b) $F_2 < Br_2 < Cl_2 < I_2$

(c) $F_2 > Br_2 > Cl_2 > I_2$ (d) $I_2 < Br_2 < Cl_2 < F_2$

[AIIMS-1997]

Ans. (d): Metals are good reducing agents while non-metals are good oxidizing agents further among halogens metallic character increases as we move from top to bottom in a group i.e. the correct order of oxidizing nature is

$$I_2 < Br_2 < Cl_2 < F_2$$

1386. The correct order of the thermal stability of hydrogen halides (H–X) is

(a) $HI > HCl < HF > HBr$

(b) $HCl < HF > HBr < HI$

(c) $HF > HCl > HBr > HI$

(d) $HI < HBr > HCl < HF$

VITEEE-2018

Ans. (c) : The given hydrogen halides are H–F, H–Cl, H–Br and H–I. The stability of these halides decreases moving down in the group due to decrease in bond (H–X) dissociation energy.

the order: H–F > H–Cl > H–Br > H–I.

Thus HF is the most stable and most acidic.

1387. Transition metals usually exhibit highest oxidation states in their

(a) chlorides (b) fluorides

(c) bromides (d) iodides

VITEEE- 2010

Ans. (b) : Due to highest reduction potential of fluorine. Transition metals exhibit highest oxidation states in their fluoride.

1388. Which of the following reactions does not take place?

(a) $F_2 + 2Cl^- \rightarrow 2F^- + Cl_2$

(b) $Br_2 + 2I^- \rightarrow 2Br^- + I_2$

(c) $Cl_2 + 2Br^- \rightarrow 2Cl^- + Br_2$

(d) $Cl_2 + 2F^- \rightarrow 2Cl^- + F_2$

AP-EAMCET – 2016

Ans. (d) : With progressive increase in atomic number the reduction potential of halogens decreases the oxidizing power also decrease.

Cl_2 cannot displace F_2. The relevant stereochemistry relationship is–

$Cl_2 + 3F_2 \rightarrow 2ClF_3$

Fluorine is strong oxidising agent (under goes reduction) oxidising nature $F_2 > Cl_2 > Br_2 > I_2$.

1389. Which of the following is not correct ?

(a) $2F_2 + 4NaOH \rightarrow 4NaF + 2H_2O$

(b) $3F_2 + NaOH \rightarrow 5NaF + NaFO_3$

(c) $F_2 + 2NaOH \rightarrow NaF + NaOF + H_2O$

(d) $2F_2 + 2NaOH \rightarrow 2NaF + OF_2 + H_2O$

AP-EAMCET (Engg.)-2004

Ans. (d) : Fluorine react with NaOH into two reaction condition i.e. at hot concentration and at cold concentration.

At hot concentration of NaOH –

$$F_2 + 2NaOH \rightarrow 2NaF + \frac{1}{2}O_2 + H_2O$$

At cold concentration of NaOH –

$$F_2 + 2NaOH \rightarrow 2NaF + H_2O + \frac{1}{2}O_2$$

1390. Which one of the following is formed apart from sodium chloride when chlorine reacts with hot concentrated sodium hydroxide?

(a) NaOCl (b) $NaClO_3$

(c) $NaClO_2$ (d) $NaClO_4$

AP-EAMCET- (Engg.) - 2010

Ans. (b) : When chlorine is treated with hot concentrated sodium hydroxide then sodium chloride and sodium chlorate is formed.

$$3Cl_2(g) + \underset{\text{(hot conc.)}}{6NaOH} \xrightarrow{70^\circ C} 5\ NaCl + \underset{\substack{\text{Sodium}\\\text{chlorate}}}{NaClO_3} + 3H_2O$$

1391. Assertion (A) : The bond dissociation energy of fluorine is less than bromine.

Reason (R) : In fluorine molecule, large lone pair electronic repulsions and appreciable internuclear repulsions are present.

The correct answer is

(a) Both (A) and (R) are true and (R) is the correct explanation of (A)

(b) Both (A) and (R) are true but (R) is not the correct explanation of (A)

@apna_pdf

(c) Only (A) is true but (R) is not true
(d) (A) is not true but (R) is true

AP - EAMCET(MEDICAL) - 2009

Ans. (a) : The order of bond dissociation energy of halogens can be written as–

$Cl_2 > Br_2 > F_2 > I_2$

Fluorine has less bond dissociation energy than bromine. Due to high inter electronic replusions F-F bond becomes weak and broken easily.

Therefore, Both (A) and (R) are true and (R) is the correct explanation of (A).

1392. Which of the following dissolves in water but does not give any oxyacid solution ?

(a) SO_2
(b) OF_2
(c) SCl_4
(d) SO_3

AP - EAMCET (Medical) - 2007

Ans. (b) : OF_2 dissolves in water but does not give any oxyacid solution. While SO_2, SCl_4 and SO_3 give oxyacid solution in water.

$$SO_2 + H_2O \rightarrow \underset{\text{Sulphurous acid}}{H_2SO_3}$$

$$SCl_4 + 3H_2O \rightarrow \underset{\text{Sulphurous acid}}{H_2SO_3} + \underset{\text{Hydrochloric acid}}{4HCl}$$

$$SO_3 + H_2O \rightarrow \underset{\text{Sulphuric acid}}{H_2SO_4}$$

1393. Which one of the following halogens does not exhibit positive oxidation state in its compounds?

(a) I
(b) Br
(c) Cl
(d) F

AP – EAMCET - (Medical)-1997

Ans. (d) : Fluorine, the most electronegative element, has no positive oxidation states, it exhibits only–1 oxidation state, but the other halogens include chlorine, bromine and iodine commonly exhibit +1, +3, +5, and +7 states.

1394. Which of the following has the maximum vapour pressure?

(a) HCl
(b) HBr
(c) HF
(d) HI

AMU-2018

Ans. (a) : Vapour pressure is inversely proportional to boiling point. so we can say that the vapour pressure decreases as boiling point increases.

HCl has least boiling point due to its week inter molecular force. Thus, HCl has maximum, vapour pressure.

1395. Which of the following is used for he estimation of halogens in organic compounds?

(a) Carius method
(b) Dumas method
(c) Kjelahl's method
(d) Newman method

AMU-2018

Ans. (a) : Carius method is used for estimation of halogens in organic compound.

A known mass of the organic compound is reacted with fuming nitric acid in the presence of silver nitrate then the halogen converted into silver halide.

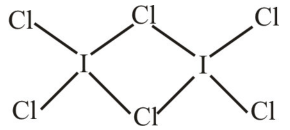
1396. The interhalogen having dimeric structure is

(a) ClF_3
(b) BrF_3
(c) IF_3
(d) ICl_3

AMU-2014

Ans. (d) : Among the given option, interhalogen compounds only ICl_3 exists as I_2Cl_6 i.e. exists in diametric form.

The structure of dimeric



1397. Which of the following statement is not true?

(a) Halogens act as strong oxidizing agents.
(b) Fluorine oxidizes water to oxygen and ozone.
(c) Iodine has good solubility in water.
(d) Solubility of iodine in water much increases by adding KI due to formation of I_3^- ions.

AMU-2013

Ans. (c) : Halogen can shows negative, zero as well as positive oxidation states.

Iodine is not soluble in water.

$I_2 + H_2O \rightarrow$ No reaction

1398. The element with atomic number 117 if discovered would be placed in

(a) noble gas family
(b) alkali family
(c) alkaline earth family
(d) halogen family.

AMU – 2009

Ans. (d) : The atomic number 117 of element tennessin (Ts) is placed in a halogen family. While element 117 may not behave like halogens chemically but follow physical properties like melting and boiling point with halogen.

The electronic configuration of $_{117}TS$ = $[Rn]5f^{14}6d^{10}7s^27p^5$

1399. Which of the following halides is least stable and has a doubtful existence?

(a) Cl_4
(b) GeI_4
(c) SnI_4
(d) PbI_4

AMU – 2008

Ans. (d) : PbI_4 halides is least stable and has a doubtful existence. The thermal stability of tetrahalides of same element decreases with increase in molecular mass of the tetrahalides.

$Cl_4 > SiI_4 > GeI_4 > PbI_4$

Thus, PbI_4 has least stability.

Non existence of PbI_4 can be explained on the base of strong oxidising nature of Pb^{4+}. I^- is a reducing agent i.e. in presence of this ion, Pb^{4+} ions are reducing to Pb^{2+} ions.

$$Pb^{4+} + 2I^- \rightarrow Pb^{2+} + I_2$$

1400. Moist iodine reacts with ozone to give

(a) HI
(b) HIO_3
(c) I_2O_4
(d) I_2O_5

Assam CEE-2014

Ans. (b) : $5O_3 + I_2 + H_2O \rightarrow 2HIO_3 + 5O_2$

It forms oxyacids with moist iodine

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1401. Iodine stains on clothes can be removed by

(a) NaCl (b) NaBr

(c) KI (d) $Na_2S_2O_3$

Assam CEE-2014

Ans. (d) : $2Na_2S_2O_3 + I_2 \rightarrow Na_2S_4O_6 + 2NaI$

$Na_2S_2O_3$ dissolves I_2 by oxidizing it to HIO_3 thus it can be used to remove free strain of iodine.

1402. Which one will liberate Br_2 from KBr?

(a) I_2 (b) SO_2

(c) HI (d) Cl_2

BCECE-2006

Ans. (d) : Cl is placed below Br in electrochemical series.

$2KBr + Cl_2 \rightarrow 2KCl + Br_2$

The reaction is based on the fact that Cl_2 has greater oxidizing power than Br_2 and therefore Br_2 can liberate from KBr.

1403. When chlorine is passed through concentrated solution of KOH, the compound formed is:

(a) $KClO_4$ (b) $KClO_3$

(c) $KClO_2$ (d) KClO

BCECE-2006

Ans. (b) : The chlorine passed through not concentrated solution of KOH, potassium chlorate is formed.

$$3Cl_2 + 6KOH \rightarrow \underset{\text{potassium chlorate}}{KClO_3} + 5KCl + 3H_2O$$

1404. Strongest oxidising agent among halogen is :

(a) I_2 (b) Br_2

(c) Cl_2 (d) F_2

BCECE-2006

Ans. (d) : The geometry of phosphorus is tetrahedral due to sp^3- hybridization in all the three acids.

The reason for bring the strongest oxidizing agent is as follows the elements has 5 electrons in its valence shell as the nearest stable electronic configuration are held lightly with the nucleus.

Due to the least atomic radii among the halides electrons are attracted towards the nucleus more effectively.

Less energy is required to break the F-F bond

Oxidising power $F_2 > Cl_2 > Br_2 > I_2$

1405. Which of the following is more acidic in nature?

(a) HClO (b) $HClO_2$

(c) $HClO_3$ (d) $HClO_4$

BCECE-2004

Ans. (d) : Acidity of oxycids of halogen increases with increase in oxidation number of halogen.

Oxidation number of HClO is +1, $HClO_2$ is +3, $HClO_3$ is +5 and $HClO_4$ is +7

$\therefore$ $HClO_4$ is most acidic among given choices

1406. Correct order of reactivity :

(a) $I_2 > Br_2 > Cl_2 > F_2$ (b) $Br_2 > I_2 > Cl_2 > F_2$

(c) $Cl_2 > Br_2 > I_2 > F_2$ (d) $F_2 > Cl_2 > Br_2 > I_2$

BCECE-2004

Ans. (d) : Since, reactivity decreases as the electronegativity of the halogen decreases.

So, the correct order of reactivity of halogen is –

$F_2 > Cl_2 > Br_2 > I_2$

1407. Highest electron affinity among the following is–

(a) fluorine (b) chlorine

(c) sulphur (d) xenon

BCECE-2008

Ans. (b) : Halogens have higher electron affinity here chlorine has higher electron affinity than fluorine due to smaller size of fluorine.

1408. In fluorine group of Periodic Table, on going down

(a) ionic radius increases

(b) electro negativity increases

(c) ionisation potential increases

(d) reactivity increases

BCECE-2011

Ans. (a) : In the fluorine group of periodic table as we go down wards ionic radius increases while electro negativity, ionization potential and reactivity decrease this is due to decrease in effective nuclear charge.

1409. Conc·HNO_3 reacts with I_2 to form

(a) HI (b) HOI

(c) HIO_2 (d) HIO_3

BCECE-2010

Ans. (d) : Reaction –

$I_2 + 10HNO_3 \rightarrow 2HIO_3 + 10NO_2 + 4H_2O$

1410. Which of the following statement about halogens is correct?

(a) HF the strongest hydrohallic acid

(b) F_2 is the strongest reducing agent among all type of halogen.

(c) The order of –negative electron gain enthalpy for halogens is F > Cl > Br > I

(d) F_2 has lower bond dissociation energy than Cl_2

BCECE-2017

Ans. (d) : F_2 has lower bond dissociation energy than Cl_2 due to its small size and high electro negativity.

1411. When I_2 is passed through KCl, KBr and KF solution

(a) Cl_2 and Br_2 are evolved

(b) Cl_2 is evolved

(c) Cl_2, Br_2, F_2 are evolved

(d) None of the above

Assam CEE-2014

Ans. (d) : I_2 cannot displace Br_2, Cl_2, F_2 from KBr, KCl, KF because it is weakest oxidizing agent

As I is less reactive than Cl, Br, and F. so, it cannot displace any halogen (Cl, Br, I)

1412. Which of the following halides is not oxidized by MnO_2

(a) F^- (b) Cl^-

(c) Br^- (d) I^-

[BITSAT-2012]

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Ans. (a) : Fluorine is the strongest oxidizing agent so its oxidizes and itself cannot be oxidized.

1413. The correct order of reactivity of halogens with alkalies is

(a) F>Cl>Br>I
(b) F < Cl > Br < I
(c) F < Cl < Br < I
(d) F < Cl < Br > I

[BITSAT-2010]

Ans. (a) : The correct order of reactivity of halogens with alkalies is

$$F > Cl > Br > I$$

1414. When chlorine water is exposed to sunlight, O_2 is liberated. Hence,

(a) hydrogen has little affinity to O_2
(b) hydrogen has more affinity to O_2
(c) hydrogen has more affinity to chlorine
(d) it is a reducing agent.

[BITSAT-2012]

Ans. (c) : When chlorine water is exposed to sunlight O_2 is liberated hence hydrogen has more affinity to Cl_2

$$Cl_2 + H_2O \longrightarrow 2HCl + \frac{1}{2}O_2$$

Chlorine water = $H_2O + Cl_2$

$$H_2O(l) + Cl_2(g) \xrightarrow{\text{sunlight}} HCl(aq.) + HClO(aq.)$$

$HClO \rightarrow HCl + [O]$

$2HClO \rightarrow 2HCl + O_2$

HClO formed into HCl ,as H has more affinity than Cl_2.

1415. Which of the following halogens exhibit only one oxidation state in its compounds?

(a) Bromine
(b) Chlorine
(c) Fluorine
(d) Iodine

[BITSAT-2014]

Ans. (c) : Fluorine shown only one (-1) state oxidation Cl, Br, and I exhibit -1, +1, +3, +5 and +7 oxidation states. This is because they are less electronegative than F and process empty d-orbital's in the valence shell and therefore, can expand the octed.

1416. Starch can be used as an indicator for the detection of traces of

(a) Glucose in aqueous solution
(b) Proteins in blood
(c) Iodine in aqueous solution
(d) Urea in blood

[BITSAT-2014]

Ans. (c) : The colour of the starch complex is so deep that it can as 0.00002m at 20°C. Starch is colourless.

Starch +Iodine→Starch Iodine

1417. When chlorine water is added to an aqueous solution of sodium iodide in the presence of chloroform, a violet colouration is obtained. On adding more of chlorine water and vigorous shaking, the violet colour disappears. This shows the conversion of ……. into…….

(a) I_2, HIO_3
(b) I_2, HI
(c) HI, HIO_3
(d) I_2, HOI

[BITSAT-2019]

Ans. (a) : Chlorine reacted with aqueons solution of NaI in the presence of $CHCl_3$ then violet colour of I_2 is formed.

$$Cl_2 + 2NaI \rightarrow 2NaCl + I_2$$

Further, iodine reacts with chlorine water then the iodine converts into HIO_3.

$$6Cl_2 + 6H_2O + I_2 \rightarrow \underset{\text{Colourless}}{2HIO_3} + 10HCl$$

So, I_2 formed and it is converted to HIO_3.

1418. Which of the following compounds liberate Cl_2 gas when react with I_2?

(a) Potassium permanganate
(b) Potassium chlorate
(c) Hypo
(d) Potassium dichromate

CG PET- 2016

Ans. (b) : When $KClO_3$ reacted with I_2 then chlorine gas evolved during the process.

$$2KClO_3 + I_2 \longrightarrow 2KIO_3 + Cl_2$$

1419. Which of the following properties increases on going down from F to I in group VII-A of the periodic table?

(a) Electronegativity
(b) Volatile nature
(c) Ionic radius
(d) Oxidising power

CG PET -2007

Ans. (c) : Ionic radius increases on going down the group because number of shells increases.

1420. The strongest oxidising agent amongst F_2, Cl_2, Br_2 and I_2 is

(a) F_2
(b) I_2
(c) Cl_2
(d) Br_2

CG PET -2007

Ans. (a) : An element that can readily accept an electron is a good oxidizing agent. Halogens are good oxidizing agents because they have a strong tendency to accept an electron due to-

(i) Small atomic size
(ii) High electronegativity
(iii) High electron affinity

So, fluorine is the smallest and has the highest electro negativity among halogens and hence, it is best oxidizing agent.

1421. Which is the weakest acid out of HF, HCl, HBr and HI?

(a) HF
(b) HBr
(c) HCl
(d) HI

CG PET -2007

Ans. (a) : It is classified as a weak acid mainly because it fails to completely dissociate in water. HF, due to intermolecular H–bonding is weakest among HX acids.

1422. Which of the following is pseudo halogen?

(a) IF_7
(b) $(CN)_2$
(c) ICl_2^-
(d) I_2^-

CG PET -2007

Ans. (b) : Ions which consists of two or more electronegative atoms of which at least one is nitrogen and have properties similar to those of halide ions are called pseudohalide ions. Just as halide ions have corresponding diatomic molecules, pseudohalide ions

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have also corresponding dimeric molecules. These are called pseudo halogens and show properties similar to those of halogens.
e.g. $(CN)_2$, $(SCN)_2$, $(OCN)_2$

1423. Which of the following will replace Br_2, from the aqueous solution having bromide ion?

(a) Cl_2 (b) I_3^-
(c) I_2 (d) Cl^-

CG PET -2007

Ans. (a) : Chlorine displaces bromine from an aqueous solution containing bromide. Reactivity of chlorine is more than that of bromine. So chlorine replaces Bromine.

$$Cl_2 + 2Br^- \rightarrow 2Cl^- + Br_2$$

1424. Chlorine cannot displace

(a) Fluorine from NaF (b) Iodine from NaI
(c) Bromine from NaBr (d) None of the above

CG PET -2007

Ans. (a) : $Cl_2 + NaF \rightarrow$ No reaction
Since Cl_2 is less electronegative then F_2, Therefore unable to displace fluorine from its salt.

1425. Fluorine forms chemical compounds with

(a) He (b) Ne
(c) Ar (d) Xe

CG PET -2004

Ans. (d) : The Xe has total of 8 outside shell e^- while the Fluorine has 7 valence electrons. The outside electrons are very far away from the center, therefore Xe can't pay attention to all of the electrons. Fluorine is smaller, therefore it has stronger positive attraction towards the electron.
'F' is only element that react with Xe because it is most electronegative. It is the only element that is strong enough to pull electrons out of the stable Xenon.

1426. Carbon-halogen bond is strongest among the following

(a) CH_3Cl (b) CH_3Br
(c) CH_3F (d) CH_3I

CG PET -2005

Ans. (c) : The carbon-halogen bonds (apart from the carbon-iodine bond) are polar, because the electron pair is pulled closer to the halogen atom than the carbon. This is because (a part from iodine) the halogens are more electronegative than carbon. The carbon-fluorine bond is strongest.

1427. Which of the following elements exhibits the most basic properties?

(a) F (b) Cl
(c) Br (d) I

CG PET -2005

Ans. (d) : A base is a substance which can easily give its lone pair of electrons. All the elements given belong to group 17th and in this group electronegativity decrease down the group. Lesser the electronegativity more is the basic nature. So, iodine is the most basic among the given element.

1428. The correct sequence of decrease in size of the following species is

(a) $I > I^+ > I^-$ (b) $I > I^- > I^+$
(c) $I^+ > I^- > I$ (d) $I^- > I > I^+$

CG PET -2005

Ans. (d) : As the number of electron decreases (but proton number remains same) So effective nuclear charge increases and so size decrease.

$$I^- > I > I^+$$

1429. Chlorine atom differs from chloride in the number of which of the following?

(a) Protons (b) Neutrons
(c) Electrons (d) Both (a) and (c)

CG PET -2005

Ans. (c) : Cl and Cl^- differs in number of electrons. Cl has $17e^-$ while Cl^- has $18e^-$.

1430. Strongest bond among halogens is in

(a) F_2 (b) Cl_2
(c) Br_2 (d) I_2

CG PET- 2015

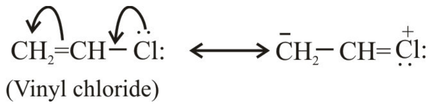
Ans. (b) : In fluorine there is greater lone pair-lone pair repulsion due to its very small size. So, Cl–Cl bond is stronger than F–F bond.
However the bond energy decreases with increase in atomic size in case of bromine and iodine.

1431. Chlorine is least reactive in

(a) methyl chloride (b) ethyl chloride
(c) vinyl chloride (d) allyl chloride

CG PET- 2015

Ans. (c) : The least reactive chlorine is vinyl chloride due to partial double bond character and unstable carbocation formation, vinyl carbocation is least stable.



1432. Hypochlorous acid is

(a) HOCl (b) $HClO_2$
(c) $HClO_3$ (d) $HClO_4$

CG PET- 2010

Ans. (a) : The chemical formula of hypochlorous acid is HOCl.

1433. Which of the following is allyclic halide?

(a) 3-chloro cyclo hex-1-ene
(b) (1 bromo ethyl) benzene
(c) 1-bromo benzene
(d) Benzyl chloride

GUJCET-2016

Ans. (a) : Allylic halides are the halides in which the halogen atom is bonded to sp^3 hybridized.
General chemical structure of allylic halides:

$$CH_2 = CH - CH_2 - X$$

Here, X is any halogen atom.

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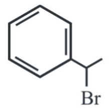
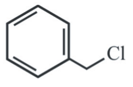
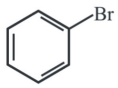


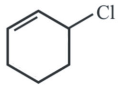
(1-Bromo ethyl) benzene



Benzyl chloride



1-Bromo benzene



3 Chloro cyclohex -1-ene

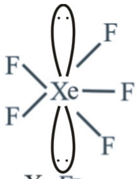
So, according to the rule, only in 3-chloro cyclohex-1-ene halide (Cl) is attached with sp^3 carbon which is next carbon-carbon double bond.

1434. The shape/structure of $[XeF_5]^-$ and XeO_3F_2, respectively, are

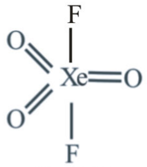
(a) pentagonal planar and trigonal bipyramidal
(b) octahedral and square pyramidal
(c) trigonal bipyramidal and pentagonal planar
(d) trigonal bipyramidal and trigonal bipyramidal

(JEE Main 2020, 2 Sep Shift-II)

Ans. (a) : Pentagonal planar and trigonal bipyramidal



XeF_5^-
sp^3d^3
Pentagonal planar



XeO_3F_2
sp^3d
Trigonal bipyramidal

1435. Identify the incorrect statement among the following

(a) Ozone reacts with SO_2 to give SO_3
(b) Silicon reacts with NaOH (aq) in the presence of air to give Na_2SiO_3 and H_2O
(c) Cl_2 reacts with excess of NH_3 to give N_2 and HCl
(d) Br_2 reacts with hot and strong NaOH solution to give NaBr, $NaBrO_4$ and H_2O

(AIEEE 2007)

Ans. (d) : (a) Ozone reacts with SO_2 to give SO_3.

$3SO_2 + O_3 \rightarrow 3SO_3$ (correct)

(b) Silicon reacts with NaOH(aq.) in the presence of air to give Na_2SiO_3 and H_2O.

$2Si + 2NaOH + 4H_2O \rightarrow 2NaSiO_3 + 5H_2$ (correct)

(c) Cl_2 reacts with excess of NH_3 to give N_2 and HCl

$3Cl_2 + 2NH_3 \rightarrow 6HCl + N_2$ (correct)

(d) Br_2 reacts with hot and strong NaOH solution to give NaBr, $NaBrO_4$ and H_2O

$3Br_2 + 6NaOH \rightarrow NaBrO_3 + 5NaBr + 3H_2O$ (incorrect)

1436. A metal, M forms chlorides in its +2 and +4 oxidation states. Which of the following statements about these chlorides is correct?

(a) MCl_2 is more volatile than MCl_4
(b) MCl_2 is more soluble in anhydrous ethanol than MCl_4
(c) MCl_2 is more ionic than MCl_4
(d) MCl_2 is more easily hydrolysed than MCl_4

(AIEEE 2006)

Ans. (c) : MCl_2 is more ionic than MCl_4 because according to Fajan's rule, compounds of metal in lower oxidation state are more ionic than those in a higher state.

1437. The correct order of the thermal stability of hydrogen halides (H – X) is

(a) HI > HCl > HF > HBr
(b) HCl < HF > HBr > HI
(c) HF > HCl > HBr > HI
(d) HI > HBr > HCl > HF

(AIEEE 2005)

Ans. (c) : As we move down the group in hydrogen halides the thermal stability decreases due to decrease in bond strength. So the correct order of thermal stability is-

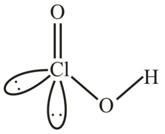
HF > HCl > HBr > HI

1438. Number of Cl = O bonds in chlorous acid, chloric acid and perchloric acid respectively are

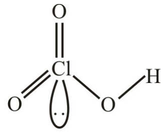
(a) 3, 1 and 1
(b) 4, 1 and 0
(c) 1, 1 and 3
(d) 1, 2 and 3

(JEE Main 2021, 27 July Shift-II)

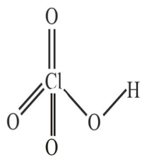
Ans. (d) : To determine the number of Cl = O bonds, structure of the given compounds are to be drawn. The chemical formula of chlorous acid is $HClO_2$, chloric acid is $HClO_3$ and perchloric acid is $HClO_4$. The structures of all those compounds is-



(Chlorous acid)



(Chloric acid)



(Perchloric acid)

From the above structures, it is clear that chlorous acid has one Cl = O bond, chloric acid has two Cl = O bonds and perchloric acid has three Cl = O bonds.

1439. Choose the incorrect statement.

(a) Cl_2 is more reactive than CIF.
(b) F_2 is more reactive than CIF.
(c) On hydrolysis CIF from HOCl and HF.
(d) F_2 is a stronger oxidising agent than Cl_2 in aqueous solution.

(JEE Main 2021, 26 Aug Shift-I)

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Ans. (a) : Cl_2 is less reactive than ClF because Cl–F bond is weaker than Cl–Cl in Cl_2. Here, F_2 is more reactive than Cl–F and Cl_2 because of bond length of F–F is weak.

- The Hydrolysis of ClF is give the HOCl and HF.

$$ClF + H_2O \rightarrow HOCl + HF$$

- Oxidising power in aqueous solution is-

$$F_2 > Cl_2 > Br_2 > I_2$$

1440. The absolute value of the electron gain enthalpy of halogens satisfies

(a) I > Br > Cl > F (b) Cl > Br > F > I

(c) Cl > F > Br > I (d) F > Cl > Br > I

(JEE Main 2021, 17 March Shift-I)

Ans. (c) : The magnitude of electron gain enthalpy of halogen atoms down the group show abnormal behavior. The $|\Delta H_{eg}|$ of F is lower than of Cl due to its smaller size.

The incoming electron experiences higher repulsive force due to valence electrons of F than Cl. The correct order is-

Cl > F > Br > I

1441. The correct order of bond dissociation enthalpy of halogens is

(a) $F_2 > Cl_2 > Br_2 > I_2$ (b) $I_2 > Br_2 > Cl_2 > F_2$

(c) $Cl_2 > Br_2 > F_2 > I_2$ (d) $Cl_2 > F_2 > Br_2 > I_2$

(JEE Main 2021, 25 Feb Shift-II)

(NEET-I 2016)

Ans. (c) : Correct order of bond dissociation enthalpy of halogens is $Cl_2 > Br_2 > F_2 > I_2$ due to inter electronic repulsions F – F bond becomes weak and easily broken.

1442. The hydrogen Halide which has highest reducing power is

(a) HCl (b) HI

(c) HBr (d) HF

Assam CEE-2020

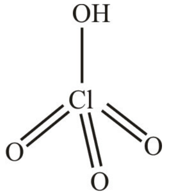
Ans. (b) : The increasing order of the reducing power is HF < HCl < HBr < HI.

So, the HI has highest reducing power

1443. The number of Cl = O bonds in perchloric acid is "..................."

(JEE Main 2020, 6 Sep Shift-I)

Ans. (3) : The molecular formula of perchloric acid is $HClO_4$. The structure of $HClO_4$ is-



Here, the acid contains three Cl=O bonds.

1444. Which inter halogen compound is not possible to form

(a) FCl (b) ClF

(c) ICl (d) lBr

Assam CEE-2019

Ans. (a) : The inter halogen compound is not possible to form FCI .

1445. Among the following reactions of hydrogen with halogens, the one that requires a catalyst is

(a) $H_2 + Cl_2 \rightarrow 2HCl$ (b) $H_2 + I_2 \rightarrow 2HI$

(c) $H_2 + F_2 \rightarrow 2HF$ (d) $H_2 + Br_2 \rightarrow 2HBr$

(JEE Main 2019, 10 Jan Shift-I)

Ans. (b) : Chemical reactivity of halogens decreases down the group ($F_2>Cl_2>Br_2>I_2$)

The chemical reactivity of fluorine is attributed to two factors.

(i) The low dissociation energy of F-F bond (which result in low attraction energy for the reaction).

(ii) Very strong bonds which are formed. Both properties arise from, small size of fluorine. I_2 is being the least reactive halogen it requires a catalyst for the reaction.

$$H_2 + I_2 \rightarrow 2HI$$

1446. What products are expected from the disproportionation reaction of hypochlorous acid?

(a) $HClO_3$ and Cl_2O (b) $HClO_2$ and $HClO_4$

(c) HCl and Cl_2O (d) HCl and $HClO_3$

(AIEEE 2006)

Ans. (d) : In hypochlorous acid, chlorine is in +1 state. So on disproportionation it gets oxidized and get reduced simultaneously to form HCl and $HClO_3$.

$$HOCl \rightarrow HCl + HClO_3$$

Chlorine in HCl is in –1 state that is it get reduced and in $HClO_3$ it has +5 oxidation state, hence it gets oxidised.

1447. The correct statement about ICl_5 and ICl_4^- is

(a) ICl_5 is square pyramidal and ICl_4^- is tetrahedral

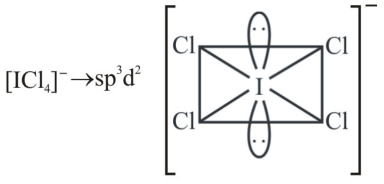
(b) ICl_5 is square pyramidal and ICl_4^- is square planar

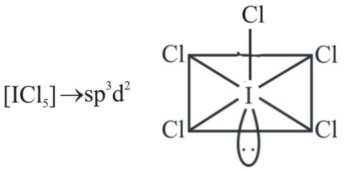
(c) Both are isostructural

(d) ICl_5 is trigonal bipyramidal and ICl_4^- is tetrahedral

(JEE Main 2019, 8 April Shift-II)

Ans. (b) : ICl_5 is square pyramidal and ICl_4^- is square planar.





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1448. HF has highest boiling point among hydrogen halides, because it has
(a) lowest ionic character
(b) strongest van der Waals' interactions
(c) strongest hydrogen bonding
(d) lowest dissociation enthalpy
(JEE Main 2019, 10 April Shift-I)

Ans. (c) : HF has the highest boiling point among hydrogen halides because it has the strongest hydrogen bonding.
Fluorine being more electronegative will have partial negative charge and hydrogen being less electronegative will have partial positive charge.

1449. The chloride that cannot get hydrolysed is
(a) $SnCl_4$ (b) CCl_4
(c) $PbCl_4$ (d) $SiCl_4$
(JEE Main 2019, 11 Jan Shift-I)

Ans. (b) : CCl_4 cannot hydrolysed due to the absence of vacant orbital at carbon atom and cannot extend its covalency above four but in $SiCl_4$ silicon has vacant d-orbitals which can be used for hydrolysis. Hence CCl_4 cannot undergo hydrolysis.

1450. Iodine reacts with concentrated HNO_3 to yield Y along with other products. The oxidation state of iodine in Y, is
(a) 1 (b) 3
(c) 7 (d) 5
(JEE Main 2019, 12 Jan Shift-I)

Ans. (d) : The reaction of iodine with concentrated nitric acid is given by-

$$I_2 + 10HNO_3 \rightarrow 2HIO_3 + 10NO_2 + H_2O$$

The product Y, is HIO_3
The oxidation state of Y (HIO_3) is-
HIO_3
Let, x be the O.S of I.
$1 + x + (-6) = 0$
$1 + x - 6 = 0$
$x = 6 - 1$
$x = 5$

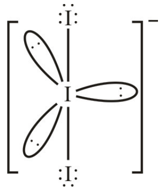
1451. Chlorine on reaction with hot and concentrated sodium hydroxide gives
(a) Cl^- and ClO^- (b) Cl^- and ClO_3^-
(c) ClO_3^- and ClO_2^- (d) Cl^- and ClO_2^-
(JEE Main 2019, 12 Jan Shift-II)

Ans. (b) : Chlorine on reaction with hot and concentrated sodium hydroxide gives Cl^- and ClO_3^-.

$$3Cl_2 + 6OH \rightarrow 5Cl^- + ClO_3^- + 3H_2O$$

1452. Total number of lone pair of electron in I_3^- ion is
(a) 3 (b) 6
(c) 9 (d) 12
(JEE Main 2018)

Ans. (c) : The hybridization of I_3^- is sp^3d. The lone pair of electron in central atom of I_3^- is 3. The structure of I_3^- is-



Hence, it contains the nine lone pairs.

1453. The products obtained when chlorine gas reacts with cold and dilute aqueous NaOH are
(a) ClO^- and ClO_3^- (b) ClO_2^- and ClO_3^-
(c) Cl^- and ClO^- (d) Cl^- and ClO_2^-
(JEE Main 2017)

Ans. (c) : The reaction between chlorine gas and aqueous sodium hydroxide gives chloride and Hypochlorite. Chlorine is a very good oxidiser. When chlorine gas reacts with cold and dilute aqueous NaOH, the chlorine undergoes disproportionation. This reaction produces both chloride and hypochlorite. The Chlorine gas is reduced to chloride and oxidised to hypochlorite at the same time. The reaction is-

$$Cl_2 + 2NaOH \rightarrow NaCl + NaOCl + H_2O$$

1454. Which among the following is the most reactive?
(a) Cl_2 (b) Br_2
(c) I_2 (d) ICl
(JEE Main 2015)

Ans. (d) : Cl_2, Br_2 and I_2 are homonuclear and are not polarised so these are less reactive. On the other hand, ICl is polarised due to the electronegativity difference between I and Cl and so it is the most reactive.

1455. Which one of the following correctly represents the order of stability of oxides, X_2O (X = halogen)?
(a) Br > Cl > I (b) Br > I > Cl
(c) Cl > I > Br (d) I > Cl > Br
JEE Main 13.09.2021 Shift-I

Ans. (d) : In oxides of halogen, the bond polarity however, increases as we move from F to I. The stability of oxides of iodine is greater than those of chlorine. Iodine oxygen bond is stable due to greater polarity of the bond while the stability of the chlorine oxygen bond is due to multiple bond formed involving d orbital's of the chlorine atom. The stability order of oxide is given as-
I > Cl > Br

1456. KI and $CuSO_4$ solutions on mixing produce
(a) $Cu_2I_2 + K_2SO_4$ (b) $Cu_2I_2 + I_2 + K_2SO_4$
(c) $CuI_2 + K_2SO_4$ (d) $CuI_2 + I_2 + K_2SO_4$
BCECE-2007

Ans. (b) : When KI and $CuSO_4$ solution are mixed then–

$$4KI(aq) + 2CuSO_4(aq) \rightarrow Cu_2I_2(s) + I_2(s) + 2K_2SO_4(aq)$$

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1457. The correct order of decreasing acid strength among the following acids is

(a) HClO >HBrO >HIO
(b) HIO > HBrO > HClO
(c) HBrO >HClO >HIO
(d) HClO > HIO >HBrO

J & K CET-(2019)

Ans. (a) : Acid strength of oxocids of different halogens having same oxidation state decreases with the increase in atomic number i.e. HOCl > HOBr > HOI. As the electronegativity of the halogen decreases from Cl to I, the shared pair of electrons of the oxygen halogen bond moves closer and closer towards the oxygen atom. As a result, O – H bond breaks most readily in HOCl and least readily in HOI.

1458. The most powerful oxidising agent of the following is

(a) I_2 (b) F_2
(c) Br_2 (d) Cl_2

J & K CET-(2009)

Ans. (b) : Fluorine is most powerful oxidizing agent because it consist of $E^o = +2.5$ volt.

1459. The bond dissociation energy of Cl_2, Br_2 and I_2 follow the order

(a) $Cl_2 > I_2 > Br_2$ (b) $I_2 > Br_2 > Cl_2$
(c) $I_2 = Cl_2 = Br_2$ (d) $Cl_2 > Br_2 > I_2$

J & K CET-(2006)

Ans. (d) : As we move from top to bottom in halogen family the bond energy of the molecules decreases as the bond distance increases. As the bond distance increases it requires less energy to break the bond.

So, the order of bond energy of the molecules is $Cl_2 > Br_2 > I_2$

1460. The strongest reducing agent among the following is

(a) F^- (b) Cl^-
(c) Br^- (d) I^-

J & K CET-(2004)

Ans. (d) : A reducing agent is usually a metal or a negative ion.

Strongest reducing agent among the halide ions is I^-. Tendency to lose electrons and reducing power are directly related to each other. Large sized iodide ion has maximum tendency to lose electrons and has maximum reducing power.

1461. The correct order of increasing oxidising power is

(a) $F_2 < Cl_2 < I_2 > Br_2$ (b) $F_2 < Br_2 < Cl_2 < I_2$
(c) $Cl_2 < Br_2 < F_2 > I_2$ (d) $I_2 < Br_2 < Cl_2 < F_2$

J & K CET-(2003)

Ans. (d) : Metals are good reducing agents, while non-metals are good oxidizing agents. Further among halogens, metallic character increases as we move from top to bottom in a group. i.e. the oxidizing nature is

$I_2 < Br_2 < Cl_2 < F_2$

1462. The acidic strength of halogen acids increases from

(a) HI < HBr < HCl < HF
(b) HF < HCl < HBr < HI
(c) HF < HCl > HBr > HI
(d) HF < HCl < HBr < HI

J & K CET-(1997)

Ans. (d) : The acid strength of hydrogen halides follows the following order:

HF < HCl < HBr < HI

– Acid strength increases →

The stability of these halides decreases down the group due to decrease in bond dissociation (H – X) enthalpy.

1463. The oxidizing ability of halogens

(a) increases from fluorine to iodine
(b) decreases from fluorine to iodine
(c) increases from fluorine to chlorine and then decreases
(d) remains constant down the group

J & K CET-(1997)

Ans. (b) : In displacement reactions between halogens and halides, the halogen acts as an oxidizing agent. This means that the halogen oxidizes the halide ion to the halogen and gain electrons and is reduced to form the halide ion since, fluorine is the strongest oxidizing agent amongst halogen. Therefore, it will oxidize all other halide ions to the corresponding halogen in solution.

Therefore, the correct order of oxidizing power of halogen is $F_2 > Cl_2 > Br_2 > I_2$.

Hence, it is clear that the oxidizing ability of halogen decreases from fluorine to iodine.

1464. Which of the following is the correct order of increasing oxidizing character of oxoacids of chlorine?

(a) $HClO_3 < HClO_4 < HClO_2 < HClO$
(b) $HClO_4 < HClO_3 < HClO_2 < HClO$
(c) $HClO < HClO_4 < HClO_3 < HClO_2$
(d) $HClO < HClO_2 < HClO_3 < HClO_4$

J & K CET-(2013)

Ans. (b) : The oxoacids of chlorine are HClO, $HClO_2$, $HClO_3$, $HClO_4$.

The oxidizing power is depend upon the oxidation state of Cl. The oxidation state of oxoacids are given below–

$$\begin{array}{ccc} HClO_4 & HClO_3 & HClO_2 \\ +1+x+4(-2)=0 & 1+x+3(-2)=0 & 1+x+2(-2)=0 \\ x=+7 & x=+5 & x=+3 \end{array}$$

HClO

$+1+x-2 = 0$

$x = +1$

If the oxidation state decreases then the oxidizing power of oxoacids of chlorine is increases. Hence, the correct order of oxidizing power will be–

$HClO_4 < HClO_3 < HClO_2 < HOCl$

1465. Oxidation number of fluorine is – 1 in:

(a) F_2O (b) NF_3
(c) both (a) and (b) (d) none of these

JCECE - 2004

@apna_pdf

Ans. (b) : NF_3

$$(+3) + 3F = 0$$
$$3F = -3$$
$$F = \frac{-3}{3}$$
$$F = -1$$

Oxidation states of F in NF_3 is –1.

1466. Water is oxidized to oxygen by:

(a) ClO_2 (b) $KMnO_4$

(c) H_2O_2 (d) Fluorine

JCECE - 2005

Ans. (d) : H_2O cannot be oxidized by $KMnO_4$, H_2O_2, O_3 or ClO_2. Fluorine being a good oxidizing agent, oxidizes H_2O to O_2.

$$2\overset{0}{F_2}\ (g) + 2H_2O(l) \longrightarrow 4H\overset{-1}{F} + O_2(g)$$

Reduction

Therefore, water is oxidised to O_2 by F_2.

$$3F_2 + 3H_2O \rightarrow 6HF + O_3$$

1467. Freon used as refrigerant is

(a) $CF_2 = CF_2$ (b) CH_2F_2

(c) CCl_2F_2 (d) CF_4

JCECE - 2007

Ans. (c) : Freon is used as refrigerant(cooling agent) is $CCl_2 F_2$.

$$CCl_4 + 2HF \xrightarrow{Sb_2F_5} \underset{\text{(Freon)}}{CF_2Cl_2} + 2HCl$$

1468. In the conversion of Br_2 to BrO_3^-, the oxidation number of Br changes from

(a) zero to + 5 (b) + 1 to + 5

(c) zero to – 3 (d) + 2 to + 5

JCECE - 2009

Ans. (a) : Given that, $Br_2 \rightarrow BrO_3^-$

Bromine has zero oxidation state because it is in free state

In BrO_3^-, let the oxidation number of Br, be x

Therefore, $x + 3 \times (-2) = -1$

$x = -1 + 6 = +5$

$$\overset{0}{Br_2} \rightarrow \overset{+5}{Br}O_3^-$$

∴ In the conversion of Br_2 to BrO_3^- the oxidation state of Br changes from 0 to +5.

1469. Hydrolysis of NCl_3 gives NH_3 and X. Which of the following is X?

(a) $HClO_4$ (b) $HClO_3$

(c) HOCl (d) $HClO_2$

JCECE - 2009

Ans. (c) : Hydrolysis of NCl_3 gives NH_3 or NH_4OH and HClO as

$$NCl_3 + 4H_2O \rightarrow NH_4OH + 3HOCl$$

or $$NCl_3 + 3H_2O \rightarrow NH_3 + \underset{(x)}{3HOCl}$$

Hence, X is HOCl

1470. Which of the following forms acidic halides?

(a) HF (b) HCl

(c) HBr (d) HI

JCECE - 2013

Ans. (a) : $HF + F^- \longrightarrow HF_2^-$

It is an acidic halide.

1471. HBr and HI reduce H_2SO_4, HCl can reduce $KMnO_4$ and HF reduces

(a) H_2SO_4 (b) $KMnO_4$

(c) $K_2Cr_2O_7$ (d) None of these

JCECE - 2016

Ans. (d) : HBr and HI are the strongest reducing hydracids and therefore, they reduce H_2SO_4. Other than that HCl is stable and it is oxidized by strong oxidizing agent such as $KMnO_4$. In the smallest F^- ion, HF is not a reducing agent.

The electron which is reduced at the time of oxidation is nearest to the nucleus and the most difficult to removed. Hence, HF represents a poor reducing agent.

1472. Which one among the following is not correct as per indicated property?

(a) $Br_2 < Cl_2 < F_2$ (Oxidising power)

(b) $Br_2 < F_2 < Cl_2$ (Electron gain enthalpy)

(c) $Br_2 < Cl_2 < F_2$ (Electronegativity)

(d) $Br_2 < Cl_2 < F_2$ (Bond energy)

JCECE - 2016

Ans. (d) : Due to small size and high electron density, electron-electron repulsion between two F-atom, causes increase in bond-length and thus decrease in bond energy. Hence, correct order is $F_2 < Br_2 < Cl_2$.

1473. When Br_2 is treated with aqueous solutions of NaF, NaCl, NaI separately

(a) $F_2Cl_2$and I_2 are liberated

(b) Only F_2 and Cl_2 are liberated

(c) Only I_2 is liberated

(d) Only Cl_2 is liberated

JIPMER-2013

Ans. (c) : Within a group the element above can displace the element below in a redox reaction.

When bromine gas is passed through solutions of NaF, NaCl, NaI, bromine cannot displace fluorine and chlorine compound but it can displace iodine compound

$2NaI + Br_2 \rightarrow 2NaBr + I_2$

It is clear from the above reaction that iodine gas is released.

1474. Affinity for hydrogen decreases in the group from fluorine to iodine. Which of the halogen acids should have highest bond dissociation enthalpy?

(a) HF (b) HCl

(c) HBr (d) HI

JIPMER-2013

Ans. (a) : HF has the highest bond dissociation enthalpy due to the smallest bond length and presence of intermolecular hydrogen bonding.

1475. The most basic element is

(a) fluorine (b) iodine

(c) chlorine (d) bromine

JIPMER-2012

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Ans. (b) : All the elements given belong to group 17th and in this group electronegativity decreases down the group. Lesser the electronegativity more is the basic nature. So iodine is the most basic among the given element.

1476. Which method is used to find halogen in organic compound?

(a) Duma's method (b) Leibig's method
(c) Kjeldahl method (d) Carius method

JIPMER-2019

Ans. (d) : The Carius halogen is a method used for the quantitative determination of halogen in chemical substance.

1477. Consider the reaction,
$H_2 + X_2 \longrightarrow 2HX$, where X is halogen. The reactivity of halogens decrease in the order of

(a) $Cl_2>F_2>Br_2>I_2$ (b) $I_2>Br_2>F_2>Cl_2$
(c) $F_2>Cl_2>Br_2>I_2$ (d) $I_2>Br_2>Cl_2>F_2$

JIPMER-2016

Ans. (c) : $H - H + X - X \rightarrow 2\,HX$, where X = halogen.
The hydrogen – halogen reactions get gradually less reactive towards the heavier halogens.
The correct decreasing order of reactivity of halogen molecule towards
H_2 is $F_2 > Cl_2 > Br_2 > I_2$

1478. The property which is not true about fluorine is

(a) most of its reactions are exothermic
(b) it forms only one oxo acid
(c) highest electronegative
(d) high F-F bond dissociation enthalpy

Karnataka-CET-2016

Ans. (d) : Due to the presence of 7 valence electrons in a very small volume of fluorine atom, its bond dissociation energy is low (that is why they repel each other strongly).

1479. Neon atom require energy to remove one electron from its outermost orbit, so also to add one electron into the outermost orbit.
Which of the following is correct about fluorine?

(I) Fluorine releases energy when an electron is removed.
(II) Fluorine requires energy to add one electron.

(a) (I) and (II) are correct
(b) (I) is correct, (II) is false
(c) (I) is false, (II) is correct
(d) (I) and (II) are false

Manipal-2020

Ans. (d) : (i) Fluorine required energy when on electron is removed, i.e. ionisation energy.
(ii) Fluorine release energy to add one electron, i.e. electron affinity ($-328 kJ mol^{-1}$)

1480. Ozone when reacts with potassium iodide solution liberates certain product, which turns starch paper blue. The liberated substance is :

(a) oxygen (b) iodine
(c) hydrogen iodide (d) potassium hydroxide

Manipal-2019

Ans. (b) : Ozone when reacts with potassium iodine solution liberates certain product which turns starch paper blue. Thus, the liberated substance is iodine.
Ozone react with KI solution to liberate I_2 gas.
$2KI + O_3 + H_2O \rightarrow 2KOH + I_2 + O_2$

1481. Least stable oxide of chlorine is–

(a) Cl_2O (b) ClO_2
(c) Cl_2O_7 (d) ClO_3

BCECE-2007

Ans. (a) : The stability of oxides increase with increase in the oxidation state of halogen oxidation states

$Cl_2O = +1$
$ClO_2 = +4$
$Cl_2O_7 = +7$
$Cl_2O_6 = +6$

Hence, Cl_2O is the least stable oxide of chlorine
$Cl_2O_7 > Cl_2O_6 > ClO_2 > Cl_2O$

1482. Which among the following does not form polyhalide ion?

(a) Chlorine (b) Bromine
(c) Iodine (d) Fluorine

MHT CET-02.05.2019, SHIFT-II

Ans. (d) : Univalent ions are formed when halide ions react with halogen molecules or interhalogen. F is the only alternative that does not generate a polyhalide ion because it lacks d-orbital's and hence cannot display a higher oxidation state.

1483. With which halogen the reactions of alkanes are explosive?

(a) Fluorine (b) Chlorine
(c) Bromine (d) Iodine

MHT CET-2018

Ans. (a) : Reaction of alkanes with fluorine are explosive. This is an explosive process which is difficult to control. Therefore, it carried out in dark. In this process replacement of one or more hydrogen of alkane by halogen takes place. For this reaction the order of reactivity of halogen is.
$I_2 < Br_2 < Cl_2 < F_2$

1484. What is the highest oxidation state exhibited by group 17 elements?

(a) +1 (b) +3
(c) +5 (d) +7

MHT CET-2016

Ans. (d) : The element of group 17 of the periodic table are known as halogens. Halogens are reactive nonmetals and include fluorine, chlorine, bromine, and iodine. The oxidation state of oxygen is usually -2 except in compounds with fluorine, oxygen has a positive oxidation number. All the elements of group 17 from compounds in odd oxidation states (-1,+1,+3, +5, +7) but down the group importance of the higher oxidation states generally decreases. group 17 elements only required one additional electron to form a full octet.

1485. Which halogen forms an oxyacid that contains the halogen atom in tripositive oxidation state?

(a) Fluorine (b) Chlorine
(c) Bromine (d) Iodine

MHT CET-2015

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Ans. (b) : Chlorine halogen forms an oxyacid that contains the halogen atom in tripositive oxidation state, the oxyacid is $HClO_2$. In $HClO_2$ the oxidation number of Chlorine is +3.

1486. Which among the following gases can be liquified easily?

(a) Chlorine (b) Nitrogen

(c) Oxygen (d) Hydrogen

MHT CET-2014

Ans. (a) : When the temperature of a gas falls below the critical point, it can be liquefied by cooling or compressing it.

Gases which have high critical temperatures (such as Cl_2, NH_3, CO_3, SO_2 etc) can be liquified by applying a suitable pressure alone. Permanent gases (such as H_2, N_2, O_2 etc) cannot be liquefied by the action of pressures and cooling.

1487. When Cl_2 gas reacts with hot and concentrated sodium hydroxide solution, the oxidation number of chlorine changes from

(a) zero to + 1 and zero to – 5

(b) zero to – 1 and zero to +5

(c) zero to – 1 and zero to +3

(d) zero to +1 and zero to –3

(NEET-2012)

Ans. (b) : The reaction of chlorine gas with hot and concentrated sodium hydroxide solution is

$$3Cl_2 + 6\,NaOH \rightarrow NaClO_3 + 5NaCl + 3H_2O$$

So, in this process the oxidation number of chlorine changes from zero to –1 and zero to +5.

1488. Which of the following is used in the preparation of chlorine?

(a) Both MnO_2 and $KMnO_4$

(b) Only $KMnO_4$

(c) Only MnO_2

(d) Either MnO_2 or $KMnO_4$

BITSAT-2009, (NEET-1999)

Ans. (a) : Chlorine can be prepared by heating concentrated hydrochloric acid with an oxidizing agent such manganese dioxide, potassium permanganate, etc.

$MnO_2 + 4HCl \rightarrow MnCl_2 + 2H_2O + Cl_2$

$2KMnO_4 + 16HCl \rightarrow 2KCl + 2MnCl_2 + 8H_2O + 5Cl_2$

1489. Which of the following elements is extracted commercially by the electrolysis of an aqueous solution of its compound?

(a) CI (b) Br

(c) Al (d) Na

(NEET-1993)

Ans. (a) : Generally alkali metals and alkali earth metals elements extracted by the fused electrolysis method. Chlorine gas is obtained by the electrolysis of an aqueous solution of NaCl.

$$NaCl(aq) \xrightarrow{\text{Electrolysis}} NaOH + H_2 + Cl_2$$

1490. When chlorine is passed over dry slaked lime at room temperature, the main reaction product is

(a) Ca $(ClO_2)_2$ (b) $CaCl_2$

(c) $CaOCl_2$ (d) Ca(OCI)

(NEET-1992)

Ans. (c) : When chlorine is passed over dry slaked lime at room temperature, the main product is $CaOCl_2$ (bleaching powder). The reaction is as follows :

$$\underset{\text{slaked lime}}{Ca(OH)_2} + \underset{\text{Chlorine}}{Cl_2} \longrightarrow \underset{\substack{\text{Bleaching powder}\\ \text{Calciumoxychloride}}}{CaOCl_2} + \underset{\text{Water}}{H_2O}$$

1491. In the manufacture of bromine from sea water, the mother liquor containing bromides is treated with

(a) carbon dioxide (b) chlorine

(c) iodine (d) sulphur dioxide

(NEET-1992)

Ans. (b) : Chlorine bromide in the mother liquor (containing $MgBr_2$ is oxidised to Br_2 by passing Cl_2 which is a stronger oxidising agent.

$MgBr_2 + Cl_2 \rightarrow MgCl_2 + Br_2$

1492. The bleaching action of chlorine is due to

(a) reduction (b) hydrogenation

(c) chlorination (d) oxidation

(NEET-1991)

Ans. (d) : Bleaching action of chlorine is due to oxidation in the presence of moisture.

$Cl_2 + H_2O \rightarrow 2HCl + O$

1493. Among the following the correct order of acidity is

(a) $HClO_2 < HClO < HClO_3 < HClO_4$

(b) $HClO_4 < HClO_2 < HClO < HClO_3$

(c) $HClO_3 < HClO_4 < HClO_2 < HClO$

(d) $HClO < HClO_2 < HClO_3 < HClO_4$

(NEET-I 2016, 2007, 2005)

Ans. (d) : $HClO < HClO_2 < HClO_3 < HClO_4$

The acidic character of the oxoacids increases with increase in oxidation number of the halogen atom i.e. $HClO < HClO_2 < HClO_3 < HClO_4$. They can be explained on the basis of relative stability of the anions left after removal of a proton stability of the anions left after removal of a proton.

The stability of the anion decreases in the order : $ClO_4^- > ClO_3^- > ClO_2^- > ClO^-$

acid strength also decrease in the some order.

1494. The variation of the boiling points of the hydrogen halides is the order HF > HI > HBr > HCI

What explains the higher boiling point of hydrogen fluoride?

(a) There is strong hydrogen bonding between HF molecules

(b) The bond energy of HF molecules is greater than in other hydrogen halides

(c) The effect of nuclear shielding is much reduced in fluorine which polarizes the HF molecule.

(d) The electronegativity of fluorine is much higher than for other elements in the groups

(NEET-2015)

Ans. (a) : The higher boiling point of hydrogen fluoride is due to the presence of strong hydrogen bonding between HF molecules which leads to the association of HF molecules and requires higher energy for boiling.

Hence, HF > HCl > HBr > HI.

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1495. Among the following which is the strongest oxidizing agent?

(a) Br_2 (b) I_2

(c) Cl_2 (d) F_2

(NEET-2009)

Ans. (d) : An element having higher tendency to get reduced or to accept an electron is a strong oxidizing agent.

Fluorine is the most electronegative element because electronegativity decreases on moving down the group. hence, it gets reduced readily into F^- ion and is a strongest oxidizing agent.

1496. Which statement is wrong?

(a) Bond energy of $F_2 > Cl_2$

(b) Electronegativity of F > Cl

(c) F is more oxidizing than Cl

(d) Electron affinity of Cl > F

(NEET-2000)

Ans. (a) : Actually, bond energy of $Cl_2 > F_2$. As fluorine is small in size and in fluorine 2p sub shell is compact and close no. of electrons are held in a compact volume and there is a strong repulsion amongst non-bonding electrons.

Hence, bond becomes weak though the bond is short.

Due to this reason bond energy of fluorine is less than other halogens.

1497. Which of the following has the greatest electron affinity?

(a) I (b) Br

(c) F (d) Cl

(NEET-1996)

Ans. (d) : The atomic number of Cl is 17, which can be written as (2, 8, 7). Thus, there are 7 electrons in the outermost shell. Every element wants to go to their nearest inert gas Argon's structure by accepting one more electron in its outermost shell, that is why it is get converted into its electronic configuration (2, 8, 8). It is very easy for chlorine too, as it has to and is very easy for chlorine too, as it has to accept only one electron. Therefore, Cl has the greatest affinity for electrons.

1498. Which of the following displaces Br_2 from an aqueous solution containing bromide ions?

(a) I_2 (b) I_3^-

(c) Cl_2 (d) Cl^-

(NEET-1994)

Ans. (c) : Since chlorine is more electronegative than bromine, therefore it will displace bromine from an aqueous solution containing bromide ions.

$$Cl_2 + 2Br^- \longrightarrow 2Cl^- + Br_2$$

1499. Statement I : Acid strength increases in the order given an HF << HCI << HBr << HI.

Statement II : As the size of the element F, CI, Br, I increase down the group, the bond strength of HF, HCI, HBr and HI decreases and so the acid strength increases.

In the light of the above statements, choose the correct answer from the options given below.

(a) Statement I is incorrect but statement II is true

(b) Both statement I and statement II are true

(c) Both statement I and statement II are false

(d) Statement I is correct but statement II is a false

(NEET 2021)

Ans. (c) : Down the group acidic strength increases as bond length increases and bond strength decreases due to which case of release of H^+ increases Acidic strength increases.

1500. Elements of which of the following groups will form anions most readily?

(a) Oxygen family (b) Nitrogen family

(c) Halogen (d) Alkali metals

NEET-1992

Ans. (c) : Halogens have maximum electron gain enthalpy due to the fact that the atoms of these elements have only one electron less than the stable noble gas (ns^2np^6) configuration. Therefore they have maximum tendency to accept the electron to form negative ion (anion).

1501. Iodine value is related to

(a) fats and oils (b) alcohols

(c) ethers (d) esters

UP CPMT-2011

Ans. (a) : Iodine value is the number of gram of iodine required to saturate 100 g oil or fat. In other words, the degree of unsaturation of an oil or fat is expressed in terms of iodine number.

1502. To make a painting glass, we use

(a) fluorine (b) chlorine

(c) bromine (d) hydrogen chloride

UP CPMT-2010

Ans. (a): Fluorine attacks on glass but very slowly. Thus, it is used to make painting over glass.

- Etching is a process used for making designs on plates or any other object. To make the artwork corrosive action of an acid is required.

1503. When I_2 is passed through KCl, KF and KBr solutions,

(a) Cl_2 and Br_2 are evolved

(b) Cl_2 is evolved

(c) Cl_2, Br_2 and F_2 are evolved

(d) None of the above

UP CPMT-2004

Ans. (d) : More electronegative halogen displaces less electronegative halogen from its salt solution.

$\because$ I_2 is least electronegative.

$\therefore$ It cannot liberate F_2, Cl_2, Br_2 from KF, KCl and KBr solutions.

1504. Which of the following elements never show positive oxidation number?

(a) O (b) Fe

(c) Ga (d) F

UP CPMT-2004

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Ans. (d) : The most electronegative element will never show positive oxidation state.

∴ Fluorine is most electronegative element of periodic table.

∴ It never shows positive oxidation state.

1505. Which of the following is anhydride of perchloric acid?

(a) Cl_2O_7 (b) Cl_2O_5

(c) Cl_2O_3 (d) HClO

UP CPMT-2004

Ans. (a) : Oxy acids form anhydride by giving out water molecule.

$$\underset{\text{Perchloric acid}}{2HClO_4} \xrightarrow{\Delta} \underset{\text{Chlorine heptachloride}}{Cl_2O_7} + H_2O$$

1506. Chloroform, when kept open is oxidized to

(a) CO_2 (b) $COCl_2$

(c) CO_2, Cl_2 (d) None of these

UP CPMT-2004

Ans. (b) : On exposure to oxygen and light, Chloroform is slowly oxidized to phosgene (carbonyl chloride)

$$CHCl_3 + O_2 \longrightarrow \underset{\substack{\text{Phosgene}\\ \text{(carbonyl chloride)}}}{COCl_2} + HCl$$

1507. Fluorine reacts with water to produce

(a) $HF + O_2 + O_3$ (b) $HF + O_2$

(c) $HF + OF_2$ (d) $HF + O_3$

UP CPMT-2001

Ans. (a) : $2F_2 + 2H_2O \longrightarrow 4HF + O_2$

$3F_2 + 3H_2O \longrightarrow 6HF + O_3$

∴ The products of reaction between fluorine and water are HF, O_2 and O_3.

1508. The total number electrons present in all the p-orbitals of bromine is

(a) 5 (b) 15

(c) 17 (d) 35

UP CPMT-2001

Ans. (c) : On writing the electronic configuration of bromine according to atomic orbital theory, we can find the total number of p electrons in bromine.

Atomic number of bromine is 35

∴ $Br = 1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 4s^2, 3d^{10}, 4p^5$

∴ Total number of p-electrons in bromine is 17.

1509. Which among the following factors is the most important in making fluorine the strongest oxidizing agent?

(a) Electron affinity

(b) Ionization enthalpy

(c) Hydration enthalpy

(d) Bond dissociation energy

UPTU/UPSEE-2007

Ans. (c) : Fluorine is the strongest oxidizing agent due to low heat of dissociation and high heat of hydration. It compensate the lower value of electron affinity.

1510. Fluorine exhibits an oxidation state of only-1 because:

(a) It can readily accept an electron

(b) It is very strongly electronegative

(c) It is a non-metal

(d) It belongs to halogen family

UPTU/UPSEE-2006

Ans. (b) : Flourine is the most electronegative atom so it accepts electrons very easily and shows only -1 oxidation state.

Flourine cannot exhibit any positive oxidation state as it does not have d orbitals in its valence shell.

1511. Iodine is a:

(a) electrovalent solid (b) atomic solid

(c) molecular solid (d) covalent solid

UPTU/UPSEE-2005

Ans. (c) : I_2 is a molecular solid. Each Iodine molecule is made up of 2 iodine atoms held together by a strong covalent bond. Each iodine molecule is held to another by weak Vander Waals forces.

1512. The only non-metal which is Liquid at ordinary temperature is:

(a) Hg (b) Br_2

(c) NH_3 (d) None of these

UPTU/UPSEE-2005

Ans. (b) : Bromine (Br, element 35) also found as a diatomic (Br_2) is a liquid at room temperature.

Solidifying at $-7.2°C$.

- NH_3 is used chiefly for refrigerator, and in manufacturing of chemicals.

1513. Oxidation number of chlorine atom in Ca(OCl)Cl is

(a) –1 (b) +1, –1

(c) 0 (d) –1, 0

UPTU/UPSEE-2013

Ans. (b) : Bleaching Powder $(CaOCl_2)$ has two types of chlorine atoms with oxidation number of $+1 \& -1$.

One cl^- ion is in -1 oxidation state.

Other OCl^- ion has a +1 oxidation state.

1514. Which one of the following statements regarding helium is incorrect?

(a) It is used to fill gas balloons instead of hydrogen because it is lighter and non-inflammable

(b) It is used as a cryogenic agent for carrying out experiments at low temperatures

(c) It is used to produce and sustain powerful superconducting magnets

(d) It is used in gas cooled nuclear reactors

UPTU/UPSEE-2012

BCECE-2010

Ans. (c) : Helium is not lighter than hydrogen. Helium is twice as heavy as hydrogen. Its lifting power is 92% of that of hydrogen. Helium has the lowest melting and boiling point of any element which makes liquid helium an ideal coolant for many extremely low temperature application such as superconducting magnet and cryogenic research where temperature close to absolute zero is needed.

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1515. Transport number of Cl^- is least in

(a) HC*l* (b) NaC*l*

(c) KC*l* (d) CaC*l*

UPTU/UPSEE-2012

Ans. (a) : Transport no (T) = $\frac{\text{Current carried by ion}}{\text{total current}}$

Transport number = Speed of ion

$$T_{Cl}^-(HCl) = \frac{V_{Cl^-}}{V_{Cl^-} + V_{H^+}}$$

$$T_{Cl}^-(NaCl) = \frac{V_{Cl^-}}{V_{Cl^-} + V_{Na^+}}$$

$$T_{Cl}^-(KCl) = \frac{V_{Cl^-}}{V_{Cl^-} + V_{K^+}}$$

$$T_{Cl}^-(CaCl) = \frac{V_{Cl^-}}{V_{Cl^-} + V_{Ca^+}}$$

1516. Which one of the following will dissolve in water most readily?

(a) I_2 (b) $BaCo_3$

(c) KF (d) PbI_2

UPTU/UPSEE-2008

Ans. (c) : All the alkali halides except lithium fluoride are freely soluble in water, I_2 (non-poler) is least soluble in water. Group IIA carbonate ($BaCO_3$) are insoluble in water. PbI_2 is sparingly soluble in cold water but quite soluble in hot water. KF is most readily soluble in water.

1517. The correct order of acidity of the following hydra acids is

(a) HF > HCl > HBr > HI

(b) HF < HCl < HBr < HI

(c) HF < HCl > HBr > HI

(d) HF > HCl < HBr > HI

WB-JEE-30.04.2022

Ans. (b) : HI is most acidic due to weak bonding between H and I. It breaks into H^+ and I^+. HF is weakest acid because of extensive hydrogen bonding. It does not release H^+ ion.

1518. The boiling points of HF, HCI, HBr and HI follow the order

(a) HF > HCI > HBr > HI

(b) HF > HI > HBr > HCI

(c) HI > HBr > HCI > H

(d) HCI > HF > HBr > HI

WB-JEE-2016

Ans. (b) : Boiling point depends upon the hydrogen bonding present between the molecules.

- HF has strong hydrogen bonding and has the highest boiling point.

1519. At room temperature, the reaction between water and fluorine produces

(a) HF and H_2O_2 (b) HF,O_2 and F_2O_2

(c) F^-,O_2 and H^+ (d) HOF and HF

WB-JEE-2018

Ans. (c) : At room temperature, the reaction between water and fluorine produces F^-, O_2 and H^+.

$$F_2 + H_2O \xrightarrow{\text{room temperature}} HF + O_2$$

1520. Cl_2O_7 is the anhydride of

(a) HOCl (b) $HClO_2$

(c) $HClO_3$ (d) $HClO_4$

WB-JEE-2018

Ans. (d) : Cl_2O_7 is the anhydride of $HClO_4$

$$Cl_2O_7 + H_2O \longrightarrow 2HClO_4$$

1521. The reactive species in chlorine bleach is

(a) Cl_2O (b) OCl^-

(c) ClO_2 (d) HCl

WB-JEE-2019

Ans. (b) : OCl^- is used as a bleaching agent

$$OCl^- \rightarrow [O] + Cl^-$$

1522. The electronic configuration of four elements are given below. Which elements does not belong to the same family as others?

(a) $[Xe]4f^{14}5d^{10}4s^2$ (b) $[Kr]4d^{10}5s^2$

(c) $[Ne]3s^2,3p^5$ (d) $[Ar]3d^{10}4s^2$

NEET-1989

Ans. (c) : The electronic configuration of $[Ne]3s^2, 3p^5$ not belong to the same family. Since each one of them have 2 electrons in the outermost shell in contrast element has 7 electrons in the valence shell.

1523. Dipole moment value of the halogen acids follows which trend actually?

(a) HF > HCl > HBr > HI

(b) HI > HBr > HF > HF

(c) HI > HF > HCl > HBr

(d) HI > HCl > HF > HBr

Tripura JEE-2021

Ans. (a) : The increasing order of dipole moment of bond in halogen acids is HF > HCl > HBr > HI

Fluorine is the most electronegative atom.

The electronegativity order is F > Cl > Br > I.

1524. Which of these statement in incorrect?

(a) Alkali metals are good reductants

(b) Halogens are good reducing agents

(c) Chlorine has the maximum electron affinity

(d) Fluorine is the most electronegative element

UP CPMT-2014

Ans. (b) : Halogens are good oxidizing agents, not the reducing agents.

1525. Which one of the following liberate bromine when reacted with KBr?

(a) Iodine (b) Chlorine

(c) Sulphur (d) Carbon

UP CPMT-2012

Ans. (b) : $2KBr+Cl_2 \rightarrow 2KCl+Br_2$

A halogen can oxidize halide ions of higher atomic number. Furthermore, the oxidizing ability of halogens in aqueous solution decreases down the group with increase in atomic number.

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1526. CS_2 layer gives a test for

(a) Cl^- (b) Br^- and I^-

(c) Br^- only (d) I^- only

UP CPMT-2011

Ans. (b) : CS_2 layer dissolves Br_2 and I_2 which are obtained by oxidation of Br^- and I^- by Cl_2 water.

9. Noble gases

1527. Which noble gas has least tendency to form compounds ?

(a) Ar (b) Kr

(c) He (d) Ne

Karnataka CET-17.06.2022, Shift-II

Ans. (c) : Helium (He) due to highest Ionization potential, electrons are more highly held with nucleus.

1528. Identify the element having zero valency

(a) Sulphur (b) Phosphorous

(c) Lead (d) Radon

NDA (II)-2016

Ans. (d) : Radon is having zero valency because Rn is an inert gas and inert gas has completely filled outer most shell.

1529. Match List I with List II and select the correct answer using the code given below the Lists

	List I (Noble gas)		List II (Use)
A.	Argon	1.	In lights for advertising display
B.	Neon	2.	Airport landing lights and in light houses
C.	Krypton	3.	Light in Photographer's flash gun
D.	Xenon	4.	In tungsten filament to last longer

Code:

	A	B	C	D
(a)	3	1	2	4
(b)	3	2	1	4
(c)	4	2	1	3
(d)	4	1	2	3

NDA (I)-2017

Ans. (d) :

List I (Noble gas)	List II (Use)
A. Argon	In tungsten filament to last longer.
B. Neon	In lights for advertising display
C. Krypton	Airport landing lights and in light houses.
D. Xenon	Light in Photographer's flash guns

1530. Radon is

(a) an inert gas (b) an artificial fibre

(c) an explosive (d) a metal

NDA (I)-2017

Ans : (a) Radon is an inert gas. It is a naturally-occurring radioactive gas that can cause lung cancer. Radon is naturally in the atmosphere in trace amounts.

1531. The property of halogens which is not correctly matched is

(a) I > Br > Cl > F (density)

(b) F > Cl > Br > I (electron gain enthalpy)

(c) F > Cl > Br > I (ionization enthalpy)

(d) F > Cl > Br > I (electronegativity)

Karnataka CET-17.06.2022, Shift-II

Ans. (b) : The electron gain enthalpy of Cl is maximum.

So, the trend is : Cl>F>Br>I.

1532. Polar stratospheric clouds facilitate the formation of:

(a) $ClONO_2$ (b) HOCl

(c) ClO (d) CH_4

JEE Main-26.06.2022, Shift-I

Ans. (b) : In summer season Nitrogen dioxide and methane react with chlorine monoxide and chlorine atom forming, chlorine sinks, preventing much ozone depletion, where as in winter season, special type of clouds are formed over antalica, these polar stratospheric cloud provide surface on which chlorine nitrate formed gels hydrated to form hypochloro acid.

$$ClO(g)+NO_2(g)\longrightarrow ClONO_2(g)$$

$$ClONO_2(g)+H_2O(g)\longrightarrow HOCl(g)+HNO_3(g)$$

Both reaction takes place in stratosphere.

1533. Given below are two statements: one is labelled as Assertion A and the other is labelled as Reason R.

Assertion A: Fluorine forms one oxoacid.

Reason R: Fluorine has smallest size amongst all halogens and is highly electronegative. In the light of the above statements, choose the most appropriate answer from the option given below.

(a) Both A and R are correct and R is the correct explanation of A.

(b) Both A and R are correct but R is NOT the correct explanation of A.

(c) A is correct but R is correct

(d) A is not correct but R is not correct.

JEE Main-27.06.2022, Shift-II

Ans. (a) : Fluorine forms only one oxoacid because of smaller size & high electronegativity.

Both the assertion and reason are correct and Reason is the correct explanation.

1534. HIO_3 On heating at 170°C give:

(a) I_2 (b) I_2O_5

(c) I_2O_4 (d) HIO_4

CG PET-22.05.2022

Ans. (b) : 2 moles of HIO_3 on heating at 170°C, we get

$$2HIO_3\xrightarrow{\Delta}I_2O_5+H_2O$$

1535. Which one of the following will NOT produce carbon dioxide on reacting with an aqueous solution of hydro-chloric acid ?

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(a) Limestone (b) Quick Lime
(c) Chalk (d) Marble

NDA (I)-2019

Ans : (b) Quick lime on reaction with HCl does not produce carbon dioxide.

$$\underset{\text{Quick lime}}{CaO} + 2HCl \rightarrow CaCl_2 + H_2O$$

1536. Which one of the following is not a monoatomic element ?
(a) Copper (b) Helium
(c) Iodine (d) Barium

NDA (II)-2019

Ans : (c) Iodine is not a monoatomic element. It exist in the form of diatomic, I_2. Except Iodine, all the given elements exist in monoatomic.

1537. Which one of the following reactions of xenon compounds is not feasible?
(a) $3XeF_4 + 6H_2O \rightarrow 2Xe + XeO_3 + 12HF + 1.5O_2$
(b) $2XeF_2 + 2H_2O \rightarrow 2Xe + 4HF + O_2$
(c) $XeF_6 + RbF \rightarrow Rb[XeF_7]$
(d) $XeO_3 + 6HF \rightarrow XeF_6 + 3H_2O$

VITEEE-2016

Ans. (d) : Xenon fluorides easily hydrolysed to give xenon oxides. Reverse form of this reaction is impossible because xenon fluorides will again reverse the reaction to give xenon oxides.
Therefore, $XeO_3 + 6HF \rightarrow XeF_6 + 3H_2O$ is not feasible.

1538. Which of the following can form compounds with xenon?
(a) I_2 (b) F_2
(c) Br_2 (d) Al

AP-EAMCET (Med.)-1999

Ans. (b) : Fluorine is the electronegative element which can only form compound with xenon are –XeF_2, XeF_4 and XeF_6.

1539. The rare gas which is more abundant in atmosphere is
(a) Ne (b) Rn
(c) Xe (d) Ar

AP EAMCET- 1993

Ans. (d) : Argon is the most abundant rare earth (noble) gas in atomosphere. The percentage of argon is 0.934% and that of neon and helium is 0.0018% and 0.00052% respectively.

1540. At what temperature will the total kinetic energy of 0.30 moles of He be same as the total kinetic energy of 0.40 moles of Ar at 400 K?
(a) 400 K (b) 300 K
(c) 273 K (d) 533 K

AP-EAMCET 25-08-2021 Shift - I

Ans. (d) : Given,

K.E. of He = K.E. of Ar

n_{He} = 0.30 mole, T_{He} = ?K

n_{Ar} = 0.40 mole, T_{Ar} = 400K

Now, $\text{K.E.} = \dfrac{3nRT}{2}$

$$\therefore \frac{\text{K.E. of He}}{\text{K.E. of Ar}} = \frac{n_{He} \times T_{He}}{n_{Ar} \times T_{Ar}}$$

$$\frac{1}{1} = \frac{0.30 \times T_{He}}{0.40 \times 400}$$

$$T_{He} = \frac{0.40 \times 400}{0.30}$$

$$T_{He} = 533K$$

1541. Xenon reacts with fluorine at 873 K and 7 bar to form XeF_4. In this reaction, the ratio of xenon and fluorine required is
(a) 1 : 5 (b) 10 : 1
(c) 1 : 3 (d) 5 : 1

TS-EAMCET-2016

Ans. (a) : XeF_4 is obtained by heating a mixture of xenon and fluorine in the ratio of 1:5 at 873 K and 7 bar pressure.

$$\underset{1}{Xe} + \underset{5}{2F_2} \xrightarrow[7\,bar]{873K} XeF_4$$

1542. Match the following –

List-I (Element)	**List-II (Property)**
(A) He	(I) can be used as inert atmosphere
(B) Ar	(II) Radioactive element
(C) Xe	(III) Form fluoride compounds
(D) Rn	(IV) can be used as airship balloons

The correct match is
(a) A-IV, B-III, C-II, D-I
(b) A-IV, B-I, C-III, D-II
(c) A-I, B-II, C-III, D-IV
(d) A-II, B-I, C-IV, D-III

TS-EAMCET (Engg.), 07.08.2021 Shift-II

Ans. (b) :
He → can be used as airship balloons
Ar → Can be used as inert atmosphere
Xe → Form fluoride compounds
Rn → Radioactive element

1543. The formation of oxide ion O^{2-} from oxygen atom requires and exothermic step as shown below. The process of formation of O^{2-} in gas phase in unfavorable (is ΔH^{θ} = +ve), even thought it has stable configuration of the nearest noble gas, Neon. This is because ——

$$O(g) + e^- \rightarrow O^-(g);\ \Delta H^{\theta} = -141\ kJmol^{-1}$$

$$O^-(g) + e^- \rightarrow O^{2-}(g);\ \Delta H^{\theta} = +760\ kJmol^{-1}$$

(a) O^{2-} has larger size than that of Neon
(b) Oxygen is more electronegative than Neon
(c) O^- has larger size than oxygen atom
(d) Electron repulsion in oxide ion is more which over comes the stability achieved by noble.

AP EAPCET 25.08.2021, Shift-II

@apna_pdf

Ans. (d) : The formation of oxide ion O^{2-} from oxygen atom requires an exothermic reaction followed by an endothermic step as –

$$O(g)+e^- \rightarrow O^-(g);\ \Delta H^0=-141\ kJmol^{-1}$$

$$O^-(g)+e^- \rightarrow O^{2-}(g);\ \Delta H^0=+760\ kJmol^{-1}$$

Electron repulsion in oxide ion is more which overcomes the stability achieved by gas configuration.

1544. Assertion (A) : The boiling points of noble gases increases from He to Xe.

Reason (R) : The interatomic van der Waals' attractive forces increases from He to Xe.

The correct answer is

(a) Both (A) and (R) are true, and (R) is the correct explanation of (A)
(b) Both (A) and (R) are true, and (R) is not the correct explanation of (A)
(c) (A) is true but (R) is not true
(d) (A) is not true but (R) is true

AP EAMCET (Engg.) - 2012

Ans. (a) : : The boiling points of noble gases increases from He to Xe because the interatomic van der Waals' attractive forces increases from He to Xe.

1545. The inert gases producing maximum number of compounds are

(a) He and Ne (b) Ar and Ne
(c) Kr and Ne (d) Ar and Xe

MPPET-2008

Ans. (d) : Ar and Xe are inert gases producing maximum number of compounds because of their low ionization energy. Compounds of Xe are XeF_2, $XeOF_2$, XeF_4, $XeOF_4$, XeF_6, XeO_3 etc.

1546. Helium is used in diving apparatus because

(a) It is lighter than nitrogen
(b) It is completely miscible with oxygen
(c) It is insoluble in blood at high pressure
(d) None of the above

SCRA - 2009

Ans. (c) : Helium is used as a diluent for oxygen in modern diving apparatus because of its very low solubility in blood. It reduces decompression and causes less discomfort to the diver in breathing.

1547. Find the product of the following reaction, when Xe is taken in excess,

$$Xe(g) + F_2(g) \rightarrow ?$$

(a) XeF_4 (b) XeF_2
(c) XeF_6 (d) XeF_7

AP EAMCET (Engg.) 21.09.2020, Shift-II

Ans. (b) : When excess of xenon gas react with fluorine gas at high temperature (673 K) and 1 bar pressure xenon difluoride (XeF_2) is formed.

$$Xe(excess)+F_2 \xrightarrow{673K,1bar} XeF_2$$

1548. When helium gas is allowed to expand into vacuum, heating effect is observed. The reason for this is (assume He as a non ideal gas)

(a) He is an inert gas
(b) The inversion temperature of helium is very high
(c) The inversion temperature of helium is very low
(d) He has the lowest boiling point

TS EAMCET-2017

Ans. (c) : Gases which have low inversion temperature gets heated when allowed to expand in vacuum.

- The inversion temperature of helium is very low.

1549. Two compounds X and Y can react with XeF_6 to form cationic and anionic species respectively X and Y can be ________

(a) RbF, PtF_5 (b) BF_3, PtF_5
(c) CsF, SbF_5 (d) BF_3, NaF

AP EAPCET-6 Sep. 2021, Shift-II

Ans. (d): BF_3 reacts with XeF_6 to produce Xenon pentafluoride tetra fluoro borate (III)

$$BF_3+XeF_6 \rightarrow XeF_5^+[BF_4]^-$$

- Reaction of sodium fluoride (NaF) with XeF_6 gives $Na^+[XeF_7]^-$

$$\boxed{XeF_6+NaF \rightarrow Na^+[XeF_7]^-}$$

1550. Which one of the following noble gases is used in miner's cap lamps?

(a) Helium (b) Neon
(c) Argon (d) Krypton

AP EAMCET (Engg.) -2007

Ans. (d) : Krypton is the inert gas which is used in miner's cap lamps, because its light does not produce glare.

1551. Xenon best reacts with_________

(a) Neutral atoms
(b) Most electronegative elements
(c) Most electropositive elements
(d) Transition elements

AP EAPCET 20.08.2021 Shift-II

Ans. (b): Xenon is noble gas. Xenon reacts with most electronegative elements since it has very little tendency to lose electrons.

1552. Assertion (A) The boiling points of noble gases increases from He to Xe.

Reason (R) The interatomic van der Waals' attractive forces increases from He to Xe.

The correct answer is

(a) Both (A) and (R) are true, and (R) is the correct explanation of (A)
(b) Both (A) and (R) are true, and (R) is not the correct explanation of (A)
(c) (A) is true but (R) is not true
(d) (A) is not true but (R) is true

AP EAMCET (Engg.) 2012

Ans. (a) : As the size of noble gases increases from He to Xe, Van der Waal's forces increases and due to which boiling point increases. When looking at the noble gases, the boiling point is predicted to increase in downward, in the order He, Ne, Ar, Kr, Xe, Rn.

1553. Which of the following noble gases has the highest van der Waal's forces of attraction?

(a) Ar (b) Ne
(c) Xe (d) He

COMEDK-2012

@apna_pdf

Ans. (c) : As we know, from He to Xe the size of atom increases, the vander waals forces of attraction also increases.

1554. Identify the incorrect statement, regarding the molecule XeO_4.

(a) XeO_4 molecule is square planar.

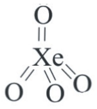
(b) There are four $p\pi - d\pi$ bonds.

(c) There are four $sp^3 - p, \sigma$ bonds.

(d) XeO_4 molecule is tetrahedral.

KARNATAKA NEET 2013

Ans. (a) : The Structure of XeO_4 are given as :



(sp^3–tetrahedral)

The molecule contains the four sp^3-p and σ bonds. The dπ-pπ bonds are also present in XeO_4.

1555. Which of the following inert gas compounds is not formed?

(a) $XeOF_4$ (b) XeO_3

(c) XeF_2 (d) NeF_2

COMEDK 2014

Ans. (d) : The expansion of octal of Ne atom, all the valence electron are closer to the nucleus and suffer the more electrostatic attraction due to which the removing of electron to higher energy state consumed the more amount of energy which cannot be compensated by the formation of the Ne-F bond.

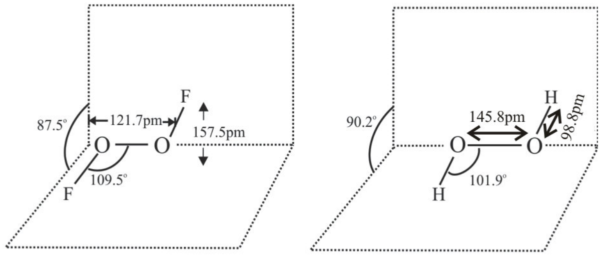
1556. Shape of O_2F_2 is similar to that of

(a) C_2F_2 (b) H_2O_2

(c) H_2F_2 (d) C_2H_2

COMEDK 2018

Ans. (b) : The structure of H_2O_2 is similar to the structure of O_2F_2 both have half open book shape.



1557. The noble gas used in atomic reactors is

(a) Krypton (b) Oxygen

(c) Neon (d) Helium

AP-EAMCET (Medical), 2003

Ans. (d) : • Helium gas used in atomic reactors because helium provides highly efficient form of nuclear power with virtually no waste and no radiation. He is used as a coolant in nuclear reactor as it condenses at very low temp.

• Krypton is used commercially as a filling gas for energy-saving fluorescent lights. It is also used in some flash lamps used for high speed photography.

• Neon is reddish-orange colored in neon lamps and vacuum discharge tubes and a second lightest noble gas.

1558. Which of the following statements about noble gases are correct?

(I) XeO_3 is an explosive tetrahedral molecule.

(II) In Fischer Ringe's method, a mixture of $CaCl_2$ and CaC_2 is used to remove N_2 and O_2.

(III) He and Ne are chemically inert due to lack of d-orbitals and high ionization potential.

(IV) At 173K He and Ne are adsorbed on activated charcoal.

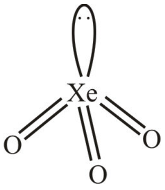
The correct answer is

(a) I and II (b) II and III

(c) II, III and IV (d) I, II, III and IV

AP-EAMCET (Medical), 2008

Ans. (b) : (I) Xe atom contains the one lone pair of electron due to which XeO_3 shows the explosive properties. XeO_3 has the pyramidal geometry with sp^3 hybridisation.



(II) In Fischer-Ringe's method of separation of nobles gas mixture from air, 90% of CaC_2 + 10% $CaCl_2$ is used. Fischer-Ring's method is used for large scale production of noble gases from the air. It is a modern method.

(III) Due to unavailability of d-orbital in He and Ne, they behave as chemically inert and highly ionisation potential.

(IV) As we know all inert gases are absorbed on activated charcoal and the extent of adsorption increases on moving down the group.

Thus, statement II and III are correct.

1559. What is the atomic number (z) of the noble gas that reacts with fluorine?

(a) 54 (b) 10

(c) 18 (d) 2

AP-EAMCET (Medical), 2001

Ans. (a) : There are three fluorides compounds which are formed by Xenon (54).

Ex.:- XeF_2, XeF_4 and XeF_6.

They are obtained by interaction of xenon and fluorine.

1560. What are the products formed in the reaction of xenon hexafluoride with silicon dioxide?

(a) $XeSiO_4 + HF$ (b) $XeF_2 + SiF_4$

(c) $XeOF_4 + SiF_4$ (d) $XeO_3 + SiF_2$

AP-EAMCET (Medical), 2002

AIIMS-2012

Ans. (c) : When Xenon hexafluoride (XeF_6) is treated with silica (SiO_2) then xenon oxyfluoride ($XeOF_4$) and silicon tetrafluoride will be formed.

$$\underset{\text{Xenonhexa Fluoride}}{2XeF_6} + \underset{\text{Silica}}{SiO_2} \longrightarrow \underset{\text{Xenonoxy fluoride}}{2XeOF_4} + \underset{\text{Silicon tetrafluoride}}{SiF_4}$$

@apna_pdf

1561. Which of the following does not exist?

(a) $XeOF_4$ (b) NeF_2

(c) XeF_2 (d) XeF_6

TS-EAMCET (Engg.), 06.08.2021

Ans. (b): NeF_2 does not exist as it would require d-orbital for bonding and Ne is present in a 2nd period of elements. To unpair them and move it to a higher energy orbital will need high amount of energy which cannot be compensated by the formation of the Ne-F bond. Hence NeF_2 does not exist.

1562. Complete hydrolysis of XeF_4 and XeF_6 gives its oxides P and Q, respectively. Identify P and Q

	P	Q
(a)	XeO_2	XeO_3
(b)	XeO	XeO_2
(c)	XeO_3	XeO_3
(d)	XeO_2	XeO_2

TS EAMCET 04.08.2021, Shift-I

Ans. (c) : Complex hydrolysis of XeF_4 and XeF_6 result in the formation of XeO_3.

Complete hydrolysis of XeF_4 –

$$\underset{\substack{\text{Xenon}\\\text{tetrafluoride}}}{6XeF_4} + 12H_2O \longrightarrow \underset{\text{Xenon}}{4Xe^+} + \underset{\substack{\text{Xenon}\\\text{trioxide}}}{2XeO_3} + \underset{\substack{\text{Hydrogen}\\\text{fluoride}}}{24HF} + 3O_2$$

Complete hydrolysis of XeF_6 –

$$\underset{\substack{\text{Xenon}\\\text{hexafluoride}}}{XeF_6} + 3H_2O \longrightarrow \underset{\substack{\text{Xenon}\\\text{trioxide}}}{XeO_3} + \underset{\substack{\text{Hydrogen}\\\text{fluoride}}}{6HF}$$

1563. Which of the following inert gas participates in chemical reaction?

(a) Xe (b) He

(c) Ne (d) None

AIIMS 25 May 2019 (Morning)

Ans. (a): (Xe) Xenon gas takes part in chemical reactions because ionising power of Xe and oxygen are almost same and atomic size of Xe is large.

1564. Assertion: Inert gases are monoatomic.
Reason: Inert gases have stable configuration.

(a) If both Assertion and Reason are correct and the Reason is a correct explanation of the Assertion.

(b) If both Assertion and Reason are correct but Reason is not a correct explanation of the Assertion.

(c) If the Assertion is correct but Reason is incorrect.

(d) If both the Assertion and Reason are incorrect.

(e) If the Assertion is incorrect but the Reason is correct.

[AIIMS-1999]

Ans. (a): Inert gases have stable electron configuration and their outermost shell is completely filled hence they are stable by themselves and hence they are mono atomic in nature.

1565. In Fischer-Ringe method of separation of noble gases mixture from air, ...is used.

(a) 90% CaC_2+10%$CaCl_2$

(b) coconut charcoal

(c) soda lime + potash solution

(d) 90% $CaCO_3$+10% urea

AP EAMCET- 2005

Ans. (a) : Fischer - Ringe method is used for large scale production of noble gases from the air.

In Fischer - Ringe method of separation of nobles gas mixture from air, 90% CaC_2+10% $CaCl_2$ is used.

1566. Which one of the following noble gases is used in miner's cap lamps?

(a) Helium (b) Neon

(c) Argon (d) Krypton

AP EAMCET- 2007

Ans. (d) : Krypton (kr) is used in miner's cap lamps because krypton's light does not produce glare.

1567. Which of the following compounds of xenon cannot be prepared?

(a) XeF (b) XeF_2

(c) XeF_4 (d) XeF_6

MPPET - 2012

Ans. (a) : Xenon has only three compounds of fluoride which are XeF_2, XeF_4 and XeF_6.

1568. The geometries of XeF_4 and $XeOF_4$ respectively are ________

(a) Pyramidal and distorted octahedral

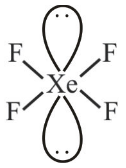
(b) Square-pyramidal and square-pyramidal

(c) Square planar and square pyramidal

(d) Square planar and square planar

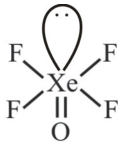
AP EAPCET 23-08-2021 Shift-I

Ans. (c) : Structure of XeF_4 is-



Geometry of XeF_4 is square planar.

Structure of $XeOF_4$ is-



Geometry of $XeOF_4$ is square pyramidal.

1569. The structures of XeF_2 and XeF_4 respectively are_____.

(a) Linear and Square planar

(b) Bent and Square planar

(c) Linear and Tetrahedral

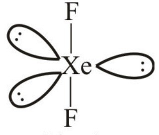
(d) Bent and Trigonal pyramidal

AP-EAMCET 25-08-2021 Shift - I

Ans. (a) :

$XeF_2 \rightarrow$ hybridisation = 3(Lone pair) + 2(Bond pair)

= 5(sp^3d)



(Linear)

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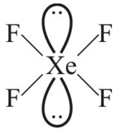
$XeF_4 \rightarrow$ hybridisation = 2(Lone pair) + 4(Bond pair)
= 6(sp^3d^2)



(Square planar)

1570. Assertion: A mixture of He and O_2 is used for respiration for deep sea divers.
Reason: He is soluble in blood.

(a) If both Assertion and Reason are correct and the Reason is a correct explanation of the Assertion.
(b) If both Assertion and Reason are correct but Reason is not a correct explanation of the Assertion.
(c) If the Assertion is correct but Reason is incorrect.
(d) If both the Assertion and Reason are incorrect.
(e) If the Assertion is incorrect but the Reason is correct.

[AIIMS-1998]

Ans. (c): A mixture of He and O_2 is used for respiration by deep sea divers it reduces decompression and causes less discomfort to the diver in breathing but (He) Helium is not soluble in blood.

1571. Which gas is used as cooling tube of MRI tube?

(a) He
(b) Ar
(c) CO_2
(d) N_2

[AIIMS-26 May, 2018(E)]

Ans. (a): He gas use as cooling agent in superconducting magnet. It cools down the superconducting magnets, which generate images of the human body to a temperature below 4.15 kelvin.

1572. Which one of the following statements regarding helium is incorrect?

(a) It is used to produce and sustain powerful superconducting magnets.
(b) It is used as a cryogenic agent for carrying out experiments at low temperatures.
(c) It is used to fill gas balloons instead of hydrogen because it is lighter and non-inflammable.
(d) It is used in gas-cooled nuclear reactors.

[AIIMS-2015]

Ans. (c) : It is used to fill gas balloons instead of hydrogen because it is lighter and non-inflammable.
Helium gas is light compared to most gases but the only gas lighter than Helium which is hydrogen. Helium is preferred due to its non flammable nature and its light nature.

1573. The reason for not storing XeF_6 in a glass or a quartz vessel is that

(a) It forms an explosive having the formula XeO_2F_2
(b) It forms an explosive having the formula $XeOF_4$
(c) It forms XeO_2 which is explosive substance.
(d) It forms XeO_6^{4-} which is explosive in nature.

[AIIMS-2011]

Ans. (b): It forms an explosive having the formula $XeOF_4$.
Xenon hexafluoride is a compound of noble gas. It is strongest fluorinating agent of the series. It reacts with silica at normal temperature.

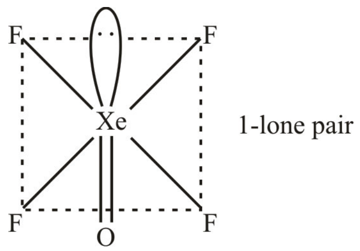
$$\underset{}{2XeF_6} + \underset{(Glass)}{SiO_2} \longrightarrow \underset{(explosive\ nature)}{2XeOF_4} + SiF_4$$

1574. Total number of lone pair of electrons in $XeOF_4$ is

(a) 0
(b) 1
(c) 2
(d) 3

[AIIMS-2011]

Ans. (b): 1
In $XeOF_4$, Xe is sp^3d^2, hybridised (6 electron pairs). 5 bond pairs and 1 lone pair.



1575. Which statements among the following are correct about Helium?

(i) Liquid helium is used to sustain powerful superconducting magnets.
(ii) Liquid helium is useful to carry low temperature experiments.
(iii) It is heavy gas.
(iv) It is a flammable gas.

(a) (i) & (ii) only
(b) (ii) & (iii) only
(c) (i) & (iv) only
(d) (iii) & (iv) only

AP EAPCET 19-08-2021, Shift-II

Ans. (a) : (i) and (ii) only.

- Liquid helium is used as coolant for many super conducting magnets.
- Liquid helium is useful to carry low temperature in many experiments.
- It is the second lighter gas in the periodic table.
- Helium is an inert gas. Inert gases are non-combustible.

1576. In XeF_2, XeF_4, XeF_6 the number of lone pairs on Xe are respectively

(a) 2, 3, 1
(b) 1, 2, 3
(c) 4, 1, 2
(d) 3, 2, 1

AIEEE-2002

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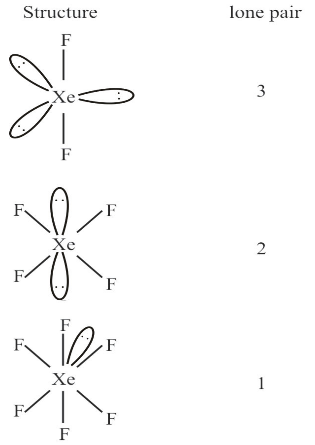
Ans. (d) :



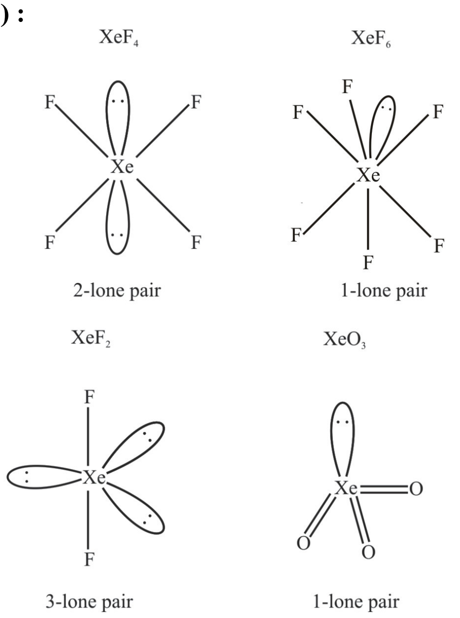
1577. Which of the following has maximum number of lone pairs associated with Xe ?

(a) XeF_4 (b) XeF_6

(c) XeF_2 (d) XeO_3

VITEEE-2017

Ans. (c) :



So, the option (c) has maximum lone pairs.

1578. XeF_4 disproportionate in water to give

(a) Xe + HF (b) Xe and XeO_3

(c) $XeOF_4$ and HF (d) XeO_4Fe and HF

VITEEE-2016

Ans. (b) : $6XeF_4 + 12H_2O \rightarrow 2XeO_3 + 4Xe + 3O_2 + 24HF$

So, XeF_4 disproportionate in water to give Xe and XeO_3.

1579. Assertion (A) :Noble gases have very low boiling points.

Reason (R) : All noble gases have general electronic configuration of ns^2 np^6(except He).

(a) Both (A) and (R) are true and (R) is correct explanation of (A).

(b) (A) is false, but (R) is true.

(c) (A) is true, but (R) is false.

(d) Both (A) and (R) are true and (R) is the not the correct explanation of (A).

AP-EAMCET (Engg.) 2015

Ans. (d) : All the noble gases have general electronic configuration ns^2, np^6 (except He) is correct statement. Boiling point of noble gases are quite low as compared to other elements of comparable atomic masses due to weak Vander Waal's force of attraction which hold the atoms together in the liquid and in the solid states.

1580. Liquid Xe is used in bubble chamber to detect neutral mesons and gamma photons. Then, X is

(a) He (b) Ne

(c) Kr (d) Xe

AP-EAMCET (Engg.) 2013

Ans. (d) : Liquid xenon is used in bubble chamber to detect neutral mesons and gamma photons.

1581. Which one of the following statements is not correct?

(a) In the Dewar's method for the separation of noble gases, activated coconut charcoal is used.

(b) Krypton is used in miners cap lamps.

(c) The electron affinity values of noble gases are nearly equal to zero.

(d) Xenon gives different colors when mixed with mercury vapors.

AP - EAMCET(MEDICAL) - 2009

Ans. (a) : This statement is true because the individual noble gases can be separated by 'Dewar' charcoal adsorption method. Activated coconut charcoal adsorbs all the noble gases excluding helium.

(b) This statement is true Krypton is used in miner's cap lamps because it's light does not produce glare.

(c) As we know, there is no vacant orbital present in the outer shell of noble gases due to which they shows the zero electron affinity. Hence the statement is true.

(d) Xenon produces flash (photographic) when mixed with mercury vapor inspite of different colors. Hence the given statement is false.

1582. In the separation of noble gas mixture from air by Ramsay-Rayleigh's first method, the substances used for the removal of N_2 and O_2 respectively are

(a) Cu and Mg (b) Mg and Cu

(c) C and CaC_2 (d) KOH solution

AP - EAMCET (Medical) - 2007

Ans. (b) : In Ramsay Rayleigh's method, the separation of noble gas mixture from air, magnesium and copper used for the removal of N_2 and O_2 respectively.

1583. Which of the following is not correct?

(a) XeO_3 has four σ and four π bonds

(b) The hybridisation of Xe in XeF_4 is sp^3d^2

(c) Among noble gases, the occurrence (percent by weight) of argon is highest in air

(d) Liquid helium is used as cryogenic liquid

AP-EAMCET (Engg.)-2005

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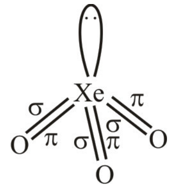
Ans. (a) : The molecular structure of XeO_3 is given as-



Hybridisation - sp^3

number of σ - bond = 3

number of π - bond = 3

Thus, statement (a) is false.

1584. The ease of loss of electron from Ne and Na^+ ion (both isoelectronic) are

(a) 4562 kJ mol^{-1}, 2081 kJ mol^{-1}

(b) 2081 kJ mol^{-1}, 4562 kJ mol^{-1}

(c) 2081 kJ mol^{-1} each

(d) 4562 kJ mol^{-1} each.

SRMJEEE – 2008

Ans. (b) : The Na^+ ion and the Ne atom are isoelectronic. The ease of loss of an electron i.e. ionization energies for Ne and Na^+ are 2081 kJ mol^{-1} and 4562 kJ mol^{-1} respectively.

1585. Hydrolysis of XeF_4 and XeF_6 with water gives

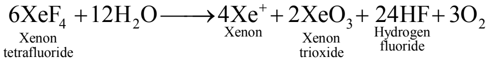
(a) $XeOF_4$ (b) XeO_2F_2

(c) XeO_3 (d) $XeOF_2$

AMU-2011

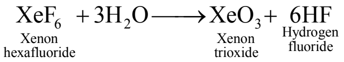
Ans. (c) : Complex hydrolysis of XeF_4 and XeF_6 result in the formation of XeO_3.

Complete hydrolysis of XeF_4 –



$$\underset{\text{Xenon tetrafluoride}}{6XeF_4} + 12H_2O \longrightarrow \underset{\text{Xenon}}{4Xe^{+}} + \underset{\text{Xenon trioxide}}{2XeO_3} + \underset{\text{Hydrogen fluoride}}{24HF} + 3O_2$$

Complete hydrolysis of XeF_6 –



$$\underset{\text{Xenon hexafluoride}}{XeF_6} + 3H_2O \longrightarrow \underset{\text{Xenon trioxide}}{XeO_3} + \underset{\text{Hydrogen fluoride}}{6HF}$$

1586. Who discovered the first noble gas compound?

(a) Neils Bohr (b) Neil Bartlett

(c) Neil Armstrong (d) William

AMU – 2010
Manipal-2017

Ans. (b) : Neil Bartlett discovered first noble gas compound which is $XePtF_6$. It is formed by deep red vapours PtF_6 of Xenon at room temperature.

1587. Which compound is prepared by the following reaction ?

$$Xe + F_2 \xrightarrow[673K]{Ni}$$

(1:2 volume ratio)

(a) XeF_6 (b) XeF_4

(c) XeF_2 (d) None of these

AMU–2001

Ans. (c) : $Xe + F_2 \xrightarrow[673K]{Ni\,tube} XeF_2$ (1:2 volume ratio)

$Xe + 2F_2 \xrightarrow[873K]{Ni\,tube} XeF_4$ (1 : 5 volume ratio)

$Xe + 3F_2 \xrightarrow[673K]{Ni\,tube} XeF_6$ (1 : 20 volume ratio)

1588. The most abundant inert gas in the atmosphere is

(a) He (b) Ne

(c) Ar (d) Kr

Assam CEE-2014

Ans. (c) : Argon- 0.934% Neon-0.0018%, Helium, 0.00052%

1589. The gas not absorbed by coconut charcoal is-

(a) He (b) Ne

(c) Ar (d) Kr

BCECE-2007

Ans. (a) : Helium is not absorbed by activated coconut charcoal due to its small size. Activated charcoal is used to treat-poisonings, induce intestinal gas.

1590. Which one of the following represents noble gas configuration?

(a) $1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 3d^{10}, 4s^2, 4p^6, 4d^{10}, 5s^2, 5p^6, 5d^6, 6s^2$

(b) $1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 3d^{10}, 4s^2, 4p^6, 4d^{10}, 5s^2, 5p^6, 5d^1, 6s^2$

(c) $1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 3d^{10}, 4s^2, 4p^6, 4d^{10}, 5s^2, 5p^6$

(d) $1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 3d^{10}, 4s^2, 4f^{14}, 5s^2, 5p^6, 5d^1$

BCECE-2007

Ans. (c) : $1s^2, 2s^2, 2p^6, 3s^{10}, 3p^6, 3d^{10}, 4s^2, 4p^6, 4d^{10}, 5s^2, 5p^6$.

Noble gas have completely filled orbitals with general electronic configuration ns^2, np^6.

1591. Ionisation potential for a noble gas is :

(a) maximum in a period

(b) minimum in a period

(c) either minimum or maximum

(d) constant

BCECE-2006

Ans. (a) : Due to extra stability on attaining the complete octet in out a shell.

1592. Which of the following noble gases is most reactive?

(a) He (b) Ne

(c) Ar (d) Xe

BCECE-2008

Ans. (d) : The noble gas (Xe) has most reactive due to its large size.

1593. Which is isoelectronic with hydride ion?

(a) He (b) He^+

(c) Li (d) H^+

BCECE-2009

Ans. (a) :

- hydride ion 1s $\left.\begin{array}{l} H^- = 1s^2 \\ He = 1s^2 \end{array}\right\}$ Isoelectronic species.

1594. Complete hydrolysis of XeF_2 gives

(a) Xe (b) O_2

(c) HF (d) All of these

BCECE-2011

Ans. (d) :

- Hydrolysis of XeF_2:

$$2XeF_2 + 2H_2O \longrightarrow 2Xe + 4HF + O_2.$$

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1595. Gradual addition of electronic shells in the noble gases causes a decrease in their

(a) Ionization energy (b) Atomic radius

(c) Boiling point (d) Density

[BITSAT-2006]

Ans. (a) : • Ionization energy ∝ nuclear attraction $\propto \frac{1}{\text{size of atom}}$ gradual increase of electronic shell, increases the size of atom and decreases the ionisation energy.

1596. Atomic radii of fluorine and neon in Angstrom units are respectively given by

(a) 0.72; 1.60 (b) 1.60; 1.60

(c) 0.72; 0.72 (d) None

[BITSAT-2006]

Ans. (a) : Atomic no Group

Fe = 9 Fe = 7

Ne = 5 Ne = 8

Fe - $1s^2, 2s^2, 2p^5$

Ne - $1s^2, 2s^2, 2p^6$

In Fe the 2P Orbital occupies only 5 electrons while in Ne the 2P orbital is entirely filled. Fluorine has 5 electrons in 2p-orbitals which is less than the required to ideal configuration inert gas configuration. Hence, nuclear charge is high leading smaller size then the next inert gas neon.

1597. Which of the following fluorides of xenon is impossible?

(a) XeF_2 (b) XeF_3

(c) XeF_4 (d) XeF_6

[BITSAT-2015]

Ans. (b) : Xenon is an inert gas.

[kr], $4d^{10}, 5s^2, 5p^6$.

All orbital's that are filled have paired electrons. When one, two or three electrons are promoted from 5p (filled) to 5d (empty) orbital's, two, four and six half filled orbital's are formed. Xenon can combine with even number of F atoms to forms XeF_2, XeF_4 or XeF_6. It cannot combine with odd number of F atoms. Thus, formation of XeF_3 and XeF_5 is not possible.

1598. In the clathrates of xenon with water, the nature of bonding between xenon and water molecule is

(a) covalent

(b) hydrogen bonding

(c) co-ordinate

(d) dipole-induce dipole interaction

[BITSAT-2019]

Ans. (d) : In the clathrates the bonding between noble gas atom and water is dipole-induce dipole interaction.

1599. Match list-I with List-II and select the correct answer using following codes

List-I		List-II
A.	XeF_2	1. Regular tetrahedral
B.	XeO_3	2. Distorted octahedral
C.	XeO_4	3. Linear
D.	XeF_6	4. Square planar
E.	XeF_4	5. Pyramidal

Code

	A	B	C	D	E
(a)	3	5	1	2	4
(b)	5	3	2	4	1
(c)	1	3	5	2	4
(d)	4	5	2	1	3

CG PET -2019

Ans. (a) :

XeF_2	sp^3d	Linear shape
XeO_3	sp^3	trigonal pyramidal
XeO_4	sp^3	regular tetrahedral
XeF_6	sp^3d^3	Distorted octahedral
XeF_4	sp^3d^2	Square planar

Hence, option (a) is correct.

1600. Which gas behaves abnormally when liquified?

(a) Xenon (b) Krypton

(c) Helium (d) Argon

CG PET- 2013, UP CPMT-2006

Ans. (c) : Gaseous He on cooling below 4.18k changes to liquid known as He (I) which on cooling to 2.2K and 1 atmospheric pressure changes to an abnormal liquid known as He (II). He (II) liquid behaves as a gas and hence thus state of liquid is said to be fourth state of matter, He (II) behaves as super fluid and hence abnormal state. He (I) is a normal liquid.

1601. Noble gases are absorbed by

(a) anhydrous calcium chloride

(b) ferric hydroxide

(c) conc. H_2SO_4

(d) activated coconut charcoal

[AIIMS-2010]

Ans. (d): Activated coconut charcoal is a very good absorbent of gas, whereas anhydrous $CaCl_2$, $Fe(OH)_3$ and concentrated H_2SO_4 are dehydrating agent. The adsorption of different noble gases occurs at different temperature. Hence, charcoal is used to separate these gases. Helium is not observed by charcoal.

1602. The gas most difficult to liquefy is:

(a) He (b) Ne

(c) Xe (d) Ar

HP CET-2018

Ans. (a) :

He

Ne

Ar ↓ Size increase

Kr

liquified easily → Xe

1603. The noble gas that does not occur in the atmosphere is

(a) Ra (b) Kr

(c) He (d) Ne

(JEE Main 2019, 10 April Shift-II)

Ans. (a) : It is a chemical element with symbol Rn and atomic number 86.

- It is radioactive, colorless, orderless, tasteless noble gas, occurring naturally as the decay product of uranium of thorium.
- Radon belongs to the Nobel Gases family
- The placement of Radon is in Group 18 in period 6

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1604. Which one of the following reaction of xenon compounds is not feasible?

(a) $XeO_3 + 6HF \rightarrow XeF_6 + 3H_2O$

(b) $3XeF_4 + 6H_2O \rightarrow 2Xe + XeO_3 + 12HF + 1.5O_2$

(c) $2XeF_2 + 2H_2O \rightarrow 2Xe + 4HF + O_2$

(d) $XeF_6 + RbF \rightarrow Rb[XeF_7]$

(AIEEE 2009)

Ans. (a) : This reaction is not feasible because the produces again react to give reactants back. All the Xenon fluorides easily undergo hydrolysis, and give Xenon oxides.

1605. Inert gases are mixed in iodine vapours. Then there are ____ between them.

(a) H-bonding

(b) Van der Waal's forces

(c) Electrostatic forces

(d) Metallic bonds

[AIIMS-2007]

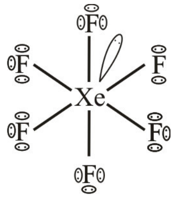
Ans. (b): Noble gases are least reactive, their inertness to chemical reactivity is because of the completing filled ns^2, np^6 electronic configuration in their valance shell except He, hence they only exists the short range force i.e., Vander Waal's force between them.

1606. A xenon compound 'A' upon partial hydrolysis gives XeO_2F_2. The number of lone pair of electrons present in compound A is .... (Round off to the nearest integer).

(JEE Main 2021, 18 March Shift-II)

Ans. (19) :

$$\underset{A}{XeF_6} + 2H_2O \longrightarrow XeO_2F_2 + 4HF$$



Total lone pair = 19

1607. XeF_6 on complete hydrolysis gives

(a) Xe (b) XeO_2

(c) XeO_3 (d) XeO_4

CG PET -2019
J & K CET-(2004)
CG PET -2006

Ans. (c) : Complete hydrolysis of XeF_6 to give

$$\underset{\text{Xenon hexafluoride}}{XeF_6} + 3H_2O \longrightarrow \underset{\text{Xenon trioxide}}{XeO_3} + \underset{\text{Hydrogen fluoride}}{6HF}$$

Highly explosive and act as powerful oxiding agent in solution.

1608. Which noble gas has the highest first ionization energy?

(a) helium (b) xenon

(c) radon (d) neon

J & K CET-(1997)

Ans. (a) : $1s^2$ is the most stable electronic configuration. Hence it has highest first ionisation energy.

1609. Noble gases are used in discharge tubes to give different colours. Reddish-orange glow is due to

(a) Ar (b) Ne

(c) Xe (d) Kr

JCECE - 2007, JIPMER-2008

Ans. (b) :

- Ne (Neon): Orange-red
- Ar (Argon): Purple
- Xe (Xenon): blue-green
- Kr (Krypton): silvery-white

1610. What is the correct order of occurrence (% by weight) in air of Ne, Ar and Kr?

(a) Ne > Ar > Kr (b) Ar > Ne > Kr

(c) Ar > Kr > Ne (d) Ne > Kr > Ar

JCECE - 2009

Ans. (b) :

- Occurance in air Ar = 1.285%

Ne = 1×10^{-3} %

Kr = 2.8×10^{-4} % by weight.

1611. Which one has the highest boiling point?

(a) H_2 (b) Xe

(c) CH_4 (d) He

(JEE Main 2015)
JCECE - 2010
BCECE-2005

Ans. (b) : Boiling point $\propto$ vander Waals' force

Vander Waals' force $\propto$ atomic mass (or molecular mass)

$\because$ Atomic mass of Xe is highest among H_2, He, CH_4, Xe.

$\therefore$ Boiling point of Xe is highest.

1612. XeF_2 on hydrolysis gives

(a) XeO_3 (b) XeO

(c) Xe (d) XeO_2

JCECE - 2015

Ans. (c) : XeF_2 on hydrolysis to give Xe.

$$XeF_2 + H_2O \longrightarrow Xe + HF + O_2$$

1613. In Fischer-Ringe's method of separation of nobles gas mixture from air, ... is used

(a) 90% CaC_2+10%$CaCl_2$

(b) Coconut charcol

(c) soda lime+ Potash solution

(d) 90% $CaCO_3$+ 10% urea

JIPMER-2014

Ans. (a) : • In Fischer - Range's method of separation of noble gas mixture from air, 90% CaC_2 + 10% $CaCl_2$ is used.

• Fisher-Ringe's method is used for large scale production of noble gases from the air.

1614. The correct order of solubility in water for He, Ne, Ar, Kr, Xe is

(a) He > Ne > Ar > Kr > Xe

(b) Xe > Kr > Ar > Ne > He

@apna_pdf

(c) Ne > Ar > Kr > He > Xe
(d) Ar > Ne > He > Kr > Xe

[AIIMS-2002]

Ans. (b): Xe > Kr > Ar > Ne > He
The solubility of noble gases in the water is due to dipole-induced dipole interaction from. as dipole-induced dipole-interaction increases with the increase of molecular mass of noble gases, hence, solubility of noble gases in water increase down the group. Due to increased polarity of heavier inert gas, its solubility in water also increases. So most soluble gas will be Xe and least soluble will be He.

1615. Which of the following rare gas is the abundant in air?

(a) He (b) Ne
(c) Ar (d) Kr

JIPMER-2019
Kerala-CEE-2017

Ans. (c) : The % by volume of rare gases are

	% by volume	% by weight
He	0.0005	0.000037
Ne	0.0015	0.001
Ar	0.932	1.285
Kr	0.0001	0.00028
Xe	0.0001	0.00004

So, Ar is most abundant in air.

1616. Xenon hexafluoride reacts with silica to form a xenon compound X. The oxidation state of xenon in X is

(a) +2 (b) +4
(c) +6 (d) 0

JIPMER-2018

Ans. (c) :

$$2XeF_6 + SiO_2 \longrightarrow 2XeOF_4 + SiF_4$$

The oxidation state of xenon in $XeOf_4$ is + 6 as calculated below:
Let the oxidation state of Xe is a
$\therefore$ a + 1 × (–2) +4 × (–1) = 0
a – 2 – 4 = 0
a = +6

1617. Choose the incorrect statement about noble gas?

(a) Boiling point increases with increasing atomic mass
(b) Helium has least tendency to form compound
(c) Noble gases have some value of electron affinity
(d) Xenon has maximum number of compounds

JIPMER-2016

Ans. (c) : Noble gas have some value of electron affinity. Electron affinity changes on moving down the group from He to Xe. So the is wrong statement.

1618. XeF_6 on hydrolysis produces

(a) $XeOF_6$ (b) XeO_2F_2
(c) XeO_3 (d) XeO_2

[AIIMS-2007]

Ans. (c): XeO_3.

$$XeF_6 + H_2O \longrightarrow XeOF_4 + 2HF$$
$$XeOF_4 + H_2O \longrightarrow XeO_2F_2 + 2HF$$
$$XeO_2F_2 + H_2O \longrightarrow XeO_3 + 2HF$$

XeF_6 on hydrolysis gives XeO_3.

1619. In Ramsay and Rayleigh's isolation of noble gases from air, the nitrogen of the air is finally converted into

(a) $NaNO_2$ only (b) NO and NO_2
(c) $NaNO_3$ only (d) $NaNO_2$ and $NaNO_3$

Karnataka-CET-2011

Ans. (d) : In Ramsay and Rayleigh's isolation of noble gases from air, the nitrogen of the air finally converted into $NaNO_2$ and $NaNO_3$.

$$N_2 + O_2 \xrightarrow{\text{Electric discharge}} 2NO$$
$$2NO_2 + O_2 \longrightarrow 2NO_2(g)$$
$$2NO_2 + 2NaOH \longrightarrow NaNO_2 + NaNO_3 + H_2O$$

1620. Argon is used

(a) in filling airships
(b) to obtain low temperature
(c) in high temperature welding
(d) in radiotherapy for treatment of cancer

JIPMER-2011
KARNATAKA-CET, 2009

Ans. (c) : Argon is used in high temperature welding and other operations which require a non-oxidising atmosphere and the absence of nitrogen.

1621. Which is the most easily liquefiable rare gas?

(a) Xe (b) Kr
(c) Ar (d) Ne

KARNATAKA-CET, 2008

Ans. (a) : Rare gases are relatively difficult to be liquefied as very weak van der Walls' forces of attraction exist in these gases. However, the liquefaction becomes easier from He to Xe as forces increase gradually. So, Xe can be liquefied easily.

1622. The noble gas mixture is cooled in a coconut bulb at 173 K. The gases that are not adsorbed are :

(a) Ne and Xe (b) He and Xe
(c) Ar and Kr (d) He and Ne

Karnataka-CET-2007

Ans. (d) : When the mixture of noble gas is cooled in a a cocount bulb at 173K then Ar, Kr and Xe are adsorbed on charcoal while He and Ne are not adsorbed.

1623. Which one of the following has maximum number of atoms of oxygen?

(a) 2g of carbon monoxide
(b) 2g of carbon dioxide
(c) 2 g of sulphur dioxide
(d) 2g of water

Karnataka-CET-2007

@apna_pdf

Ans. (d) : Number of oxygen atom in 2g of CO

$$= \frac{2}{28} \times 6.022 \times 10^{23} \times 1 = 0.430 \times 10^{23}$$

Number of oxygen atom in 2g of CO_2

$$= \frac{2}{44} \times 6.022 \times 10^{23} \times 2 = 0.547 \times 10^{23}$$

Number of oxygen atom in 2g of SO_2

$$= \frac{2}{64} \times 6.022 \times 10^{23} \times 2 = 0.376 \times 10^{23}$$

Number of oxygen atom in 2g of H_2O

$$= \frac{2}{18} \times 6.022 \times 10^{23} \times 1 = 0.669 \times 10^{23}$$

Hence, 2g of H_2O has maximum number of atoms of oxygen.

1624. Hydroxyl ion concentration of 10^{-2} M HCl is

(a) 1×10^{1} mol dm^{-3} (b) 1×10^{-12} mol dm^{-3}

(c) 1×10^{-1} mol dm^{-3} (d) 1×10^{-14} mol dm^{-3}

Karnataka-CET-2007

Ans. (b) : $[H^+][OH^-] = 10^{-14}$

$[10^{-2}][OH^-] = 10^{-14}$

$$[OH^-] = \frac{10^{-14}}{10^{-2}} = 10^{-12} \text{ mol dm}^{-3}$$

1625. Which of the following noble gases has the highest positive electron gain enthalpy value ?

(a) Helium (b) Krypton

(c) Argon (d) Neon

(e) Xenon

Kerala-CEE-2013

Ans. (d) :

Noble gas	Electron gain enthalpy (kJ/mol^{-1}).
He	48
Ne	116
Ar	96
Kr	96
Xe	77

1626. In which one of the following compounds of xenon, highest number of lone pair of electrons is present in xenon?

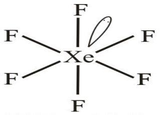
(a) XeF_6 (b) XeF_4

(c) $XeOF_4$ (d) XeO_3

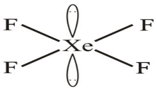
(e) XeF_2

Kerala-CEE-2016

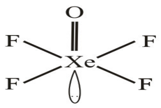
Ans. (e) : XeF_2 = 3 L.P.



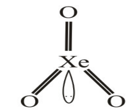
XeF_6 = 1 L.P.



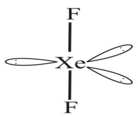
XeF_4 = 2 L.P.



$XeFO_4$ = 1 L.P.



XeO_3 = 1 L.P.



XeF_2 = 3 L.P.

1627. Rare gases are sparingly soluble in water because of

(a) Hydrogen bonding

(b) Dipole-dipole interaction

(c) Induced dipole-induced dipole interaction

(d) Dipole-induced dipole interaction

(e) (A) and (D)

Kerala-CEE-2019

Ans. (d) : Rare gases are sparingly soluble in water because of dipole-induced dipole interaction water (a polar molecule) have permanent dipole that induces a dipole on the electrically neutral atom by deforming its e^- cloud.

1628. Which element among the following does not form diatomic molecules?

(a) Argon (b) Oxygen

(c) Nitrogen (d) Bromine

MHT CET-2017

Ans. (a) : Argon has complete order shell electronic configuration hence stable its in monoatomic state.

1629. Argon possesses

(a) translational motion only

(b) translational + rotational motion

(c) translational + vibrational motion

(d) translational + rotational + vibrational motion

MHT CET-2010

Ans. (a) : • Monoatomic gas have degree of freedom 1, hence possess only translational motion.

1930. Noble gases are named because of their inertness towards reactivity. Identify an incorrect statement about them.

(a) Noble gases have large positive values of electron gain enthalpy

(b) Noble gases are sparingly soluble in water

(c) Noble gases have very high melting and boiling point

(d) Noble gases have weak dispersion force

(NEET 2021)

Ans. (c) : Noble gases have weak interatomic forces and therefore very low boiling and melting points, compared with elements of other groups.

1631. The formation of the oxide ion, $O^{2}_{(g)}$ from oxygen atom requires first an exothermic and then an endothermic step as shown below :

$O_{(g)} + e^- \rightarrow O^-(g)$; $\Delta_f H^0 = -141$ kJ mol^{-1}

$O^-_{(g)} + e^- \rightarrow O^{2-}(g)$; $\Delta_f H^0 = +780$ kJ mol^{-1}

Thus, process of formation of O^{2+} in gas phase is unfavourable even though O^{2+} is isoelectronic with neon. It is due to the fat that,

(a) O^- ion has comparatively smaller size than oxygen atom

(b) Oxygen is more electronegative

(c) addition of electron in oxygen results in larger size of the ion

(d) electronic repulsion out\weights the stability gained by achieving noble gas configuration

NEET-2015

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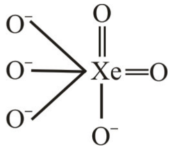
Ans. (d) : Since electro repulsion predominate over the stability gained by achieving noble gas configuration. Hence, formation of O^{2-} in gas phase is unfavourable.

1632. The number of peroxide bonds in perxenate ion $[XeO_6]^{4-}$ is

(a) 0 (b) 2
(c) 3 (d) 1

UP CPMT-2014

Ans. (a) : Structure of $[XeO_6]^{4-}$ is



Thus, it does not contain any peroxide bond.

1633. The noble gas used for treatment of cancer is

(a) helium (b) argon
(c) radon (d) krypton

Manipal-2018
UP CPMT-2011

Ans. (c) : Radon is radioactive with half-life period of 3.8 days and is used for the treatment of cancer.

1634. Which of the noble gas is most reactive?

(a) He (b) Ne
(c) Ar (d) Xenon

UP CPMT-2007

Ans. (d) : Lower is the ionization potential of an element, more would be its reducing power and also reactivity.

As we move down the group, the reactivity of noble gases increases due to the decrease in ionization energy. Hence, xenon is most reactive.

1635. Which type of bond is present in Xe molecule?

(a) Covalent (b) Ion–dipole
(c) van der Walls' (d) Dipole–dipole

UP CPMT-2007

Ans. (c) : Xenon atoms are linked to each other by Van der Wall's forces.

1636. Element having maximum electron

(a) fluorine (b) chlorine
(c) bromine (d) iodine

UP CPMT-2005

Ans. (b) : Electron affinity is the amount of energy released when an electron is added to isolate gaseous atom.

The order of electron affinity among halogen is

Cl >F>Br>I

Unexperedly chlorine has higher electron affinity than fluorine because the size of fluorine is very small and it repels the incoming electron.

1637. Radioactive metal is

(a) Li (b) Ce
(c) Na (d) Ra

UP CPMT-2005

Ans. (d): Elements with atomic number greater than 82 are naturally radiactive.

(a) Li At. no. = 3 (b) Ce At. no.= 58
(c) Na At. no. = 11 (d) Ra At. no. = 88
∴ Ra is radioactive

1638. Number of electrons surrounding Kr in KrF_2 is

(a) 10 (b) 6
(c) 4 (d) 8

UP CPMT-2005

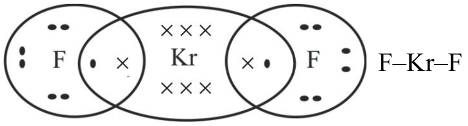
Ans. (a) Krypton(Kr) forms two covalent bonds two fluorine atoms (one with each fluorine).

Number of electrons in valence shell of Kr = 8

Number of electrons it shares with two F-atom=2

∴ Total number of electrons found around Kr in KrF

= 8 + 2 = 10



1639. Which of the following electronic configuration represents noble gas?

(a) ns^2np^6 (b) ns^2np^5
(c) ns^2np^4 (d) ns^2np^3

UP CPMT-2003

Ans. (a) : Noble gases are inert gases. Their valence shell is completely filled and their general electronic configuration is ns^2np^6.

1640. The lightest gas is

(a) N_2 (b) Ar
(c) Rn (d) He

UP CPMT-2002

Ans. (d) : Helium exists as helium gas (He) only with 2 protons present in it. It is the first element of the noble gas group. It is tasteless, colourless, inert and odourless gas. It is a monatomic gas. The atomic mass of helium gas (He) is 4. After hydrogen, He is lightest gas.

1641. For advertisement, the coloured discharged tubes contain:

(a) He (b) Ne
(c) Ar (d) Kr

UPTU/UPSEE-2006

Ans. (b) : Colored lighting in discharge tube are usually filled with neon. Mixing with other gases results, in different colored lights.

1642. The oxidation states of iodine in HIO_4, H_3IO_5 and H_5IO_6 are respectively:

(a) +1, +3, +7 (b) +7, +7, +3
(c) +7, +7, +7 (d) +7, +5, +3

UPTU/UPSEE-2006

Ans.(c): +7, +7, +7.

HIO_4	H_3IO_5	H_5IO_6
$(+1) + x + 4 \times (-2) = 0$ $x = +7$	$3 \times (+1) + x + 5 \times (-2) = 0$ $x = +7$	$5 \times (+1) + x + 6 \times (-2) = 0$ $x = +7.$

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12.

Hydrocarbons

1. Alkanes

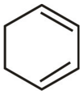
1. 'A' and 'B' respectively are:

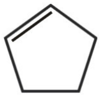
(A) $\xrightarrow[(2)Zn-H_2O]{(1)O_3}$ Ethane-1, 2-dicarbaldehyde + Glyoxal/Oxaldehyde

(B) $\xrightarrow[(2)Zn-H_2O]{(1)O_3}$ 5-oxohexanal

(A) 1-methylcyclohex-1, 3-diene and cyclopentene
(B) Cyclohex-1, 3-diene and cyclopentene
(C) 1-methylcyclohex-1, 4-diene and 1-methylcyclopent-1ene
(D) Cyclohex -1, 3-diene and 1-methylcyclopent -1 ene

JEE Main-27.06.2022, Shift-I

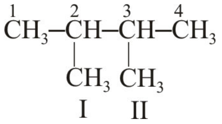
Ans. (d) : When  cyclohex -1, 3 - diene, react with O_3 and then Zn – H_2O it gives ethane - 1,2-dicarbaldehyde + Glyoxal/oxaldehyde.

When  1-methylcyclopent -1-ene react with O_3 and then Zn, H_2O it gives 5 - oxohexanal.
Hence, A is cyclohex-1,3-diene and B is 1 -methylcyclopent-1-ene.

2. Which one of the following molecules contains only primary and tertiary carbon atoms?
(a) 2,2-Dimethylbutane
(b) 3-Methylpentane
(c) 2, 3-Dimethylbutane
(d) n-Hexane
(e) 2-Methylhexane

Kerala CEE -03.07.2022

Ans. (c) : 2, 3 - dimethylbutane contains only primary and tertiary carbon atoms.



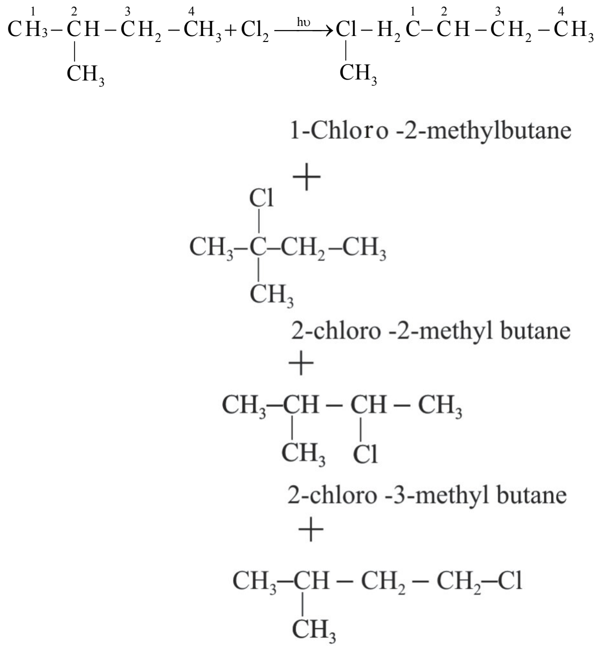
$$\overset{1}{C}H_3-\overset{2}{C}H(\underset{I}{CH_3})-\overset{3}{C}H(\underset{II}{CH_3})-\overset{4}{C}H_3$$

In 2, 3- dimethyl butane, C_1, C_2 C_I, C_{II} are primary carbons and C_2, C_3 are tertiary corbons.

3. Which one of the following molecules gives four isomeric monochlorides on photochemical chlorination?
(a) 2-Methylpropane
(b) n-Butane
(c) 2-Methylbutane
(d) 2,3-Dimethylbutane
(e) Propane

Kerala CEE -03.07.2022

Ans. (c) : 2–Methylbutane gives four isomeric monochlorides on photochemical chlorination.



$$\overset{1}{C}H_3-\overset{2}{C}H(CH_3)-\overset{3}{C}H_2-\overset{4}{C}H_3+Cl_2\xrightarrow{h\upsilon}Cl-H_2\overset{1}{C}-\overset{2}{C}H(CH_3)-\overset{3}{C}H_2-\overset{4}{C}H_3$$

1-Chloro -2-methylbutane

+

$$CH_3-C(Cl)(CH_3)-CH_2-CH_3$$

2-chloro -2-methyl butane

+

$$CH_3-CH(CH_3)-CH(Cl)-CH_3$$

2-chloro -3-methyl butane

+

$$CH_3-CH(CH_3)-CH_2-CH_2-Cl$$

1-chloro -3-methyl butane

4. Correct statement about photo-chemical smog is:
(a) It occurs in humid climate
(b) It is a mixture of smoke, fog and SO_2
(c) It is reducing smog.
(d) It result from reaction of unsaturated hydrocarbon.

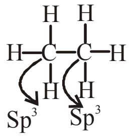
JEE Main-28.06.2022, Shift-II

Ans. (d) : NO_2 and unsaturated hydrocarbons are the primary constituents of photochemical smog. These primary constituents are introduced in the atmosphere via vehicular emissions and industrial processes.

5. The number of sigma bonds in ethane formed by the overlap of *sp*^{3} and *s* orbitals is
(a) 5
(b) 6
(c) 7
(d) 4

AP-EAMCET (Med.)-1999

Ans. (b) : The molecular formula of ethane is C_2H_6



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The C-atom of ethane is sp^3 hybridised. So, the sigma bond between C-C atom is sp^3-sp^3sigma bond and the bond formed between C and H are sp^3-s sigma bond. Hence, there are 6 sp^3-s sigma bonds in ethane.

6. 18 C-H and 7 C-C sigma bonds are present in:

(a) Cyclo hexane

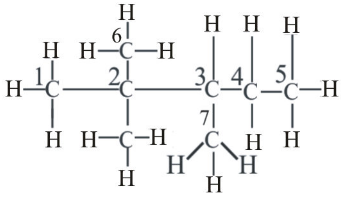
(b) 3,3-dimethyl pentane

(c) 2,2,3-trimethyl pentane

(d) n-heptane

AP-EAMCET (Med.)-1999

Ans. (c) : 2, 2, 3- trimethyl pentane contains the 18C-H and 7-C-C sigma bonds.



2, 2, 3-trimethyl pentane

Number of C-H bond = 18

Number of C-C bond =7

7. A mixture of carbon monoxide, hydrogen and hydrocarbon is known as:

(a) Water gas

(b) Carburetted water gas

(c) Semi water gas

(d) Producer gas

AP-EAMCET (Med.)-1999

Ans. (b) : Mixture of CO + H_2 is water gas.

Mixture of CO+H_2+hydrocarbons is carburetted water gas.

Mixture of CO+H_2+CO_2 is called semi water gas.

Mixture of CO+N_2 is called producer gas.

8. Chloroform is an anesthetic and a small amount of alcohol is added to its bottles because

(a) It retards anesthetic property of chloroform

(b) It accelerates the formation of phosgene

(c) It converts any phosgene formed to harmless carbonate

(d) None of the above

SCRA 2012

Ans. (a) : Chloroform is anesthetic and a small amount of alcohol is added to its bottles because chloroform ($CHCl_3$) easily gets oxidized to form the poisonous gas phosgene. To prevent its oxidation a small amount of ethyl alcohol is added to the bottle containing chloroform.

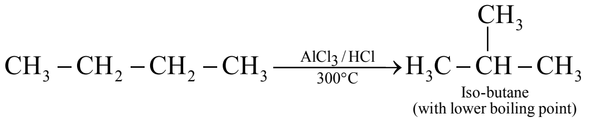
9. The method of converting high boiling hydrocarbons into low boiling hydrocarbons is known as :

(a) pyrolysis (b) isomerisation

(c) cracking (d) inversion

A.P.EAMCET-1994

Ans. (b) : The method of converting high boiling hydrocarbons into low boiling hydrocarbon is known as isomerisation.



$$CH_3-CH_2-CH_2-CH_3 \xrightarrow[300°C]{AlCl_3/HCl} H_3C-\overset{\overset{\displaystyle CH_3}{|}}{C}H-CH_3$$

Iso-butane

(with lower boiling point)

10. Which one of the following compounds is acidic?

(a) C_6H_6 (b) C_2H_6

(c) C_2H_4 (d) C_2H_2

A.P.EAMCET-1994

Ans. (d) : S- character increases then the acidic character increases.

$\boxed{\text{Acidic nature} \propto \text{s-character}}$

$C_6H_6 \rightarrow sp^2$ - s-character (33%)

$C_2H_6 \rightarrow sp^3$ s- character (25%)

$C_2H_4 \rightarrow sp^2$ s-character (33%)

$C_2H_2 \rightarrow sp$ s- character (50%)

In C_2H_2 is sp-hybridisation and s-character is high so it is a acidic nature.

11. Which one of the following compounds is most acidic?

(a) CH_3Cl (b) CH_3OH

(c) $H_2C = CH_2$ (d) $HC \equiv CH$

A.P.EAMCET-1996

Ans. (b) : CH_3OH is most acidic nature because it release H^+ ion (proton).

$$CH_3OH \rightarrow CH_3O^- + H^+$$

12. Liquid benzene burns according to $2C_6H_6(l)$ + $150_2(g) \rightarrow 1200_2(g)$ +$6H_2O$ (g) How many litres of oxygen are required for complete combustion of 39g of liquid C_6H_6 (atomic wt. of C=12, O = 16)?

(a) 11.2 (b) 22.4

(c) 42 (d) 84

A.P.EAMCET-1998, 1996

Ans. (d) :

$$2C_6H_6(l) + 15O_2(g) \rightarrow 12CO_2(g) + 6H_2O(g)$$

2×78gm 15×22.4L

For combustion of 2×78gm of C_6H_6

Volume of O_2 required = 15 ×22.4L

∵ For combustion of 39 gm of C_6H_6

$$\text{Volume of } O_2 \text{ required} = \frac{15 \times 22.4 \times 39}{2 \times 78}$$

= 84 L

13. The number of isomeric structures possible for a molecule having molecular formula C_5H_{12}, is

(a) 2 (b) 3

(c) 4 (d) 5

A.P.EAMCET-1996

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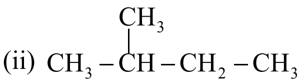
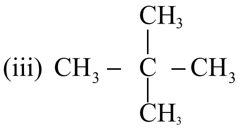
Ans. (b) : The molecular formula C_5H_{12} has isomeric structure are–

(i) $CH_3–CH_2–CH_2–CH_2–CH_3$
(n – pentane)

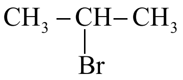
(ii) 
$$CH_3-\underset{}{\overset{CH_3}{\overset{|}{C}}}H-CH_2-CH_3$$
(iso-pentane)

(iii) 
$$CH_3-\underset{CH_3}{\underset{|}{\overset{CH_3}{\overset{|}{C}}}}-CH_3$$
(neo–pentane)

14. The alkane that yields two isomeric monobromo derivatives is
(a) Neo-pentane (b) Ethane
(c) Methane (d) Propane
A.P.EAMCET-1997

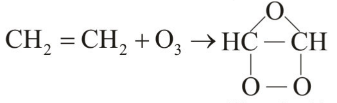
Ans. (d) : Propane is an alkane which react with bromine (Br_2) in the presence of UV light to form two isomeric monobromo derivates.

$$CH_3-CH_2-CH_3+Br_2\xrightarrow{\text{UV light}}\underset{\text{1–bromo propane}}{CH_3-CH_2-CH_2-Br}+$$


$$CH_3-\underset{Br}{\underset{|}{CH}}-CH_3$$
2-bromo propane

15. Which of the following compounds does not form an ozonide?
(a) Ethene (b) Propyne
(c) Propene (d) Propane
A.P.EAMCET-1997

Ans. (d) : Propane is a saturated compound ozonide is formed only by alkenes or alkynes. Ozonolysis take place in compounds containing double or triple bonds.


Ethene Ozonide

16. In Wurtz reaction, the reagent used is
(a) Na (b) Na/liq.NH_3
(c) Na/dry ether (d) Na/dry ethanol
A.P.EAMCET-1998

Ans. (c) : Wurtz reaction is the method of preparation of alkane from alkyl halide– explanation

$$RCl+2Na+RCl\xrightarrow[\text{Ether}]{\text{Dry}}2NaCl+\underset{\text{alkane}}{R-R}$$

The reagent used in the Wurtz reaction is sodium in the presence of dry ether.

17. A mixture contains four solid organic compounds A, B, C, D. On heating, only C changes from solid to vapour state. C can be separated from the rest in the mixture by
(a) Distillation (b) Sublimation
(c) Fractional distillation (d) Crystallisation
A.P.EAMCET-1998

Ans. (b) : On heating, only C changes from solid to vapour state.

$$C\rightarrow \text{Solid}\xrightarrow{\text{Sublimation}}\text{Vapour}$$

Hence, C can be separated by sublimation.

18. A solid organic compound X, on heating, directly converted into the vapour phase which on cooling solidifies. The best method for purifying X is
(a) Distillation
(b) Distillation at reduced pressure
(c) Sublimation
(d) Steam distillation
A.P.EAMCET-2000, 1999

Ans. (c) : A solid organic compound X, on heating directly converted into vapour phase which on cooling solidify. The best method for purifying 'X' is sublimation.

19. An organic compound having carbon and hydrogen, has 80% carbon. The empirical formula of the hydrocarbon is
(a) CH (b) CH_2
(c) CH_3 (d) CH_4
A.P.EAMCET-1998

Ans. (c) : Given that, Carbon = 80%
Remaining of Hydrogen = 20%

Element	**Percentage atomic Weight**	**Simple ratio**
C	80/12= 6.66	6.66/6.66 = 1
H	20/1=20	20/6.66 = 3

Hence, the empirical formula is CH_3

20. n – octane and n-nonane have
(a) Same molecular formula
(b) Same molecular weight
(c) Similar chemical properties
(d) Same boiling point
A.P.EAMCET-1999

Ans. (c) :
$CH_3–CH_2–CH_2–CH_2–CH_2–CH_2–CH_2–CH_3$
n-octane
$CH_3–CH_2–CH_2–CH_2–CH_2–CH_2–CH_2–CH_2–CH_3$
n-nonane
Hence, n-octane and n-nonane have similar chemical properties.

21. Which of the following alkanes cannot be prepared by Wurtz reaction?
(a) C_2H_6 (b) C_3H_6
(c) CH_4 (d) C_4H_{10}
Manipal-2016
A.P.EAMCET-1999

Ans. (c) : Methane cannot be prepared by Wurtz reaction. Hence, in methane having one carbon atom chain only. In Wurtz reaction is used for the preparation of only those alkanes that contain at least two carbon atoms.

22. Which of the following reacts with water to give ethane?
(a) CH_4 (b) C_2H_5MgBr
(c) C_2H_5OH (d) $C_2H_5–O–C_2H_5$
A.P.EAMCET-2000

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Ans. (b) : When C_2H_5MgBr (ethyl magnesium bromide) reacts with water to give ethane.

$$\underset{\text{Ethyl magnesium bromide}}{C_2H_5MgBr} + HOH \rightarrow \underset{\text{Ethane}}{C_2H_6} + Mg(OH)Br$$

23. What is the minimum quantity (in grams) of methyl iodide required for preparing one mole of ethane by Wurtz reaction?
(Atomic weight of iodine=127)

(a) 142 (b) 568
(c) 326 (d) 284

A.P.EAMCET-2002

Ans. (d) From Wurtz reaction preparation of ethane is -

$$\underset{\substack{\text{Methyl Iodine}\\ \text{1Mole}}}{2CH_3I} + Na \xrightarrow[\text{ether}]{\text{dry}} \underset{\text{1Mole}}{C_2H_6} + 2NaI$$

Hence, 1 moles of C_2H_6 is prepared by 2 moles of CH_3I required

So, the weight of 2 moles of CH_3I

$= 2 \times (12 + 3 + 127)$
$= 2 \times 142$
$= 284$ gm

24. 4 g of a hydrocarbon on complete combustion gave 12,571 g of CO_2 and 5.143 g of water. What is the empirical formula of the hydrocarbon?

(a) CH (b) CH_2
(c) CH_3 (d) C_2H_3

A.P.EAMCET-2002

Ans. (b) : % of carbon

$$= \frac{12}{44} \times \frac{\text{weight of } CO_2 \times 100}{\text{weight of organic compound}}$$

$$= \frac{12}{44} \times \frac{12.571}{4} \times 100 = 85.7\%$$

$$\% \text{ of Hydrogen} = \frac{2}{18} \times \frac{\text{weight of water}}{\text{weight of compound}} \times 100$$

$$= \frac{2}{18} \times \frac{5143 \times 100}{4} = 143\%$$

Element	% atomic weight	Simple ratio
C	$\frac{85.7}{12} = 7.15$	$\frac{7.15}{7.15} = 1$
H	$\frac{14.3}{1} = 14.3$	$\frac{14.3}{7.15} = 2$

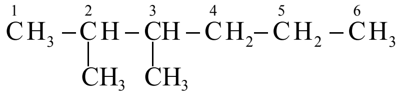
Hence the empirical formula = CH_2

25. 2, 3 dimethylhexane contains ...... tertiary ....secondary and ....primary carbon atoms, respectively.

(a) 2, 2, 4 (b) 2, 4, 3
(c) 4, 3, 2 (d) 3, 2, 4

A.P.EAMCET-2003

Ans. (a) :



$$\overset{1}{C}H_3-\underset{\underset{CH_3}{|}}{\overset{2}{C}H}-\underset{\underset{CH_3}{|}}{\overset{3}{C}H}-\overset{4}{C}H_2-\overset{5}{C}H_2-\overset{6}{C}H_3$$

2, 3 dimethyl hexane

Hence, no. of tertiary carbon atoms = 2
no. of secondary carbon atoms= 2
no. of primary carbon atoms = 4

26. Match the following column.

Column I	**Column II**
(a) Ethane	(1) 2 sp carbons
(b) Ethylene	(2) 6 sp^2 carbons
(c) Acetylene	(3) 2 sp^3 carbons
(d) Benzene	(4) 2 sp^2 carbons
	(5) 1 sp and 1sp^2 carbons

(a) 3 4 1 2
(b) 4 5 3 2
(c) 3 1 2 5
(d) 2 3 4 5

A.P.EAMCET-2004

Ans. (a) :

Column I	**Column II**
Ethane	2sp^3 carbons
Ethylene	2sp^2 carbons
Acetylene	2sp carbons
Benzene	6 sp^2 carbons

27. An organic compound containing C and H has 92.3% of carbon, Its empirical formula is

(a) CH (b) CH_3
(c) CH_2 (d) CH_4

A.P.EAMCET-2004

Ans. (a) : Given that, C = 92.3% and H is 7.7%

Element	Percentage atomic weight	Simple ratio
C	$\frac{92.3}{12} = 7.69$	$\frac{7.69}{7.69} = 1$
H	$\frac{7.7}{1} = 7.7$	$\frac{7.70}{7.69} \simeq 1$

Hence the empirical formula = CH

28. The chemicals and the reaction conditions required for the preparation of ethane are

(a) C_2H_5l, Zn–Cu, C_2H_5OH
(b) CH_3Cl, Na, H_2O
(c) KOOC–CH = CH– COOK, electrolysis
(d) CH_3CO_2Na, NaOH, CaO, Δ

A.P.EAMCET-2005

Ans. (a) : $\underset{\text{Ethyl iodide}}{C_2H_5I} \xrightarrow[C_2H_5OH]{\text{Zn–Cu}} \underset{\text{Ethane}}{C_2H_6} + HI$

29. Which of the following reagents when heated with ethyl chloride, forms ethylene?

(a) Aqueous KOH (b) Zn/HCl
(c) Alcoholic KOH (d) C_2H_4

A.P.EAMCET-2006

Ans. (c) : Ethyl chloride reacts with aq.KOH and alcohol forms.
Ethyl chloride reacts with Zn/HCl and alkane forms.
Ethyl chloride reacts with alc.KOH and ethene forms.
The reaction of the process is–

$$C_2H_5Cl \xrightarrow{\text{alc.KOH}} CH_2 = CH_2 + HCl$$

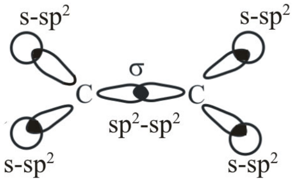
30. A molecule (X) has (i) four sigma bonds formed by the overlap of sp^2 and s orbitals (ii) one sigma bond formed by sp^2 and sp^2 orbitals and (iii) one π bond formed by p_x and p_z orbitals. Which of the following is X?

@apna_pdf

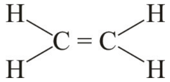
(a) C_2H_6 (b) C_2H_3Cl
(c) $C_2H_2Cl_2$ (d) C_2H_4

A.P.EAMCET-2006

Ans. (d) : A molecule C_2H_4 has four sigma bonds formed by the overlap of sp^2 and s-orbital and one sigma bond formed by sp^2 and sp^2 orbitals and one π-bond formed by p_x and p_z orbitals.



Geometry of molecule is–



31. Which of the following compounds shows maximum boiling point?

(a) Iso-octane
(b) n - octane
(c) 2,2,3,3 – tetramethyl butane
(d) n - butane

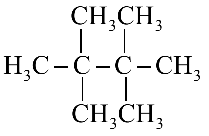
MPPET - 2012

Ans. (b) :

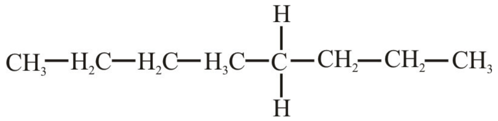
Boiling point ∝ Molecular weight of compound

$$\propto \frac{1}{\text{Branching of compound}}$$

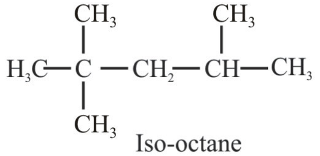
(i) $CH_3—CH_2—CH_2—CH_3$
n-Butane

(ii)

$H_3C-C(CH_3)_2-C(CH_3)_2-CH_3$

2, 2, 3, 3 - tetramethyl butane

(iii)

$CH_3—H_2C—H_2C—H_3C—CH_2—CH_2—CH_2—CH_3$

n-octane

(iv)

$H_3C—C(CH_3)_2—CH_2—CH(CH_3)—CH_3$

Iso-octane

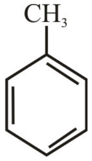
32. The most reactive compound towards nitration is:

(a) Toluene (b) benzene
(c) benzoic acid (d) nitrobenzene

MPPET - 2012

Ans. (a) : Toluene ($C_6H_5CH_3$) is more reactive towards electrophillic nitration due to presence of electron donating group (–CH_3, methyl group).

The structure of toluene is,



33. Alkyl halide reacting with metallic sodium in dry ether solution is called

(a) Friedel-Craft's reaction
(b) Sandmeyer's reaction
(c) Wurtz reaction
(d) Gabriel's reaction

A.P. EAMCET-1996

Ans. (c) : $\underset{\text{Alkyl halide}}{R-X} + \underset{\text{Sodium metal}}{Na} \xrightarrow[-NaCl]{\text{dry ether}} R-R$

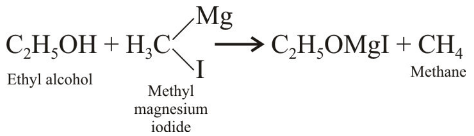
Alkyl halide reacting with metallic sodium in dry ether solution is called as Wurtz reaction.

34. Which one of the following gases is liberated when ethyl alcohol is heated with methyl magnesium iodide?

(a) Methane (b) Ethane
(c) Carbon dioxide (d) Propane

A.P.EAMCET/2003

Ans. (a) : Ethyl alcohol reacts with methyl magnesium iodide as-


$$\underset{\text{Ethyl alcohol}}{C_2H_5OH} + \underset{\text{Methyl magnesium iodide}}{H_3C-Mg-I} \longrightarrow C_2H_5OMgI + \underset{\text{Methane}}{CH_4}$$

35. In the reaction $Cl_2 + CH_4 \xrightarrow{h\nu} CH_3Cl + HCl$ presence of a small amount of oxygen

(a) Increases the rate of reaction of a brief period of time.
(b) Decreases the rate of reaction for a brief period of time.
(c) Does not affect the rate of reaction.
(d) Completely stops the reaction.

MPPET- 2009

Ans. (d) : In the reaction $Cl_2 + CH_4 \xrightarrow{h\nu} CH_3Cl+HCl$ presence of a small amount of oxygen then completely stops the reaction.

36. Which one of the following hydrocarbons has octane number 100?

(a) 2, 2, 3-trimethylpentane
(b) 2, 3, 3-trimethylpentane
(c) 2, 2, 4-trimethylpentane
(d) 2, 3, 4-trimethylpentane

SCRA-2010

Ans. (c) : Isooctane as a reference standard 2,2,4 –trimethylpentane (iso-octane) has as octane rating of 100 where as n-heptane has an octane rating of zero

37. The petrol of octane number 80 has :

(a) 80% n-heptane + 20% iso-octane
(b) 20% n-heptane + 80% iso-octane
(c) 20% n-heptane + 80% n-octane
(d) 80% n-heptane + 20% n-octane

MPPET-2013
UPTU/UPSEE-2010

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Ans. (b) : Octane Number is a figure indicate the antiknock properties of a fuel based on a comparison with mixture of isooctane and heptane. 80 octane number of petrol means, petrol has 20% n-heptane + 80% isooctance.

38. Among the following reactions, the reaction that "does not" given alkane product is

(a) $CH_3C\equiv CCH_3 \xrightarrow{Pt,\ H_2}$

(b) $CH_3CH_2CH_2CH_2CO_2Na \xrightarrow{Electrolysis}$

(c) $CH_3CH_2Br \xrightarrow{Na,\ dry\ ether}$

(d) $CH_3CH_2CH_2CH_2F \xrightarrow{Zn,\ H^{\oplus}}$

TS-EAMCET (Engg.), 05.08.2021 Shift-II

Ans. (d) :

(a) $CH_3C\equiv CCH_3 \xrightarrow{Pt,H_2} \underset{n\text{-butane}}{CH_3-CH_2-CH_2-CH_3}$

(b) $CH_3(CH_2)_3CO_2Na \xrightarrow{Electrolysis} \underset{n\text{-pentane}}{CH_3-(CH_2)_3-CH_3}$

(c) $CH_3CH_2Br \xrightarrow[\text{Wurtz reaction}]{\text{Na,Dry ether}} \underset{\text{ethane}}{CH_3-CH_3}+2NaBr$

(d) Alkyl halides (except fluorides) on reduction with zinc dilute hydrochloric acid give alkanes.

$$CH_3CH_2CH_2CH_2F \xrightarrow{Zn,H^+} \underset{(\text{No reaction})}{X}$$

This reaction that 'does not' give alkane product.

39. On the basis of which physical property separation of different fractions in fractional distillation technique takes place ?

(a) Solubility (b) Freezing point
(c) Boiling point (d) Melting point

AP EAMCET (Engg.) 17.09.2020, Shift-II

Ans. (c) : Separation of liquids into their pure form to from its liquid mixture is done by fractional distillation technique. It is done, when two liquids have difference in their boiling points (10 – 40 K).

40. Carbon and hydrogen in an organic compound are detected as.......

(a) $CaHCO_3$, $CaCO_3$
(b) $CaHCO_3$, $CuSO_4.\ 5H_2O$
(c) $CaCO_3$, $CuSO_4.\ 5H_2O$
(d) $CaCO_3$, $Cu(OH)_2$

AP EAMCET (Medical) - 2013

Ans. (c) : Carbon and hydrogen in an organic compound are detected as $CaCO_3$, $CuSO_4\ 5H_2O$.

The organic compound is treated with dry copper oxide when C and H of the organic compound are oxidized to carbon dioxide and water.

C of organic compound $+2CuO \xrightarrow{\Delta} CO_2 + 2Cu$

Carbon dioxide is detected by passing it through lime to form calcium carbonate and the presence of hydrogen is detected by passing it through anhydrous copper sulphate (white) which turns blue.

H of organic compound $+\ CuO \xrightarrow{\Delta} H_2O + Cu$

$CuSO_4 + 5H_2O \longrightarrow CuSO_4.5H_2O$
hydrated copper sulphate (blue)

$Ca(OH)_2 + CO_2 \longrightarrow CaCO_3 + H_2O$
milky

41. In an agricultural field, which among the following is the highest producer of methane?

(a) Wheat crop (b) Paddy crop
(c) Cotton crop (d) Groundnut crop

AP EAMCET (Engg.) 21.09.2020, Shift-I

Ans. (b) : Rice is grown in flooded fields, a situation that depletes the soil of oxygen. Soils that are anaerobic (lacking oxygen) allow the bacteria that produce methane from decomposing organic matter to thrive. Some of this methane then bubbles to the surface, but most of it is diffused back into the atmosphere through the rice plants themselves. Hence, the rice Paddy field that produces maximum methane gas into the atmosphere.

42. In Wurtz reaction the reagent used is:

(a) Na (b) Na/liq.NH_3
(c) Na/dry ether (d) Na/dry alcohol

AP EAMCET (Medical) -1998

Ans. (c): In Wurtz reaction, alkyl halide react with Na in the presence of dry ether to give the alkane.

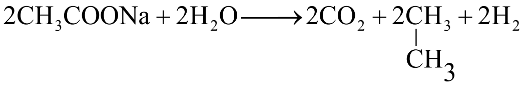
$$2CH_3-Cl+2Na \xrightarrow{ether} \underset{\text{Ethane}}{CH_3-CH_3}+2NaCl$$

43. The gaseous products formed at cathode (X) and anode (Y), when an aqueous solution of sodium acetate is electrolysed are

	X	Y		X	Y
(a)	CO_2	C_2H_6,H_2	(b)	H_2,CO_2	C_2H_6
(c)	$H_2,$	C_2H_6,CO_2	(d)	H_2H_6,H_2	CO_2

AP EAMCET-2017

Ans. (c): When sodium acetate is electrolysed in aqueous medium-



$$2CH_3COONa + 2H_2O \longrightarrow 2CO_2 + 2\underset{\substack{|\\ CH_3}}{CH_3} + 2H_2$$

At anode $-C_2H_6 + CO_2$ (Y) oxidation

At cathode – H_2 (X) reduction.

44. Thermal decomposition of alkane in the absence of air is called as

(a) Cracking (b) Oxidation
(c) Combustion (d) Hydrogenation

MPPET-2008

Ans. (a) : Thermal decomposition of alkane in the absence of air is called as cracking.

45. Consider the following :

At constant pressure, boiling point of a solution is greater than the boiling point of its pure liquid solvent because.

1. solute is non-electrolyte.

2. solute is involatile.

3. chemical potential

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Which of the above are correct ?

(a) 1 2 and 3 (b) 1 and 2 only

(c) 1 and 3 only (d) 2 and 3 only

SCRA - 2009

Ans. (d) : At constant pressure, the boiling point of a solution is greater than boiling point of pure liquid solvent because most solution have lots of ionic attraction between the different ions in the solution. This ionic attraction makes the solution less volatile. So, higher the boiling point.

46. Match the following?

	Reaction		Nature of Reaction
a.	$RBr \xrightarrow{Na}$	i.	Partial reduction
b.	$RCOO^-Na^+ \xrightarrow[CaO,\Delta]{NaOH}$	ii.	Electrophilic addition
c.	$R-C\equiv C-R' \xrightarrow[Catalyst(H_2)]{Lindlar's}$	iii.	Wurtz reaction
d.	$H_2C=CH_2 \xrightarrow{Br_2/CCl_4}$	iv.	Decarboxylation
		v.	Decarboxylative dimerization

(a) (a – iii), (b – v), (c – i), (d – ii)

(b) (a – iii), (b – iv), (c – i), (d – ii)

(c) (a – ii), (b – iii), (c – i), (d – ii)

(d) (a – v), (b –i), (c –iii), (d – ii)

AP EAPCET 24.08.2021 Shift-II

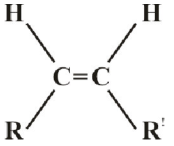
Ans. (b): (a) $RBr \xrightarrow{Na} R–R + 2Na^+X^-$

Wurtz reaction is a coupling reaction of two alkyl halides are reacted with sodium metal to form higher all cane.

(b) $RCOO^-Na^+ \xrightarrow[CaO,D]{NaOH} R – H + Na_2CO_3$

This reaction is known as decorboxylative dimerization

(c) $R-C\equiv C-R' \xrightarrow[Catalyst\ (H_2)]{Lindlar's}$



Partial reduction of alkynes.

(d) $H_2C= CH_2 \xrightarrow{Br_2/CCl_4} Br.N_2C– CH_2Br$

This reaction is electrophilic addition reaction.

So, the option (b) is correct.

47. Assertion (A): Sodium acetate on Kolbe's electrolysis gives ethane.

Reason (B) Methyl free radical is formed at cathode

(a) Both A and R are true and R is a correct explanation for A

(b) Both A and R are true but R is not a correct explanation for A

(c) A is true, R is false

(d) A is false, R is true

AP EAPCET 19-08-2021 Shift-I

Ans. (c) : An aqueous solution of sodium acetate on electrolysis gives alkane i.e. ethane.

$$\underset{\text{sodium acetate}}{2CH_3OONa}+2H_2O \xrightarrow{\text{Electroysis}} \underset{\text{ethane}}{CH_3-CH_3}+2CO_2+H_2 + 2NaOH$$

Hence, first statement is true.

At cathode reaction takes place which is given as –

$$H_2O + e^{\ominus} \longrightarrow OH^{\ominus} + \underset{\text{Hydrogen free radical}}{H^{\bullet}}$$

In this reaction, hydrogen free radical are formed.

48. The chlorination of ethane is an example which type of the following reactions?

(a) Nucleophilic substitution

(b) Electrophilic substitution

(c) Free radical substitution

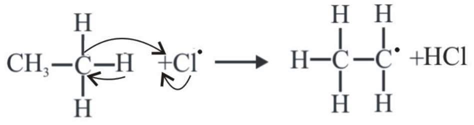
(d) Rearrangement

AP EAMCET (Engg.) 2012

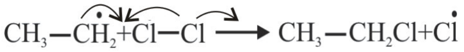
Ans. (c) : Chlorination of ethane take place by free radical substitution in the presence of light, in three steps to form ethyl chloride.

Step-I- Initiation step $Cl_2 \xrightarrow{hv} 2\dot{C}l$

Step-II- Propagation step



ethyl radical



Step-III-Termination Step

$CH_3-\dot{C}H_2+\dot{C}l \longrightarrow CH_3-CH_2Cl$

$\dot{C}l+\dot{C}l \longrightarrow Cl_2$

$2CH_3\dot{C}H_2 \rightarrow CH_3CH_2CH_2CH_3$

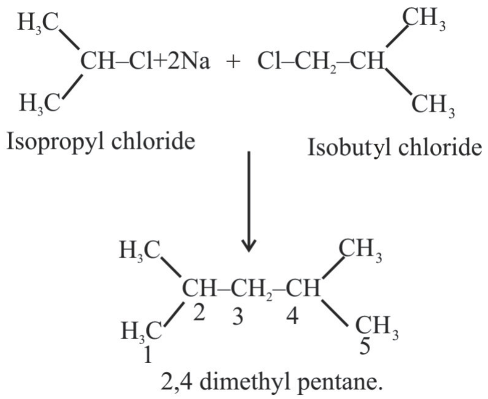
49. Isopropyl chloride and isobutyl chloride reacts with sodium in ether to give

(a) 4-methylhexane (b) 2-methylpentane

(c) 4-methylpentane (d) 2, 4-dimethylpentane.

COMEDK 2011

Ans. (d) :



Isopropyl chloride

Isobutyl chloride

2,4 dimethyl pentane.

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50. The organic compound obtained during the addition of HBr to propene in the presence of peroxide catalyst is

(a) 2-bromopropane (b) 2-bromopropene
(c) 1-bromopropane (d) 1-bromopropene

COMEDK 2012

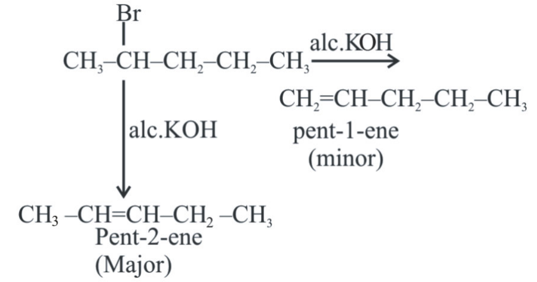
Ans. (c) : $\underset{\text{Propene}}{CH_3-CH=CH_2}+HBr\xrightarrow{\text{Peroxide}}\underset{\text{1-Bromopropane}}{CH_3-CH_2-CH_2Br}$

51. When 2-bromopentane is heated with alcoholic solution of potassium hydroxide, the major product obtained is

(a) Pent-1-ene (b) Pent-2-ene
(c) Pent-1-yne (d) Pent-2-yne

COMEDK 2014

Ans. (b) :



52. Which one of the following is the most energetic conformation of cyclohexane?

(a) Boat (b) Twisted boat
(c) Chair (d) Half chair

COMEDK 2016

Ans. (d) : Half chair is the most energetic and is the most stained and ustable conformation of cyclohexane.

53. Methane can be converted to ethane by the reaction,

(a) Chlorination followed by the reaction with alcoholic KOH
(b) Chlorination followed by the reaction with aqueous KOH
(c) Chlorination followed by Wurtz reaction
(d) Chlorination followed by decarboxylation.

COMEDK 2018

Ans. (c) : Methane can be converted to ethane by the Wurtz reaction,

$$\underset{\text{Methane}}{CH_4}+Cl_2\xrightarrow{h\nu}\underset{\text{Methyl chloride}}{CH_3Cl}+HCl$$

$$2CH_3-Cl+2Na\xrightarrow{\text{dry ether}}\underset{\text{ethane}}{CH_3-CH_3}$$

54. Which of the following reaction is expected to readily given a hydrocarbon product in good yields?

(a) $CH_3CH_3\xrightarrow[h\upsilon]{Cl_2}$
(b) $(CH_3)_2CCl\xrightarrow{C_2H_5OH}$
(c) $RCOOK\xrightarrow[\text{Oxidation}]{\text{Electrolysis}}$
(d) $RCOO\,Ag\xrightarrow{I_2}$

COMEDK 2020

Ans. (c) : When a sodium or potassium salt of a carboxylic acid is electrolysed, hydrocarbon is envolved at anode.

$$2RCOOK\xrightarrow[\text{oxidation}]{\text{electrolysis}}R-R+2CO_2+2KOH+H_2\uparrow$$

This reaction is known as Kolbe's electrolysis.

55. Which among the following is most strained cycloalkane?

(a) Cyclohexane (b) Cyclobutane
(c) Cyclopropane (d) Cyclopentane

COMEDK 2020

Ans. (c) : Cyclopropane has the highest angle strain among the cyclobutane, cyclopentane and cyclohexane.

56. Which one of the following reagents is used for detection of unsaturation in alkenes?

(a) NaOH + CaO
(b) Cold dilute alkaline $KMnO_4$
(c) $Cl_2/h\nu$
(d) KOH / C_2H_5OH

AP-EAMCET (Medical), 2003

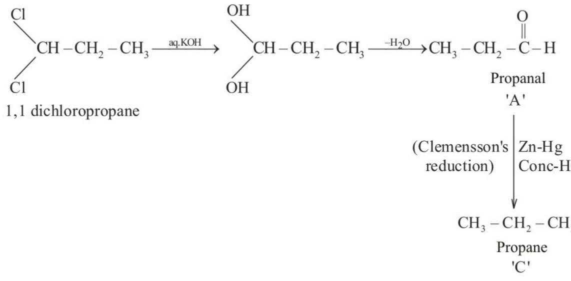
Ans. (b) : Both bromine water or alkaline $KMnO_4$ (Baeyer's reagent) are decolourised after the reaction with unsaturated compound. Unsaturation in alkyne or alkene in any organic compound is defected by reagents the organic compound with alkaline $KMnO_4$ or bromine water.

57. When 1, 1-dichloro propane and 2, 2-dichloro propane are reacted separately with aqueous potassium hydroxide solution, compounds 'A' and 'B' are formed. Both 'A' and 'B' gave the same product 'C' on reduction using amalgamated zinc and HCl Identify 'C'.

(a) Propyl alcohol (b) Isopropyl alcohol
(c) Propyl chloride (d) Propane

AP-EAMCET (Medical), 2008

Ans. (d) :



58. The compound that reacts with CH_3MgBr to yield methane as one of the products is

(a) CH_3CHO (b) CH_3COCH_3
(c) CH_3COOCH_3 (d) CH_3CH_2OH

AP-EAMCET (Medical), 2008

Ans. (d) : Ethyl alcohol reacted with Grignard reagent (CH_3MgBr) to forms the alkane i.e methane.

$$\underset{\text{Ethyl alcohol}}{C_2H_5-OH}+\underset{\text{Grignard reagent}}{CH_3MgBr}\to\underset{\text{Methane}}{CH_4}+CH_3CH_2OMgBr$$

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59. $C_2H_5OH + SOCl_2 \xrightarrow{\text{Pyridine}} X + Y + Z$, in this reaction X, Y and Z respectively, are

(a) $C_2H_4Cl_2, SO_2, HCl$ (b) C_2H_5Cl, SO_2, HCl
(c) $C_2H_5Cl, SOCl, HCl$ (d) C_2H_4, SO_2, Cl_2

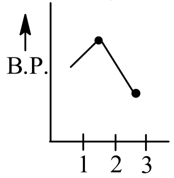
AP-EAMCET (Medical), 2008

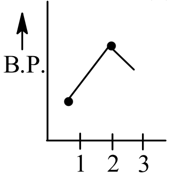
Ans. (b) : When ethyl alcohol reacted with thionyl chloride in the presence of pyridine then the following products are formed-

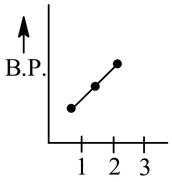
$$\underset{\text{Ethyl alcohol}}{C_2H_5-OH} + \underset{\text{Thionylchloride}}{SOCl_2} \xrightarrow{\text{Pyridine}} \underset{\substack{\text{'X'}\\ \text{Ethylchloride}}}{C_2H_5-Cl} + \underset{\text{'Y'}}{SO_2} + \underset{\text{'Z'}}{HCl}$$

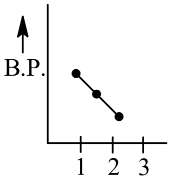
This reaction is called the Darzen reactions.

60. Which one of the following graphs represent the correct order of boiling points (b.p) and ethane (1), ethyl alcohol (2) and acetic acid (3)?

(a)


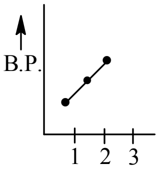
(b)


(c)


(d)


AP-EAMCET (Medical), 2008

Ans. (c) : The species are given as; ethane (1), ethyl alcohol (2) and acetic acid (3). As we know that acetic acid having more hydrogen bonding than ethyl alcohol. H-bonding increases the boiling point of the compound. Ethane have not hydrogen bonding. Hence, the correct order of boiling point is 3>2>1. Which is illustrated by following graph.



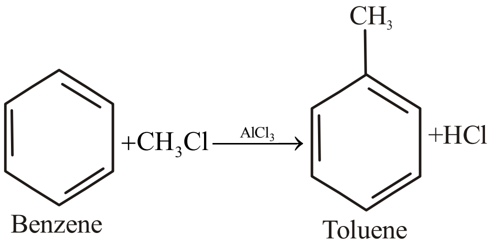
61. In the reaction

$C_6H_6 + R-Cl \xrightarrow{\Delta} C_6H_5-R + HCl$ Δ is

(a) P_2O_5 (b) PCl_5
(c) NaOH (d) $FeCl_3$

AP-EAMCET (Medical), 2001

Ans. (d) : In the Friedal-Craft's reaction benzene reacts with alkyl halide (R-X) in presence of $FeCl_3$ to form alkyl benzene.



62. In the following reaction, A and B respectively are :

$$C_2H_6 \xrightarrow{A} C_2H_5Cl \xrightarrow{Zn/HCl} B$$

(a) Cl_2/UV light and C_2H_6
(b) PCl_3 and C_2H_4
(c) HCl and C_2H_6
(d) Cl_2 and C_2H_2

AP-EAMCET (Medical), 2002

Ans. (a) : The reaction of ethane with chlorine in presence of sun light gives the ethyl chloride. Further ethyl chloride on reduction with Zn/HCl gives the ethane.

$$\underset{\text{Ethane}}{C_2H_6} \xrightarrow[Cl_2/\text{UV-light}]{\overset{A}{\downarrow}} C_2H_5Cl \xrightarrow{Zn/HCl} \underset{\substack{\text{Ethane}\\ \text{'B'}}}{C_2H_6}$$

63. Aluminium reacts with hot concentrated H_2SO_4 to liberate :

(a) SO_2 (b) H_2S
(c) SO_3 (d) S (Vapour)

AP-EAMCET (Medical), 2002

Ans. (a) : Aluminium reacts with not concentrated sulphuric acid to form aluminium sulphate with the evalution of sulphur dioxide gas Sulphuric acid acts as on oxidising agent and get itself reduced to SO_2.

$$\underset{\text{Aluminium}}{2Al} + \underset{\substack{\text{Conc–Sulfuric}\\ \text{acid}}}{6H_2SO_4} \longrightarrow \underset{\substack{\text{Aluminimum}\\ \text{sulfate}}}{Al_2(SO_4)_3} + \underset{\substack{\text{Sulfure}\\ \text{dioxide}}}{3SO_2} + \underset{\text{water}}{6H_2O}$$

Here H_2SO_4 acts as an oxidising agent and get itself reduced to SO_2.

64. In the following reaction, X and Y are :

$$2C_2H_6 + 7O_2 \xrightarrow{\text{combustion}} X + Y + \text{Heat}$$

(a) $2C_2H_5OH, 6O_2$ (b) $4HCHO, 5H_2O$
(c) $4CO, 10H_2O$ (d) $4CO_2, 6H_2O$

AP-EAMCET (Medical), 2002

Ans. (d) : The combustion of any hydrocarbon in presence of air gives carbondioxide and water (CO_2 + H_2O). The equation for the combustion of ethane is given below –

$$\underset{\text{Ethane}}{2C_2H_6} + \underset{\text{Oxygen}}{7O_2} \longrightarrow \underset{\text{Carbondioxide}}{4CO_2} + \underset{\text{water}}{6H_2O}$$

65. The reactants and reaction conditions used in the preparation of ethane are :

(a) $2CH_3I$, Na, C_2H_5OH
(b) electrolysis of $C_2H_5COO^-K^+$
(c) C_2H_4, H_2, 27°C
(d) C_2H_5I, H_2, Zn–Cu, C_2H_5OH

AP-EAMCET (Medical), 2002

Ans. (d) : Preparation of ethane in the reduction of Ethyl iodide by Zn–Cu couple in ethanol gives the ethane.

$$\underset{\text{Ethyl iodide}}{CH_3-CH_2-I} + 2[H] \xrightarrow[C_2H_5-OH]{Zn/Cu} \underset{\text{Ethane}}{C_2H_6} + HI$$

66. Which of the following aqueous solutions should have the minimum boiling point?

(a) 0.1 M Urea (b) 0.1 M K_2SO_4
(c) 0.1 M NaCl (d) 0.1 M $FeCl_3$

GUJCET-2021

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Ans. (a) : The boiling point of compounds depends upon the van't Hoff factor. The van't Hoff factor is equal to the number of discrete ions in a formula unit of the substance.

$NH_2CONH_2 \rightarrow NH_2CONH^- + H^+$ i = 1

$K_2SO_4 \rightarrow 2K^+ + SO_4^{2-}$ i = 3

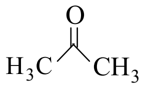
$NaCl \rightarrow Na^+ + Cl^-$ i = 2

$FeCl_3 \rightarrow Fe^{3+} + 3Cl^-$ i = 4

Hence, aqueous solution of urea is a covalent compound it show minimum boiling point.

67. The major product of the following synthetic reactions is

$$CH_3CH_2CH_3 \xrightarrow[\substack{\text{(iii) } Cl_2,\, 773K \\ \text{(iv) AgOH(aq)}}]{\substack{\text{(i) } Cl_2,\, h\nu \\ \text{(ii) alc.KOH}}}$$

(a) 

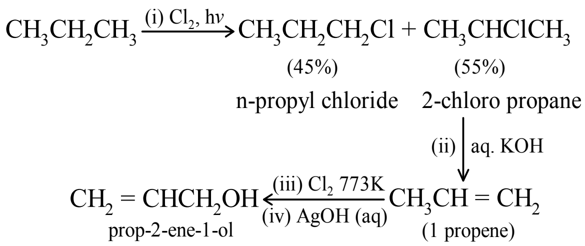
(b) CH_3CH_2CHO

(c) $CH_2 = CHCH_2OH$

(d) $CH_3CH_2CH_2OH$

TS-EAMCET (Engg.), 06.08.2021

Ans. (c):



$$CH_3CH_2CH_3 \xrightarrow{\text{(i) } Cl_2,\ h\nu} \underset{\substack{(45\%) \\ \text{n-propyl chloride}}}{CH_3CH_2CH_2Cl} + \underset{\substack{(55\%) \\ \text{2-chloro propane}}}{CH_3CHClCH_3}$$

$$\downarrow \text{(ii) aq. KOH}$$

$$\underset{\text{prop-2-ene-1-ol}}{CH_2 = CHCH_2OH} \xleftarrow[\text{(iv) AgOH (aq)}]{\text{(iii) } Cl_2\ 773K} \underset{\text{(1 propene)}}{CH_3CH = CH_2}$$

68. Which is used as antiknock in petrol?

(a) Tetraethyl Lead

(b) Tetramethyl lead

(c) Tetrapropyl lead

(d) Tetrabuty lead

[AIIMS-1997]

Ans. (a): Tetraethyl lead is used as antiknocking agent. Antiknock agents are the compounds included in little amounts to engine power to improve the antiknocking ratings of fuel.

Generally added to gasoline to raise its octane value. Tetraethyl Lead (TEL) is an organ metallic compound containing the harmful metal lead. TEL was once a major industrial compound of lead because of it is use as an antiknocking agent in gasoline.

69. What happens when chloroform is left open in air in the presence of sunlight?

(a) Polymerisation takes place

(b) Explosion takes place

(c) No reaction takes place

(d) Phosgene, a poisonous gas is formed

AIIMS-1996

Ans. (d): $\underset{\text{Chloroform}}{CHCl_3} + [O] \xrightarrow{\text{Sunlight}} \underset{\text{Phosgene}}{COCl_2} + HCl$

Chloroform in the presence of sunlight and air undergoes reaction with oxygen and form a poisonous phosgene gas.

70. **Assertion:** 2-Bromobutane on reaction with sodium ethoxide in ethanol gives 1-butene as a major product.

Reason: 1-Butene is more-stable than 2-butene.

(a) If both Assertion and Reason are correct and the Reason is a correct explanation of the Assertion.

(b) If both Assertion and Reason are correct but Reason is not a correct explanation of the Assertion.

(c) If the Assertion is correct but Reason is incorrect.

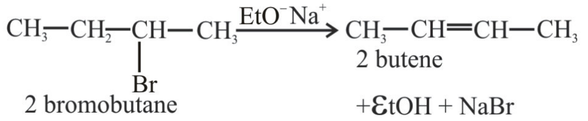
(d) If both the Assertion and Reason are incorrect.

(e) If the Assertion is incorrect but the Reason is correct.

[AIIMS-2004]

Ans. (d): 2-Bromobutane undergo dehydrohalogenation in presence of sodium ethoxide in ethanol.

The elimination is according to Satyzeff rule. Durning dehydrohalogenation H is eliminated so as to form more alkylated alkene i.e. from the carbon atom is less 'H' atm.



$$\underset{\text{2 bromobutane}}{CH_3-CH_2-\underset{\substack{| \\ Br}}{CH}-CH_3} \xrightarrow{EtO^-Na^+} \underset{\text{2 butene}}{CH_3-CH=CH-CH_3} + \mathcal{E}tOH + NaBr$$

Since, 2 – butane is more stable than 1– butane because of number of ∝ – H is maximum.

Hence, option (d) is correct according to the question.

71. **Assertion :** CH_4 does not react with Cl_2 in dark.

Reason: Chlorination of CH_4takes place in sunlight.

(a) If both Assertion and Reason are correct and the Reason is a correct explanation of the Assertion.

(b) If both Assertion and Reason are correct but Reason is not a correct explanation of the Assertion.

(c) If the Assertion is correct but Reason is incorrect.

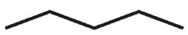
(d) If both the Assertion and Reason are incorrect.

(e) If the Assertion is incorrect but the Reason is correct.

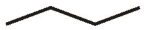
[AIIMS-2001]

Ans. (b): Chlorination of methane (CH_4) does not takes place in dark because it is a free radical reaction and free radicals are obtained in the presence of sunlight.

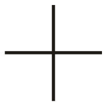
72. What is the correct decreasing order of boiling point for the following compounds?



(I)



(II)



(III)

(a) I > II > III

(b) II > III > I

(c) I > III > II

(d) III > II > I

[AIIMS-26 May, 2018 (M)]

Ans. (a): The boiling point of alkane increases with increase in molecular mass for the same alkane. The boiling point decrease with branching.

Hence, the decreasing orders of boiling point are–

Pentane (I) > butane (II) > neo pentane (III)

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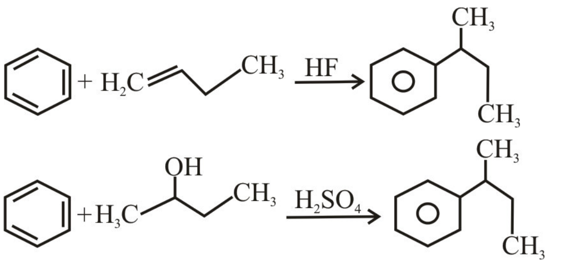
73. Which of the following would not give 2-phenylbutane as the major product in a Friedel-Craft's alkylation reaction of benzene?

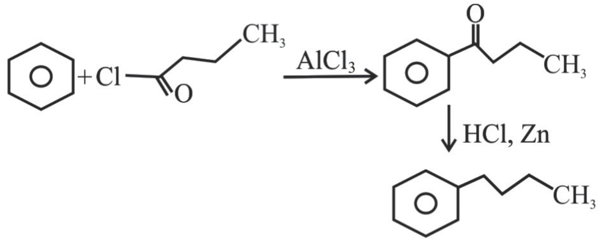
(a) 1-butene +HF
(b) 2-butanol + H_2SO_4
(c) Butanoyl chloride + $AlCl_3$ then Zn, HCl
(d) Butyl chloride + $AlCl_3$

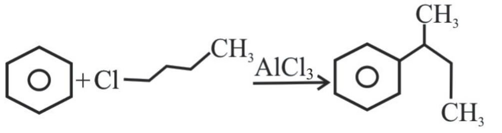
[AIIMS-2014]

Ans. (c):



The Friedal-Crafts alkylation reaction will give propyl phenyl ketone which further on clemnenson's reduction will give butyl benzene.





74. The most important method of preparation of hydrocarbons of lower carbon number is

(a) pyrolysis of higher carbon number of hydrocarbons
(b) electrolysis of salts of fatty acids
(c) Sabatier and Senderen's reaction
(d) direct synthesis

[AIIMS-2009]

Ans. (a): The most important method of preparation of hydrocarbons of lower carbon numbers is by pyrolysis of higher carbon number hydrocarbons.

Eg-

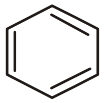
$$\underset{\text{Hexane}}{C_6H_{14}} \xrightarrow{\text{Pyrolysis}} \underset{\text{Ethene}}{C_2H_4} + \underset{\text{Butane}}{C_4H_{10}}$$

75. The size of C – C bond in benzene is

(a) 1.22 Å
(b) 1.54 Å
(c) 1.39 Å
(d) 1.56 Å

[AIIMS-2002]

Ans. (c): The structure of benzene is –



In bond length of C – C single bond is ethane = 1.54 Å and double bond (C = C) in ethane is 1.33 Å. In benzene carbon carbon bond length has 1.39 Å which lies between the single and double bond length value.

76. The boiling points of four saturated hydrocarbons are given below. Which boiling point suggests maximum number of carbon atoms in its molecule:

(a) –162ºC
(b) –88.6ºC
(c) –0.5ºC
(d) –42.2ºC

[AIIMS-2001]

Ans. (c): Boiling Point depends on the number of Carbon atom. Carbon atom is increase then the boiling point is also increase.

Saturated hydrocarbon	Boiling point	
CH_4 (methane)	–161.6°C	Boiling Point increases due to carbon Chain increases ↓
C_2H_6 (ethane)	–89°C	
C_3H_8 (propane)	–42.1°C	
C_4H_{10} (bu tan e)	–0.5°C	

77. What is Z in the following reaction?

$$CH_3-CH_2-CO_2^-Na^{\oplus} \xrightarrow{NaOH/CaO} Z$$

(a) propane
(b) n - butane
(c) ethane
(d) ethyne

AP-EAMCET (Engg.) - 2014

Ans. (c) : Sodium propanoate reacts with sodium hydroxide in presence of CaO to give the ethane.

$$\underset{\text{Sodium propanoate}}{CH_3-CH_2-CO_2^-Na^+} \xrightarrow{NaOH/CaO} \underset{\text{ethane}}{CH_3-CH_3} + Na_2CO_3$$

78. Assertion (A): Cyclohexane is the most stable cycloalkane.

Reason (R): Cyclopropane and cyclobutane are less stable due to angle strain and torsional strain.

The correct answer is

(a) Both (A) and (R) are true but (R) is not the correct explanation of (A).
(b) (A) is true but (R) is not true.
(c) (A) is not true but (R) is true.
(d) Both (A) and (R) are true and (R) is the correct explanation of (A).

AP-EAMCET- (Engg.)-2011

Ans. (a) : In cycloalkane heat of combustion is lowest than cyclohexane so it is most stable cycloalkane. Cyclopropane and cyclobutane are less stable due to angle strain and torsional strain. Therefore cylopropane and cylobutane are reactive cycloalkane.

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79. Phosgene is formed slowly from which one of the following on exposure to air and sunlight?

(a) $CHCl_3$ (b) H_3CCl

(c) H_3COH (d) C_2H_5Cl

AP-EAMCET- (Engg.)-2011

Ans. (a) : In the presence of air and light, chloroform forms carbonyl chloride (also called phosgene) which is extremely poisonous.

$$\underset{\text{Chloroform}}{CHCl_3} + \frac{1}{2}O_2 \xrightarrow{\text{air and light}} \underset{\text{Phosgene}}{COCl_2} + HCl$$

80. Which of the following belongs to the homologous series of $C_5H_8O_2N$?

(a) $C_6H_{10}O_3\,N$ (b) $C_6H_8O_2\,N_2$

(c) $C_6H_{10}O_2\,N_2$ (d) $C_6H_{10}O_2\,N$

AP-EAMCET – 2016

Ans. (d) : The general formula of alkane family or homologous series is C_nH_{2n+2}. Where, n = no. of carbon atoms and 2n + 2 stand for no. of hydrogen atom in the molecule. Since increasing the carbon atom 1 and hydrogen atom increased by 2. Hence, $C_6H_{10}O_2N$ is homologous series.

81. Wet ether is not used as a solvent in Wurtz reaction, because the water present in it :

(a) hydrolyses RX to ROH

(b) reduces RX to RH

(c) destroy the Na metal

(d) reacts with R-R

AP-EAMCET (Engg.)-2004

Ans. (c) : As we know Na metal is highly reactive in nature due to which we can not use the wet ether because it destroy the Na metal. The product is formed alkane in Wurtz reaction.

$$\underset{\text{Ethylchloride}}{C_2H_5Cl} + \underset{\substack{\text{Sodium}\\\text{metal}}}{2Na} + C_2H_5Cl \rightarrow \underset{\text{Butane}}{C_4H_{10}} + 2NaCl$$

82. The alkane that yields two isomeric monobromo derivatives:

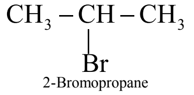
(a) Neo pentane (b) Ethene

(c) Methane (d) Propane

AP – EAMCET - (Medical)-1997

Ans. (d) : Propane exhibit two isomeric monobromo derivatives–

$$\underset{\text{Bromopropane}}{CH_3-CH_2-CH_2-Br}$$



$$\underset{\text{2-Bromopropane}}{CH_3-\underset{\displaystyle Br}{\underset{|}{CH}}-CH_3}$$

83. Hydrolysis of an ester gives a carboxylic acid which on Kolbe's electrolysis yields ethane, The ester is :

(a) Methyl ethanoate (b) Methyl methanoate

(c) Ethyl methanoate (d) Methyl propanoate

AP – EAMCET - (Medical)-1997

Ans. (a) : Hydrolysis of methyl ethanoate (CH_3COOCH_3) gives acetic acid (CH_3COOH) and methyl alcohol (CH_3OH). Acetic acid on electrolysis by Kolbe's method gives ethane. Thus, the ester will be methyl ethanoate (CH_3COOCH_3).

$$\underset{\text{Methyl ethanoate}}{CH_3COOCH_3} + \longrightarrow \underset{\text{Acetic acid}}{CH_3COOH} + \underset{\text{Methanol}}{CH_3OH}$$

In Kolbe's electrolysis, ethane is formed in anode and H_2 gas librated at cathode.

At anode :-

$$\underset{\text{Acetate ion}}{2CH_3COO^-} \longrightarrow 2CH_3COO + 2e^- \xrightarrow{\Delta} \underset{\text{Ethane}}{C_2H_6} + 2CO_2\uparrow$$

At cathode:-

$$H^+ + e^- \longrightarrow H$$

$$H + H \longrightarrow H_2(\uparrow)$$

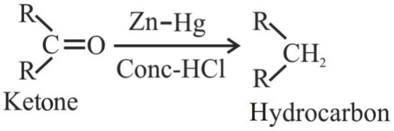
84. Which of the following reagents converts both acetaldehyde and acetone to alkanes?

(a) Ni/H_2 (b) $LiAlH_4$

(c) $I_2/NaOH$ (d) Zn-Hg/conc. HCl

AP-EAMCET (Engg.)-2005

Ans. (d): The reagent Zn-Hg/conc-HCl converts the acetone/acetaldehycle in to the alkanes. This type of reduction is called Clemmenssen reduction reaction.



85. The compounds formed at anode in the electrolysis of an aqueous solution of potassium acetate are:

(a) C_2H_6 and CO_2 (b) C_2H_4 and CO_2

(c) CH_4 and H_2 (d) CH_4 and CO_2

AP-EAMCET (Engg.)-2005

Ans. (a): Kolbe reaction is an organic reaction named after Hermann Kolbe. The Kolbe reaction is formally a decarboxylative dimerization of two carboxylic acids. After electrolysis, alkanes is formed at anode along with the release of carbondioxide.

$$CH_3COO^- \longrightarrow \dot{C}H_3 + CO_2$$

$$\dot{C}H_3 + \dot{C}H_3 \longrightarrow C_2H_6 \text{ (at anode)}$$

86. Which of the following reactions is used to prepare isobutane?

(a) Wurtz reaction of C_2H_5Br

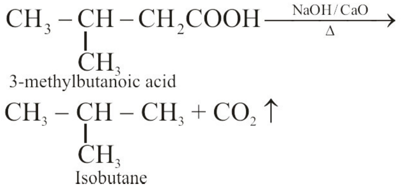
(b) Hydrolysis of n-butylmagnesium iodide

(c) Reduction of propanol with red phosphorus and HI

(d) Decarboxylation of 3-methylbutanoic acid

VITEEE-2015

Ans. (d) :



$$\underset{\text{3-methylbutanoic acid}}{CH_3-\underset{\displaystyle CH_3}{\underset{|}{CH}}-CH_2COOH} \xrightarrow[\Delta]{NaOH/CaO} \underset{\text{Isobutane}}{CH_3-\underset{\displaystyle CH_3}{\underset{|}{CH}}-CH_3} + CO_2\uparrow$$

3-methylbutanoic acid gives isobutane on decarboxylation.

@apna_pdf

87. Which of the following compounds cannot be prepared singly by the Wurtz reaction?

(a) C_2H_6
(b) $(CH_3)_2CHCH_3$
(c) $CH_3CH_2\ CH_2\ CH_3$
(d) All of the above can be prepared

VITEEE-2014

Ans. (b) : Unsymmetrical hydrocarbon cannot be Singly prepared by wurtz reaction. A mixture of two different alkyl halides is heated with sodium metal, three different alkenes will be produced.

88. $\mathbf{CH_3CH_3 + HNO_3 \xrightarrow{675K}}$

(a) $CH_3CH_2NO_2$
(b) $CH_3CH_2NO_2 + CH_3NO_2$
(c) $2CH_3NO_2$
(d) $CH_2 = CH_2$

VITEEE- 2008

Ans. (b) : Aliphatic nitro compounds are prepared by vapour phase nitration of alkanes at 693-793K, under pressure. Alkanes though less reactive do undergo nitration to give a mixture of nitro alkanes resulting through cleavage of carbon-carbon bond along with oxidation product like CO_2, NO_2, H_2O etc.

$$\underset{(\text{fuming})}{CH_3CH_3 + HNO_3} \xrightarrow{675K} \underset{(80\%)}{CH_3CH_2NO_2} + \underset{(20\%)}{CH_3-NO_2}$$

89. The electrode reaction that takes place at the anode of $CH_4 - O_2$ fuel cell is

(a) $2O_2 + 8H^+ + 8e^- \rightarrow 4H_2O$
(b) $CH_4 + 2H_2O \rightarrow CO_2 + 8H^+ + 8e^-$
(c) $CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$
(d) $2H^+ + 2e^- \rightarrow H_2$

VITEEE- 2006

Ans. (b) : At anode the following reaction takes place

$$CH_4 + 2H_2O \rightarrow CO_2 + 8H^+ + 8e^-$$

90. The product/s of following reaction is (are)

$\mathbf{C_2H_5Br + 2Na + CH_3Br \xrightarrow{dry ether} ?}$

(a) ethane
(b) propane
(c) butane
(d) ethane, propane and butane.

AMU-2014

Ans. (d) :

$$\underset{\text{Ethyl bromide}}{C_2H_5Br} + 2Na + \underset{\text{Methyl bromide}}{CH_3Br} \xrightarrow{\text{dry ether}} \underset{\text{Ethane}}{CH_3-CH_3} + \underset{\text{Propane}}{C_2H_5-CH_3} + \underset{\text{Butane}}{C_2H_5-C_2H_5}$$

When two different alkyl halides are heated with sodium metal in the presence of dry ether, a mixture of different alkenes is obtained. This reaction is known as wurtz reaction

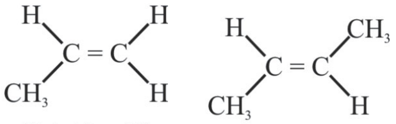
91. Among the following 1–butane (I), cis–2–butene (II), Trans–2–butene (III), the decreasing order of stability is

(a) II > I > III
(b) III > II > I
(c) II > III > I
(d) I > III > II

AMU – 2008

Ans. (b) : Heat of Hydrogenation shows that greater the no. of alkyl group attached to the double bonded carbon atoms, greater is the stability (i.e., Lower is the heat of Hydrogenation) of the alkene.

$$\underset{\text{1-Butene (I)}}{CH_3CH_2CH = CH_2}$$



Cis-but-2-ene(II) Cis-but-2-ene(III)

Relative stability of these alkenes follows the sequence :- III > II > I

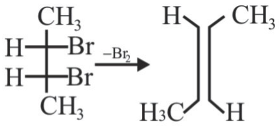
Trans-but-2-ene (III) is more stable than cis-but-2-ene (II) in which the two methyl group are close together and hence then electronic clouds repel each other.

92. During debromination of meso–dibromobutane, the major product formed is

(a) n–butane
(b) l–butane
(c) cis–2–butene
(d) trans–2–butene.

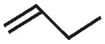
AMU – 2008

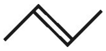
Ans. (d) : Elimination of two bromine atoms from meso-dibromobutane are predominantly trans i.e. steroselective.

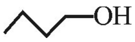


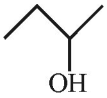
meso-dibromobutane trans-2-butane

93. Which of the following compounds will be formed as a major product on treatment of 2–bromobutane with ethenolic KOH?

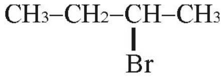
(a) 

(b) 

(c) 

(d) 

AMU–2006

Ans. (b) : 

$$CH_3-CH_2-\underset{\underset{Br}{|}}{CH}-CH_3 \xrightarrow[\text{KOH}]{\text{ethanolic}} CH_3-CH=CH-CH_3$$

According to Saytzeff's rule, during the dehydrohalogenation of secondary and tertiary haloalkanes, the hydrogen atom is preferentially eliminated from the adjacent carbon atom with lesser number of hydrogen atoms.

@apna_pdf

94. The reduction of cyanomethane using H_2/Ni yields

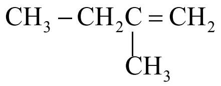
(a) methanamine (b) N-methylmethanamine
(c) ethanamine (d) ethanamide.

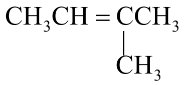
AMU-2004

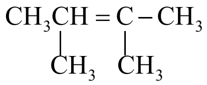
Ans. (c) : $\underset{\text{Ethanamine}}{CH_3CN} \xrightarrow[Ni]{2H_2} CH_3CH_2NH_2$

95. 2, 3-Dimethyl butane is obtained by catalytic hydrogenation of

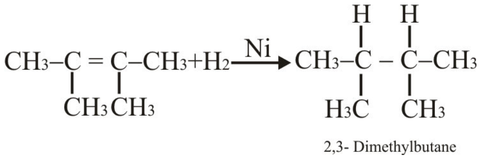
(a) $CH_3CH_2CH=CHCH_3$

(b) 
$CH_3-CH_2\underset{\displaystyle CH_3}{\underset{|}{C}}=CH_2$

(c) 
$CH_3CH=\underset{\displaystyle CH_3}{\underset{|}{C}}CH_3$

(d) 
$CH_3\underset{\displaystyle CH_3}{\underset{|}{C}}H=\underset{\displaystyle CH_3}{\underset{|}{C}}-CH_3$

AMU–2003

Ans. (d) : 
$CH_3-\underset{\displaystyle CH_3}{\underset{|}{C}}=\underset{\displaystyle CH_3}{\underset{|}{C}}-CH_3+H_2 \xrightarrow{Ni} CH_3-\overset{\displaystyle H}{\overset{|}{\underset{\displaystyle H_3C}{\underset{|}{C}}}}-\overset{\displaystyle H}{\overset{|}{\underset{\displaystyle CH_3}{\underset{|}{C}}}}-CH_3$

2,3- Dimethylbutane

96. Ethylmagnesium iodide reacts with propylamine to give

(a) propane (b) ethyl alcohol
(c) ethane (d) ethene

Assam CEE-2014

Ans. (c) :

$$\underset{\text{Ethyl magnesium iodide}}{CH_3-CH_2-MgI} + \underset{\text{Prophylamine}}{CH_3-CH_2-CH_2-NH_2}$$
$$\Big\downarrow \text{H–Br}$$
$$\underset{\text{Ethane}}{CH_3-CH_3} + CH_3-CH_2-CH_2-NH(MgI)$$

When ethyl magnesium iodide react with propylamine in presence of HBr to give ethane.

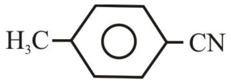
97. The compound having highest boiling point is

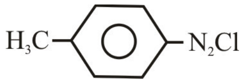
(a) $CH_3CH_2OCH_2CH_3$
(b) $CH_3CH_2CH_2CH_2CH_2OH$
(c) $CH_3CH_3CH_2CH(CH)_3OH$
(d) $CH_3CH_2C(CH_3)_2OH$

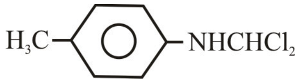
AIIMS-2006

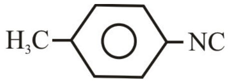
Ans. (b) : $CH_3CH_2CH_2CH_2CH_2OH$
Here alcohol and ether compounds are given in the given compounds alcohols are having more boiling point than ether due to inter moleculas hydrogen bonding. If isomeric alcoholic compounds are the order of boiling points are primary > secondry > tertiary. So in the given option B is primary alcohol and exbhits high boiling point due to the larger surface are of the primary alcohol.

98. The reaction of choloroform with alcoholic KOH and p-toluidine forms

(a) 

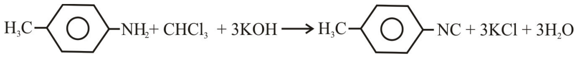
(b) 

(c) 

(d) 

Assam CEE-2018

Ans. (d) : The carbylamine reaction is a chemical test for detection of primary amines in this relations the p-toluidine is heated with allotropic potassium hydroxide and chloroform.
It a primary amine is preset, the isocynaide carbylamines is formed with are fact-smelling substances.



99. The compound having the lowest boiling point is

(a) n-butane (b) isobutane
(c) 1-butene (d) 1-butyne

Assam CEE-2018

Ans. (b) : The boiling point order
Alkyne > Alkene > n-Alkane > Branched alkane
1 butyne > 1 butene > n-butane > isobutene.

100. The correct increasing order of boiling points is

(a) Pentane-1-ol < butane-1-ol < butane-2-ol < ethanol.
(b) Ethanol < butane-2-ol < butane-1-ol < pentane-1-ol

Assam CEE-2021

Ans. (b) : Boiling point increase when number of carbon atom (carbon chain) increas. Boiling point decreases when the branching increase.
Hence, the increasing boiling point is –
Ethanol < butan-2-ol < butan-1-ol < pentan-1-ol

101. By Wurtz reaction, a mixture of methyl iodide and ethyl iodide gives :

(a) butane
(b) ethane
(c) propane
(d) A mixture of the above three

BCECE-2006

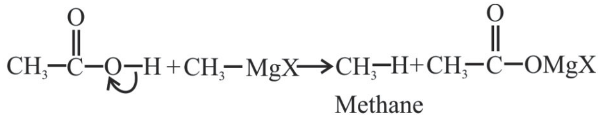
@apna_pdf

Ans. (d) : When methyl iodide and ethyl iodide are reacted with sodium metal in the presence of dry ether, a mixture of different alkanes forms. This reaction is known as Wurtz reaction.

$$CH_3I + CH_3-CH_2I + 2Na \xrightarrow{\text{dry ether}} \underset{\text{ethane}}{CH_3-CH_3} + \underset{\text{propane}}{CH_3-CH_2-CH_3} + \underset{\text{butane}}{C_2H_5-C_2H_5}$$

102. When CH_3COOH reacts (with CH_3-MgX) :
(a) CH_3COX is formed
(b) Hydrocarbon is formed
(c) acetone is formed
(d) alcohol is formed
BCECE-2006

Ans. (b) : When CH_3COOH (acetic acid) reacts with CH_3MgX to give hydrocarbon.



$$CH_3-\overset{O}{\overset{\|}{C}}-O-H + CH_3-MgX \longrightarrow \underset{\text{Methane}}{CH_3-H} + CH_3-\overset{O}{\overset{\|}{C}}-OMgX$$

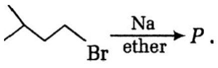
103. Which of the following is present in natural gas?
(a) n-butane
(b) Ethane
(c) Methane
(d) Propane
BCECE-2005, JCECE-2006

Ans. (c) : Methane is present in natural gas. The formula of methane is CH_4. The structure of methane is tetrahedral and an angle is 109°.28'. Methane is make up 70 – 90% of natural gas along with ethane, butane and propane.

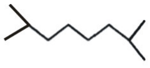
104. Gasoline is a mixture of
(a) C_6-C_{11} alkanes
(b) C_3-C_5 alkanes
(c) C_7-C_9 alkanes
(d) $C_{15}-C_{20}$ alkanes
BCECE-2010

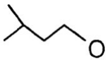
Ans. (c) : Gasoline is a refined product of petroleum consisting of a mixture of hydrocarbons, additives and binding agent. Gasoline is a mixture of C_7-C_9 alkanes.
Fossil fuel like diesel and kerosene how greater weight and density than gasoline.

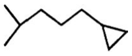
105.

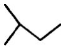


The product P is-

(a)


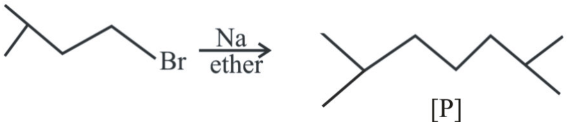
(b)


(c)


(d)


BCECE-2016

Ans. (a) : The reaction of alkyl bromide react with sodium in the presence of ether is known wurtz reaction.

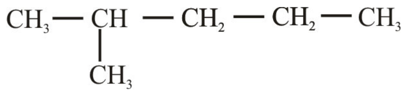


106. Among the following select the alkane that is expected to have lowest boiling point.
(a) hexane
(b) 2-methyl pentane
(c) 3-methyl pentane
(d) 2,2-dimethylbutane
BCECE-2018

Ans. (d) : Boiling point ∝ molecular weight

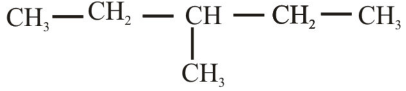
$$\propto \frac{1}{\text{Branching}}$$

The structures of the given alkane are –
(i) Hexane
$CH_3-CH_2-CH_2-CH_2-CH_3$
(ii)



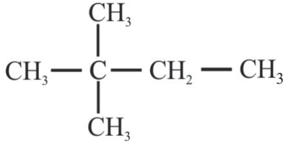
$$CH_3-\underset{CH_3}{\underset{|}{CH}}-CH_2-CH_2-CH_3$$

(iii) 3 – methyl pentane



$$CH_3-CH_2-\underset{CH_3}{\underset{|}{CH}}-CH_2-CH_3$$

(iv) 2, 2 – dimethyl butane

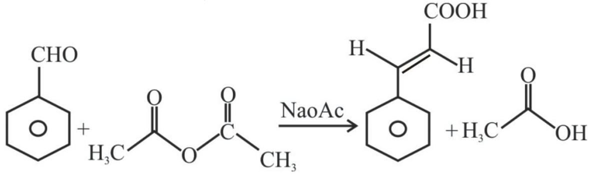


$$CH_3-\underset{CH_3}{\underset{|}{\overset{CH_3}{\overset{|}{C}}}}-CH_2-CH_3$$

Hence, the lowest boiling point is 2, 2-dimethyl butane.

107. Friedel-Crafts reaction, an aromatic aldehyde is treated with acetic anhydride in presence of corresponding salt of the acid to give an unsaturated aromatic acid?
(a) Friedel-Crafts reaction
(b) Perkin's reaction
(c) Wurtz reaction
(d) None of these
[BITSAT-2007]

Ans. (b) : In perkin reaction, aromatic aldehyde is treated with acetic anhydride in presence of corresponding salt of acid (NaOAc) to give ∝ - β - unsaturated carboxylic acid.



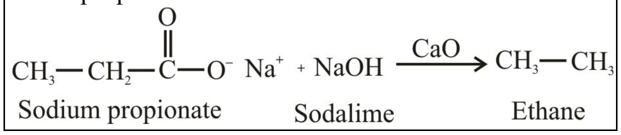
108. Which of the following compound can not be used in preparation of iodoform?
(a) CH_3CHO
(b) CH_3COCH_3
(c) HCHO
(d) 2-propanol
[BITSAT-2009]

Ans. (c) : The compound containing the group $\left(CH_3-\overset{O}{\overset{\|}{C}}-\right)$ give the positive iodoform test but those compound not containing the group $\left(CH_3-\overset{O}{\overset{\|}{C}}-\right)$ not give iodoform test.
In formaldehyde can not used in the preparation of idoform test.

@apna_pdf

109. When sodium propionate is heated with sodalime which product is formed:
(a) Propyl amine (b) Ethane
(c) Acetone (d) Acetaldehyde
[BITSAT-2008]

Ans. (b) : When sodium propionate is heated with sodalime the product is ethane.
While propionate has three carbon.



$$CH_3-CH_2-\overset{O}{\overset{\|}{C}}-O^- Na^+ + NaOH \xrightarrow{CaO} CH_3-CH_3$$

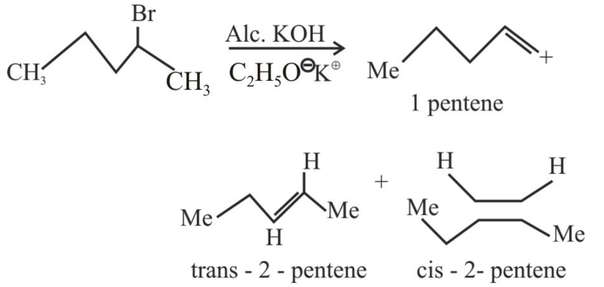
Sodium propionate Sodalime Ethane

110. Function of $AlCl_3$ in Friedel-Craft's reaction is to
(a) produce nucleophile (b) make new bond
(c) produce electrophile (d) break bond
[BITSAT-2006], JCECE-2006

Ans. (c) : $AlCl_3$ is a lewis acid catalyst is aluminium trichloride because the product ketone forms a rather stable complex with lewis acid such as $AlCl_3$.
a stiochiometric amount or more of the catalyst must generally employed.
$AlCl_3$ Will coordinate to halogens and facilitate the breaking of these bonds. It increase the electrophilicity of it's binding partner make it more reactive.

111. 2-bromopentane with alcoholic KOH yields a mixture of three alkenes. Which of the following alkene is predominant?
(a) 1-pentene (b) Cis-2-pentene
(c) Trans-2-pentene (d) Cis-1-pentene
[BITSAT-2021]

Ans. (c) :



According to the Satyzeff rule, trans alkene are more stable than cis.
So, the option (c) is correct.

112. Marsh gas contains
(a) CO_2 (b) CH_4
(c) HCl (d) C_2H_2
[BITSAT – 2006]
CG PET-2004

Ans. (b) : Marsh gas is also known as swamp gas or bog gas is a mixture of primarily methane, and smaller amount of hydrogen sulfide, carbon dioxide etc. methane is the primary gas that make up the product colloquially known as marsh gas. It is produced by the decomposition of biodegrable substance like animal excreta by the action of methanogen.

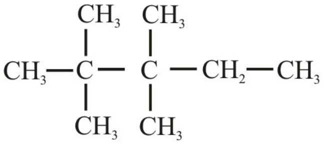
113. The reaction
$C_6H_6 + CH_3Cl \xrightarrow{AlCl_3} HCl + C_6H_5CH_3$
is called
(a) addition reaction
(b) Friedel-craft acylation
(c) Friedel-craft alkylation
(d) Friedel-craft benzoylation
[BITSAT – 2005]

Ans. (c) : Benzene react with alkyl chloride (Methyl chloride) in the presence of $AlCl_3$ then the product is formed toluene.
This reaction is known of friedal –craft alkylation.

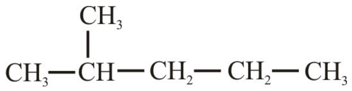
$$\underset{\text{Benzene}}{C_6H_6} + CH_3Cl \xrightarrow{AlCl_3} \underset{\text{Toluene}}{C_6H_5CH_3} + HCl$$

114. Which one of the following contain isopropyl group?
(a) 2, 2, 3, 3-Tetramethylpentane
(b) 2-Methylpentane
(c) 2, 2, 3-Trimethylpentane
(d) 3, 3-Dimethylpentane
[BITSAT – 2009]

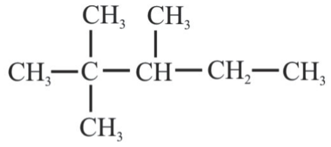
Ans. (b) : The structure of the following –

(i) 

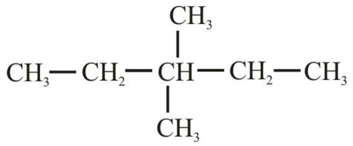
2, 2,3,3 tetramethyl butane

(ii) 

2-methyl pentane

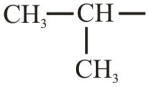
(iii) 

2, 2,3 trimethyl pentane

(iv) 

3,3 dimethyl pentane

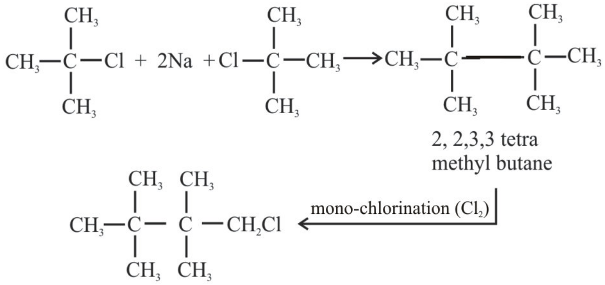
In option (b) have contain isopropyl group



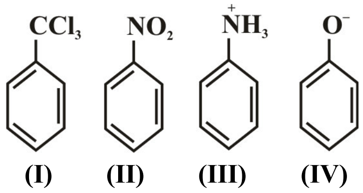
115. An organic compound A (C_4H_9Cl) on reaction with Na/diethyl ether gives a hydrocarbon which on monochlorination gives only one chloro derivative, then A is
(a) tert-butyl chloride (b) sec-butyl chloride
(c) isobutyl chloride (d) n-butyl chloride
[BITSAT – 2014]

@apna_pdf

Ans. (a) : An organic compound A is tertiary butyl chloride react with Na/diethyl ether gives a 2, 2, 3, 3 – tetra methyl butane which on mono chlorination gives a tert butyl chloride



116. In which case the $\overset{+}{N}O_2$ will attack at the meta position



(a) I, II, III (b) II, IV
(c) II and III only (d) II only

[BITSAT- 2012]

Ans. (a) : $\overset{+}{N}O_2$ is an electrophile. The nucleophile attack on meta position the group, –CCl3, $-\overset{+}{N}O_2$, NH_3^+ are electron withdrawing group its generate the positive charge on ortho and para group.
Hence, the nucleophile will be attack on the meta-position.

117. Acetylene reacting with HCN in presence of Ba $(CN)_2$ gives

(a) Vinyl cyanide (b) 1,1- dicyanoethane
(c) 1,2- dicyanoethane (d) None of the above

CG PET -2008

Ans. (a) : Acetylene (CH ≡ CH) react with HCN in the presence of $Ba(CN)_2$ gives vinyl cyanide

$$CH \equiv CH + HCN \xrightarrow{Ba(CN)_2} \underset{\text{vinylcyanide}}{CH_2 = CHCN}$$

118. Which one of the following is the best reagent to accomplish the following conversion?

$$CH_3CH_2Br \xrightarrow{?} CH_3 - CH_3$$

(a) $NaBH_4$ (b) Na|ether
(c) $Zn|C_2H_5OH$ (d) Mg followed by H_3O^+

CG PET- 2011

Ans. (c): Bromo ethane convert to ethane, He reagent Zn/C_2H_5OH.

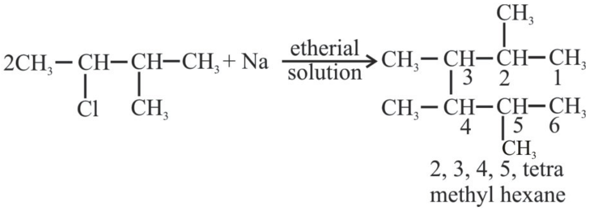
$$\underset{\text{Bromoethane}}{2CH_3 - CH_2 - Br} \xrightarrow{Z_n/C_2H_5OH} \underset{\text{Ethane}}{CH_3 - CH_3}$$

119. 2- chloro-3- methyl butane is treated with sodium in etherial solution, then it will give

(a) 2,4 dimethylhexane
(b) 3,5 dimethylhexane
(c) 2,3,4,5- tetramethylhexane
(d) 2,6- dimethyloctane

CG PET -2009

Ans. (c) : Etherial solution are a solution of an ether.

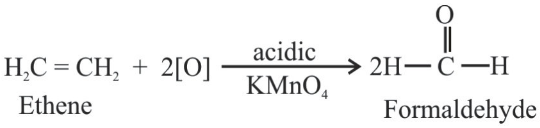


120. Ethene gives with acidic $KMnO_4$ solution

(a) ethylene glycol (b) ethylene oxide
(c) formaldehyde (d) acetaldehyde

CG PET -2007

Ans. (c) : $KMnO_4$ is a oxidising agent. Acidic $KMnO_4$ oxidised carbon – carbon double bond only.



$$\underset{\text{Ethene}}{H_2C = CH_2} + 2[O] \xrightarrow[KMnO_4]{\text{acidic}} \underset{\text{Formaldehyde}}{2H-\overset{\overset{\displaystyle O}{\|}}{C}-H}$$

121. The reaction between an alkyl halide and sodium metal in dry ether is called

(a) Clemmensen reduction
(b) Kolbe's reaction
(c) Wurtz's reaction
(d) Cannizaro's reaction

CG PET -2004,2005

Ans. (c) : The reaction between an alkyl halide and sodium metal in dry ether is called wurtz's reaction.

$$R_1x + 2Na + XR_2 \xrightarrow{Ether} R_1 - R_2 + 2Nax$$

Where, X = Halide group
R = alkyl group

122. DDT is related to

(a) insecticide (b) fungicide
(c) chlorination (d) fluorination

CG PET -2006

Ans. (a) : DDT is a chemical compound its chemical formula is $C_{14}H_9Cl_5$. DDT is dichlorodiphenyltrichloroethane. It is a colorless, crystalline solid at STP. The molecular mass of DDT is 354 – 48 g mol^{-1}, It is a chemical insecticide, dichlorodiphenyltrichloroethane is an organ chlorine compound that was first used as an insecticide.

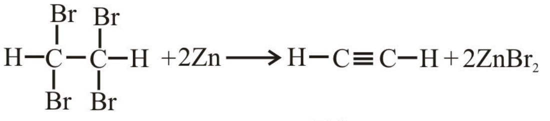
123. Tetrabromoethane on heating with Zn gives

(a) ethyl bromide (b) ethane
(c) ethyne (d) ethene

CG PET- 2015

@apna_pdf

Ans. (c) : Tetrabromoethane on heating with Zn gives ethyne.



$$\mathrm{H-\overset{Br}{\underset{Br}{C}}-\overset{Br}{\underset{Br}{C}}-H + 2Zn \longrightarrow H-C\equiv C-H + 2ZnBr_2}$$

Tetrabromo - methane

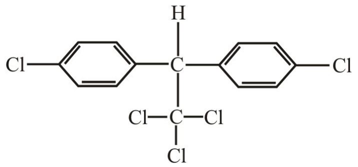
Ethyne (Acetylene)

124. How many numbers of sigma (σ) and pi (π) bonds in DDT respectively ?

(a) 28 and 6	(b) 29 and 6
(c) 30 and 6	(d) 21 and 6

GUJCET-2022

Ans. (d):



1, 1, 1-trichloro -2, 2 – di(4-chlorophenyl) ethane (DDT)

In DDT, number of σ bond is 21 and π bond is 6.

125. R'- Cl $\xrightarrow{Na/ether}$ 2,3 -dimethyl butane. What is R' in the above reaction?

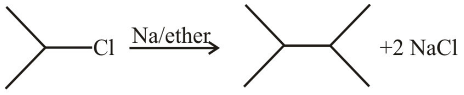
(a) Isopropyl	(b) Isobutyl
(c) Sec-butyl	(d) N-propyl

GUJCET-2020

Ans. (a) : Given,

$R'-Cl \xrightarrow{Na/ether}$ 2, 3-dimethyl butane.

In the product R' is isopropyl'



2, 3 dimethyl butane

126. Which of the following compound gives only one monochloro product on its chlorination in presence of sunlight?

(a) n – butane	(b) Iso pentane
(c) Neo pentane	(d) n – pentane

GUJCET-2017

Ans. (c) : The chlorination of neo pentane with Cl_2 in the presence of diffused sunlight gives only one mono-chloro compound, Neo pentane or 2, 2-dinethyl propane has only primary hydrogen hence it can give only monochloro derivative.

127. The resulting solution obtained at the end of electrolysis of concentrated aqueous solution of NaCl….

(a) Turns red litmus into blue

(b) Turns blue litmus into red

(c) Remains colourless with phenolphthalein

(d) The colour of red or blue litmus does not change

GUJCET-2015, 2016

Ans. (a) : Sodium chloride is dissociated and exists as sodium and chloride ions in aqueous solution, electrolysis of sodium chloride is easier in aqueous solution,

$$NaCl(aq) + H_2O(l) \rightarrow Na^+(aq) + OH^-(aq) + \frac{1}{2}H_2(g) + \frac{1}{2}Cl_2(g)$$

Hence, the resulting solution obtained at the end of electrolysis of concentrated aqueous solution of NaCl turns red litmus into blue.

128. Arrange the following in decreasing order of their boiling points

(A) n - Butane

(B) 2 - Methyl butane

(C) n - Pentane

(D) 2, 2 - Dimethly propane

(a) A > B > C > D	(b) B < C > D < A
(c) D > C > A > B	(d) C > B > D > A

HP CET-2018

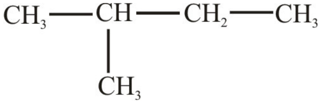
Kerala-CEE, 2011

Ans. (d) : The structure of the following hydrocarbon-

(i) n – butane

$CH_3 - CH_2 - CH_2 - CH_3$

(ii) 2-methyl butane

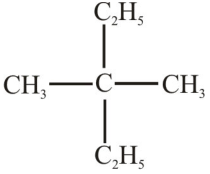


$$\mathrm{CH_3-\underset{CH_3}{CH}-CH_2-CH_3}$$

(iii) n- pentane

$CH_3-CH_2-CH_2-CH_2-CH_3$

(iv) 2, 2-dimethyl propane



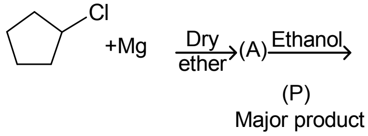
$$\mathrm{CH_3-\overset{C_2H_5}{\underset{C_2H_5}{C}}-CH_3}$$

Boiling point depends upon the number of carbon chain increase boiling point increase.

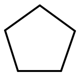
Boiling point decrease when the branching of group increase.

So, the order is C > B > D > A

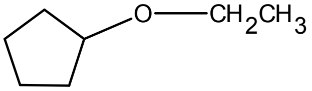
129. In the following sequence of reactions the P is:



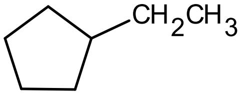
(a)



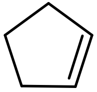
(b)



(c)



(d)



[2021, 27 Aug Shift-I]

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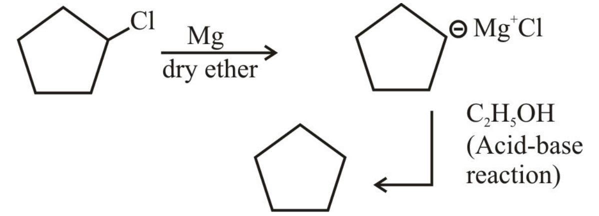
Ans. (a) :

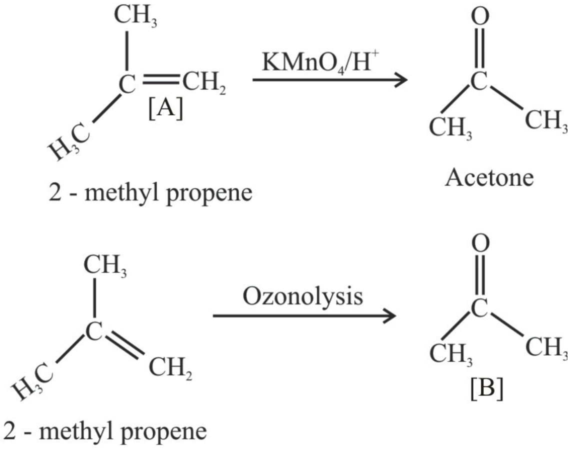

Cl
Mg
dry ether
Mg⁺Cl
C₂H₅OH
(Acid-base
reaction)

130. An organic compound 'A' C_4H_8 on treatment with $KMnO_4/H^+$ yield's compound 'B' C_3H_6O Compound 'A' also yields compound 'B' an ozonolysis. Compound 'A' is

(a) 2-methylpropene
(b) 1-methylcyclopropane
(c) but-2-ene
(d) cyclobutane

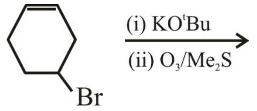
(JEE Main-2021, 25 July Shift-I)

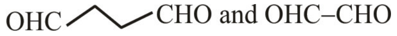
Ans. (a) :

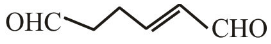

CH₃
C
CH₂
[A]
H₃C
KMnO₄/H⁺
O
C
CH₃
CH₃
2 - methyl propene
Acetone
CH₃
C
H₃C
CH₂
Ozonolysis
O
C
CH₃
CH₃
[B]
2 - methyl propene

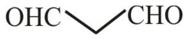
Hence, the compounds 'A' are 2-methylpropene and B is acetone.

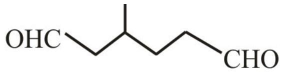
131. The major product(s) obtained in the following reaction is/are:


(i) KOᵗBu
(ii) O₃/Me₂S
Br

(a) 
OHC
CHO and OHC–CHO

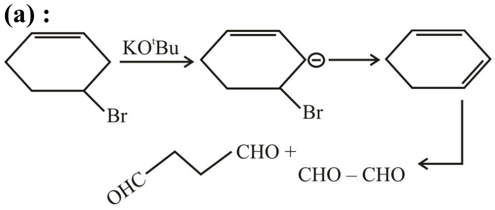
(b) 

(c) 

(d) 

[JEE Main-2019, 12 April Shift-I]

Ans. (a) :

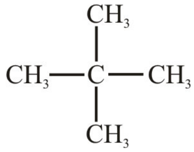

KOᵗBu
Br
Br
OHC
CHO +
CHO – CHO

132. On mixing a certain alkane with chlorine and irradiating it with ultraviolet light, it forms only one monochloroalkane. This alkane could be :

(a) Propane (b) Pentane
(c) Isopentane (d) Neopentane

WB-JEE-2010, [AIEEE 2003]

Ans. (d) : In neopentane contains all hydrogen are equivalent. So, it will give only one monochloroalkane on halogenations.


$C(CH_3)_4$

The IUPAC name of neo pentane is 2, 2-dimethylpropane.

133. Alkyl halides reacts with dialkyl copper reagents to give :

(a) Alkenyl halides (b) Alkanes
(c) Alkyl copper halides (d) Alkenes

[AIEEE 2005]

Ans. (b) : Alkyl halides react with dialkyl copper reagents to form a alkane, this reaction is known as Corey House synthesis.

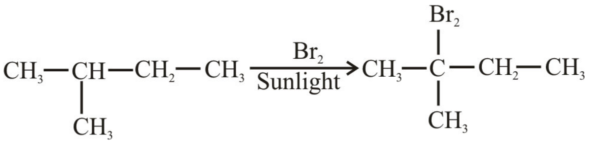
$R'-X+R_2CuLi \rightarrow RR'+RCu+LiX.$

134. 2-methyl butane on reaction with bromine in the presence of sunlight gives mainly:

(a) 1-bromo-3-methylbutane
(b) 2-bromo-3-methylbutane
(c) 2-bromo-2-methylbutane
(d) 1-bromo-2-methylbutane

[AIEEE 2005]

Ans. (c) :


CH₃—CH—CH₂—CH₃
CH₃
Br₂
Sunlight
Br₂
CH₃—C—CH₂—CH₃
CH₃

The reactivity order of abstraction of H atoms towards bromine atom alkane.

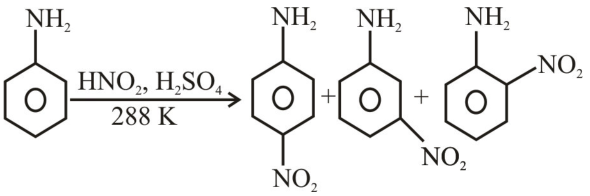
Bromine will be substituted to the hydrogen where carbon has least number of hydrogen atoms.

135. The nitration (using nitration mixture) of aniline gives

(a) p-nitroaniline (b) o-nitroaniline
(c) m-nitroaniline (d) all the above

J & K CET-(2012)

Ans. (d): Nitration of aniline yields tarry oxidation products in addition to the nitro derivatives. In strongly acidic medium aniline is protonated to form a aniline union and mixture of ortho, Para and meta nitro-aniline is formed.


NH₂
HNO₃, H₂SO₄
288 K
NH₂
NO₂
+
NH₂
NO₂
+
NH₂
NO₂

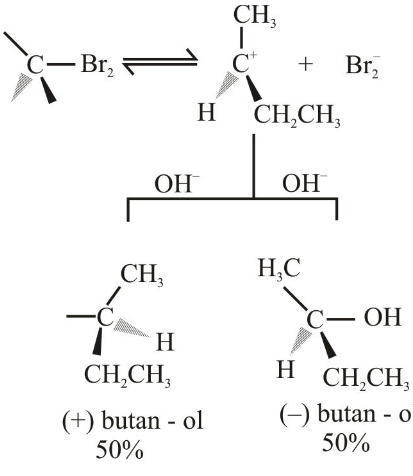
@apna_pdf

136. 2-bromobutane reacts with OH^- in H_2O to give 2-butanol. The reaction involves

(a) retention in configuration
(b) inversion in configuration
(c) racemization
(d) mutarotation

J & K CET-(2012)

Ans. (c) : 2 - bromo butane react with OH^- to give a 2 – butane. The reaction involve a racemization.



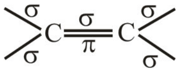
Racemic mixture

137. What kinds of bonds are present in ethene molecule?

(a) 1 pi and 5 sigma bonds
(b) 1 pi and 3 sigma bonds
(c) 1 sigma and 1 pi bond
(d) 3 sigma and 3 pi bonds

J & K CET-(2014)

Ans. (a) : The structure of ethane is –



In ethane no. of σ bond is 5 and π - bond is 1.

138. The order of stability of the following alkenes with the first being the most stable and last being the least stable is

I. $CH_3CH_2CH = CH_2$
II. $(CH_3)_2C = C(CH_3)_2$
III. $CH_3CH = C(CH_3)_2$
IV. $(CH_3)_2C = CH_2$

(a) I > II > III > IV
(b) II > III > IV > I
(c) IV > III > II > I
(d) III > IV > I > II

J & K CET-(2017)

Ans. (b) : The stability of alkene is directly proportional to the number of R-groups attached to double bonded carbon atom.

Therefore more substituted alkene or the alkene has more number of alpha hydrogen atoms are more stable.

Hence, the order is II > III > IV > I

139. Which of the following reaction is used for producing symmetrical alkane with double carbon atom?

(a) Sandmeyer's reaction
(b) wurtz reaction
(c) Gattermann reaction
(d) Riemer- Tiemann reaction

J & K CET-(2019)

Ans. (b) : Wurtz reaction is a coupling reaction which are used in organic chemistry and organ metallic chemistry. Wurtz reaction is used to prepare symmetrical alkene.

In wurtz reaction alkyl halide react with metallic sodium in presence of dry ether to form symmetrical alkanes containing double number of carbon atoms present in the alkyl halide.

$$2R-X+2Na\xrightarrow{\text{dry ether}}R-R+2NaX.$$

140. 1-chlorobutane on reaction with alcoholic potash gives

(a) 1-butanol
(b) 2-butene
(c) 1-butene
(d) 2-butanol

J & K CET-(2011)

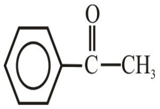
Ans. (c) :

$$\underset{\text{1-chlorobutane}}{CH_3-CH_2-CH_2-CH_2Cl}\xrightarrow{\text{alc.KOH}}\underset{\text{1-butene}}{CH_3-CH_2-CH=CH_2}+HCl$$

When 1- chloro butane on reaction with alcoholic potash gives 1 – butane.

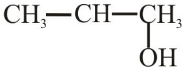
Alcoholics potash (KOH) is a dehydrohalogenation agent, it react with an alkyl halide and alkene forms as a product.

141. Which one of the following does not give iodoform?

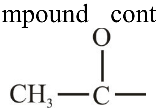
(a) 

(b) CH_3OH

(c) CH_3CH_2OH

(d) 
$CH_3-\underset{OH}{CH}-CH_3$

J & K CET-(2008)

Ans. (b) : The compound containing either the $R(CH_3)CHOH$, CH_3 = 
$CH_3-\overset{O}{\overset{|}{C}}-$ or $ROCH_3$ Group, on reaction with sodium hypoiodite (NaOI) form yellow – colored iodoform (CH_3I) and sodium salts of corresponding carboxylic acid, this is called as iodoform test.

Hence, CH_3OH is not give iodoform test.

142. In a group of isomeric alkylhalides, the order of boiling points is

(a) Primary < Secondary < Tertiary
(b) Primary > Secondary < Tertiary
(c) Primary < Secondary > Tertiary
(d) Primary > Secondary > Tertiary

J & K CET-(2007)

Ans. (d) : Alkyl halides with branched and more spherical shapes have lower boiling point as a result of their smaller surface area.

Hence, the order of boiling points is –

Primary > Secondary > Tertiary.

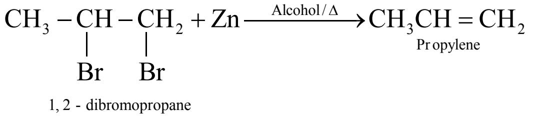
@apna_pdf

143. The reaction conditions used for converting 1,2-dibromopropane to propylene are

(a) KOH, alcohol/Δ (b) KOH, water/Δ
(c) Zn, alcohol/Δ (d) Na, alcohol/Δ

J & K CET-(2006)

Ans. (c) : 1, 2-dihalogen (vicinal) derivatives of the alkanes on reaction with zinc dust and methanol produces alkenes by loss of two halogen atoms (dehalogenation).



$$\underset{\text{1, 2 - dibromopropane}}{CH_3-\underset{Br}{\underset{|}{CH}}-\underset{Br}{\underset{|}{CH_2}}}+Zn\xrightarrow{\text{Alcohol}/\Delta}\underset{\text{Propylene}}{CH_3CH=CH_2}$$

144. Chloroform is slowly oxidised by air in the presence of light and air to form

(a) formyl chloride (b) trichloro methanol
(c) phosgene (d) formaldehyde

J & K CET-(2003)
JCECE-2006

Ans. (c) : Chloroform is slowly oxidised by air in the presence of light and air to form a phosgene.

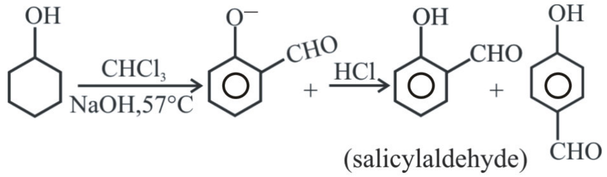
$$CHCl_3+O_2\rightarrow \underset{\text{Phosgene}}{COCl_2}+HCl$$

145. The reaction of chloroform and sodium hydroxide with phenol to form salicylaldehyde is called

(a) aldol condensation
(b) Cannizzaro reaction
(c) Claisen reaction
(d) Reimer-Tiemann reaction

J & K CET-(2002)

Ans. (d) : The reaction of chloroform and sodium hydroxide with phenol to form salicylaldehyde is called Reimer-Tiemann reaction.



146. If chloroform is left open in the presence of sunlight, then

(a) polymerization takes place
(b) explosion takes place
(c) poisonous phosgene gas is formed
(d) no reaction takes place

J & K CET-(2000)

Ans. (c) : Chloroform in the presence of sunlight and air undergoes reaction with oxygen in air and forms poisonous phosgene gas.

$$\underset{\text{Chloroform}}{CHCl_3}+\frac{1}{2}O_2\rightarrow \underset{\text{Phosgene}}{COCl_2}+HCl$$

147. The organic reaction product from the reaction of methyl magnesium bromide and ethyl alcohol is

(a) methane (b) ethane
(c) propane (d) butane

J & K CET-(1999)

Ans. (a) : Methyl magnesium bromide reacts with ethanol to give methane. Methyl group in the Grignard reagent has a lone pair with a negative charge. This methyl group attacks the hydrogen atom of –OH group and takes that hydrogen atom towards methyl group.
Its form methane.

$$CH_3-CH_2OH\xrightarrow{CH_3MgBr}\underset{\text{Methane}}{CH_3-H}+CH_3-CH_2-OMgBr$$

148. 1-Bromopropane is converted into propene in the presence of alcoholic KOH solution. The reaction involves elimination of a molecule of

(a) HBr (b) H_2
(c) H_2O (d) Br_2

J & K CET-(1997)

Ans. (a) : 1-bromopropane is converted into propene in the presence of alcoholic KOH solution

$$CH_3-CH_2-CH_2-Br\xrightarrow{\text{Alc.KOH}}CH_3-CH_2=CH_2+HBr$$

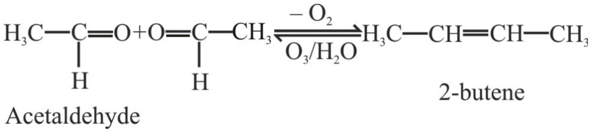
In this reaction involves elimination of a molecule of HBr.

149. Which of the following alkenes gives only acetaldehyde on ozonolysis?

(a) ethene (b) propene
(c) 1-butene (d) 2-butene

J & K CET-(2008)

Ans. (d) : Ozonolysis involves the breaking of double bond and insertion of O atoms in place of double bond. Therefore, the structure of alkene is as-



$$\underset{\text{Acetaldehyde}}{H_3C-\underset{H}{\underset{|}{C}}=O+O=\underset{H}{\underset{|}{C}}-CH_3}\underset{O_3/H_2O}{\overset{-O_2}{\rightleftharpoons}}\underset{\text{2-butene}}{H_3C-CH=CH-CH_3}$$

150. Bromination of alkanes involves

(a) Carbanions (b) Carbocations
(c) Carbenes (d) Free radicals

J & K CET-(2005)

Ans. (d) : In bromination of alkane involve in the presence of uv light, alkane will reaction.
Uv light is the condition under the reaction will form a free radicals. During this reaction, bromine atoms substitute this hydrogen atom to producing bromo alkane.

151. Methane is produced by the hydrolysis of

(a) Al_4C_3 (b) CaC_2
(c) dry ice (d) n-C_3H_7MgBr

J & K CET-(2003)

Ans. (a) : $Al_4C_3+12H_2O\rightarrow \underset{\text{Methane}}{3CH_{14}}+4Al(OH)_3$

$$n-C_3H_7MgBr+4H_2O\rightarrow \underset{\text{Propyne}}{CH_3-CO\equiv CH}$$

$$CaC_2\xrightarrow{H_2O}\underset{\text{Ethyne}}{CH\equiv CH}+Ca(OH)_2$$

Aluminium carbide by reaction with water produces a methane and aluminium hydroxide.

152. A fuel containing 25% n-heptane and 75% iso-octane has got octane number

(a) 25 (b) 50
(c) 75 (d) 100

J & K CET-(2000)

@apna_pdf

Ans. (c) : Octane is one of the most important product qualities for gasoline. Octane is a measure of the tendency of gasoline to resist auto-igniting when compressed with air in a spark ignition engine.

High octane naturals are more valuable to a refiner because they allow the refiner to make higher octane gasoline.

Octant is measured using an index reflecting the degree to which a fuel will knock under specific operating conditions A mixture of 75% isooctane mixed with 25% n-heptanes would have an octane rating of 75.

153. Lindlar's catalyst is

(a) pd and CO_2

(b) pd and H_2

(c) Palladised charcoal deactivated with sulphur

(d) Pd and $CaCO_3$

J & K CET-(2000)

Ans. (d) : A Lindlar catalyst is a heterogeneous catalyst that consists of palladium deposed on calcium carbonate or barium sulfate which is then poisoned with venous forms of lead or sulfur. It is used for the hydrogenation of alkynes to alkene. The palladium content of the supported catalyst is usually 5% by weight.

154. Which of the following is the correct statement for C_4H?

(a) It must have a double bond

(b) It must have a triple bond

(c) It should not have either a double or triple bond

(d) Such a compound is impossible

J & K CET-(2000)

Ans. (d) : For C_4H compound is impossible because carbon has four valency not satisfied by the carbon. So, such a compound is impossible.

155. The hydrocarbon which decolourises alkaline $KMnO_4$ solution and also but does not give any precipitate with ammoniacal silver nitrate is

(a) Benzene (b) Acetylene

(c) Propyne (d) Butyne-2

J & K CET-(1999)
AIIMS-1994

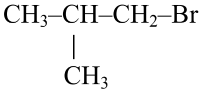
Ans. (d) : In butyne -2 has terminal acidic hydrogen atom to give decolorizes alkaline $KMnO_4$ solution but does not give any precipitate with ammoniacal silver nitrate. Ammoniacal silver nitrate solution is also known as Toller's reagent in chemical reaction.

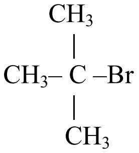
156. What is the chief product obtained when n-butane is treated with bromine in the presence of light at 130^0C?

(a) $CH_3–CH_2–CH_2–CH_2–Br$

(b) $CH_3–CH_2–CH–Br$

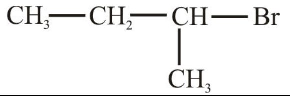
$|$
CH_3

(c) 
$CH_3–\underset{\underset{CH_3}{|}}{CH}–CH_2–Br$

(d) 
$CH_3–\overset{\overset{CH_3}{|}}{\underset{\underset{CH_3}{|}}{C}}–Br$

J & K CET-(1998)

Ans. (b) : Br_2 has a much regioselectivity so chief product formed is -2-bromo but –one. Br – Br bond cleavage forms 2 Br radicals. One radical reacts with n-butane and a n-butane radicals are formed. This n – butane radicals abstract a Br atom form another Br – Br Molecule. The reaction proceeds via free radicals mechanism. As 2° free radical are more stubble than 1°.

Hence,  is formed.
$CH_3—CH_2—\underset{\underset{CH_3}{|}}{CH}—Br$

157. Term 'Hexadecane' in petroleum is commonly called as

(a) Octane (b) Petrol

(c) Cetane (d) LPG

J & K CET-(1997)

Ans. (c) : Hexadecane is also known as cetane it is an alkane hydrocarbon with the chemical formula $C_{16}H_{34}$. Hexadecane consists of a chain of 16 carbon atom.

Cetane number is a measurement of the quality or performance of diesel fuel. Higher the number, the better the fuel burns within the engine of a vehicle. The cetane number is similar to octane rating. Pure cetane represents the highest purity of diesel fuel possible, and thus has a cetane rating at 100.

158. At room temperature the eclipsed and staggered forms of ethane can not be isolated because

(a) They inter convert rapidly

(b) Both the conformers are equally stable

(c) The energy difference between the conformers is large

(d) There is a large energy barrier of rotation about the O bond

J & K CET-(1997)
AFMC-2010

Ans. (a) : At room temperature the eclipsed and staggered forms of ethane cannot be isolated because they inter convert rapidly the energy difference between two conformations of ethane is not so large, so the eclipsed and staggered conformation interconvert rapidly. Thus, it is impossible to isolates these forms at room temperature.

159. An alkane with a molecular formula C_6H_{14} reacts with chlorine in the presence of light and heat to give two constitutionally isomeric monochlorides of molecular formula $C_6H_{13}Cl$. What is the most reasonable starting alkane?

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(a) n-Hexane (b) 2,2 Dimethylbutane
(c) 2,3-Dimethylbutane (d) 3-Methylpentane

J & K CET-(2011)

Ans. (c) : An alkane with a molecular formula, C_6H_{14} reacts with chlorine in the presence of light and heat to give two constitution isomeric monochlorides of molecular formula $C_6H_{13}Cl$. Hexane reacts with chlorine in the presence of light and heat it gives two isomene products of 2, 3 dimethyl chloride has two constitutional isomers with molecular formula of $C_6H_{13}Cl$.

160. Which of the following has lowest boiling point?

(a) NaCl (b) CuCl
(c) $CuCl_2$ (d) CsCl

JCECE - 2004

Ans. (c) : Sodium and Cesium chlorides are solid with high melting and boiling points because of the large amount of heat which is needed to break the strong ionic attractions. Copper chlorides are liquids and low melting points solids.

$$\text{Boiling Points} \propto \frac{1}{\text{Covalent character}}$$

Since, the anion that is chlorides is the same in all four compounds, compare the covalent character based on the polarizing power of the cations

In NaCl has +1 charge on catian
CuCl has +1 charge on catian
$CuCl_2$ has +2 charge on catian
C_5Cl has + 1 charge on catian
Hence, the covalent character is maximum in $CuCl_2$
So, $Cucl_2$ has the minimum boiling point.

161. Which of the following alcohol give positive iodoform test?

(a) Methanol (b) Ethyl carbinol
(c) Pentanol-3 (d) Methyl carbinol

JCECE - 2004
Haryana PMT-2003

Ans. (d) : The molecular formula of methyl carbinal (CH_3CH_2OH). It gives a iodoform test and it is oxidised to acetaldehyele in basic conditions.

$$CH_3CH_2OH + 6NaOH + 4I_2 \rightarrow CHI_3 + HCOONa + 5NaI + 3H_2O$$

162. Which of the following gas, diffuse most slowly?

(a) C_2H_6
(b) C_2H_4
(c) CH_4
(d) All of these diffuse at equal rate

JCECE - 2004

Ans. (a) : According to Graham's law of diffusion, r $\propto \frac{1}{\sqrt{M}}$ where, M = molar mass. The gas which least molar mass that can diffuse easily. The gas which has high molar mass that can diffuse slowly. Therefore, among the given gases C_2H_6 diffuse slowly.

163. Which one of the following aqueous solution will exhibit highest boiling point?

(a) 0.01 M Na_2SO_4 (b) 0.01 M KNO_3
(c) 0.015 M urea (d) 0.015 M glucose

JCECE - 2008

Ans. (a) : Molecular mass is highest then boiling point is highest. The elevation in boiling point is a colligative property of the solution i.e. elevation in boiling point is directly proportional to solute particle concentration.

The dissociation of sodium sulphate

$$Na_2SO_4 \rightarrow 2Na^+ + SO_4^{2-}$$

$\therefore$ Concentration of ions is –

0.01 M Na_2SO_4 solution is = 3 × 0.01 = 0.03 M.

164. The compound with highest boiling point

(a) n-hexane (b) n-pentane
(c) 2, 2-dimethylpropane (d) 2-methylbutane

JCECE - 2010

Ans. (a) : Boiling point $\propto$ molecular mass

$$\propto \frac{1}{\text{branching}}$$

($\because$ Surface area decreases)

$\therefore$ n-hexane has the highest boiling point among the given.

165. Which of the following liquid on electrolysis produce H_2 at cathode and Cl_2 at anode?

(a) NaCl solution in water
(b) $CuCl_2$ solution in water
(c) Pure water
(d) H_2SO_4 Solution

JCECE - 2016

Ans. (a) : NaCl solution in water gives H_2 at cathode and Cl_2 at anode because of low discharge potential of H^+ ions as compared to Na^+ (at cathode) and of Cl^- as compared to OH^- ions (due to over voltage).

$$2H^+ \xrightarrow{+2e^-} H_2(g) \text{ (at cathode)}$$

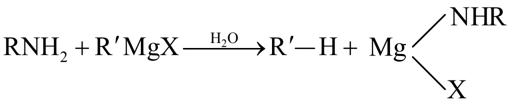
$$2Cl^- \xrightarrow{-2e^-} Cl_2(g) \text{ (at anode)}$$

166. Which of the following will give alkane?

(a) $RNH_2 + R'MgX \xrightarrow{H_2O}$
(b) $RCH_2OH + R'MgX \xrightarrow{H_2O}$
(c) $R—X—Mg \xrightarrow{H_2O}$
(d) All of the above

JCECE - 2016

Ans. (d) : (i) In the presence of H_2O and Grignard reagent, all compounds having acidic (reactive-H) hydrogen will give alkane.



$$RNH_2 + R'MgX \xrightarrow{H_2O} R'-H + Mg\begin{matrix} NHR \\ X \end{matrix}$$

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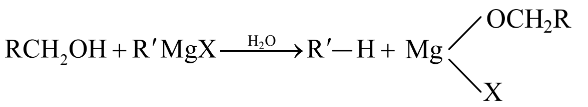
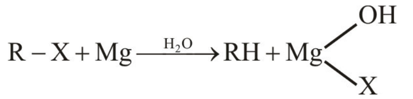


$RCH_2OH + R'MgX \xrightarrow{H_2O} R'-H + Mg\begin{smallmatrix} OCH_2R \\ X \end{smallmatrix}$

(ii) R-X in the presence of H_2O gives alkane in place of Grignard reagent.



$R-X + Mg \xrightarrow{H_2O} RH + Mg\begin{smallmatrix} OH \\ X \end{smallmatrix}$

167. Which of the following is least soluble in water?

(a) C_2H_6 (b) CH_3OH

(c) CH_3NH_2 (d) C_6H_5OH

JIPMER-2017

Ans. (a) : Alkanes is saturated hydrocarbon molecule and are non-polar molecules. The general formula of alkane is C_nH_{2n+2}. Hence, C_2H_6 is being a non-polar and least soluble in water.

168. Which one of the following does not undergo iodoform reaction

(a) Secondary butyl alcohol

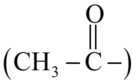
(b) ISo-propels alcohol

(c) Diethyl ketone

(d) Ethyl alcohol

JIPMER-2014

J&K-CET, 2009

Ans. (c) : Those compound which have methyl Keto group  $(CH_3-\overset{\overset{O}{\|}}{C}-)$ have give iodoform reaction.

Those compound that contains terminal methyl keto group or can be oxidised to methyl keto group can undergo iodoform reaction.

So, diethyl ketone does not undergo iodoform reaction because it does not contain methyl keto group.

169. Which of the following reagents converts both acetaldehyde and acetone alkanes?

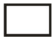
(a) Ni/H_2 (b) $LiAl/H_4$

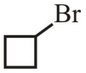
(c) $I_2/NaOH$ (d) Zn-Hg/conc. HCI

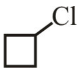
JIPMER-2009

Ans. (d) : The reagent which convert to both acetaldehyde and acetone alkane. By Zn – Hg/conc. HCl reagent.

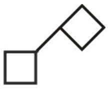
The reduction of ketones aldehydes to alkane using zinc amalgam and hydrochloric acid.

170. If  **react with Cl_2 in presence of light and then react with Na metal in dry ether, final product is**

(a) 

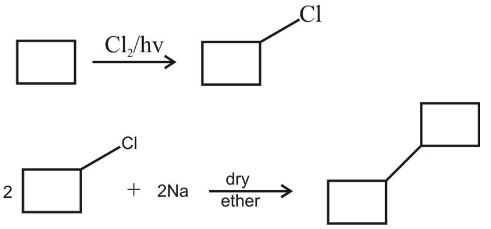
(b) 

(c)

(d) 

JIPMER-2019

Ans. (d) : Cyclobutane react with Cl_2 in presence of light and then react with Na Metal in dry ether dicyelobutane.



171. $\mathbf{CH_3-Br \xrightarrow{Mg/ether} \xrightarrow[\text{(ii) Water}]{\text{(i) } CO_2} \xrightarrow[\Delta]{CH_3OH/H^+} P}$

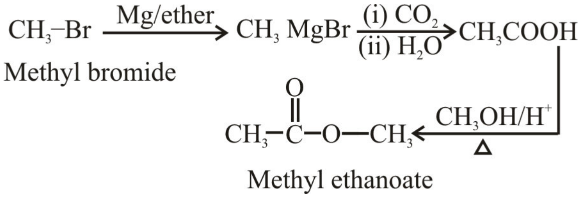
What is the product of 'P' is the above reaction?

(a) methyl ethanoate (b) Ethanoic acid

(c) Propanal (d) Methyl propanoate

JIPMER-2018

Ans. (a) :



172. Prolonged exposure of chloroform in humans many cause damage to liver. It is due to the formation of the following compound.

(a) CCl_4 (b) $COCl_2$

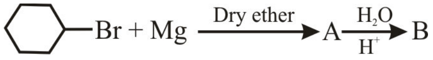
(c) CH_2Cl_2 (d) Cl_2

Karnataka-CET-2020

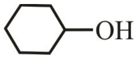
Ans. (b) : Prolonged exposure of chloroform in humans many cause damage to liver. It is due to the formation of phosgene.

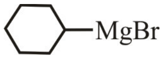
When chloroform is oxidised, it forms phosgene with is poisonous.

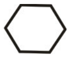
$$\underset{\text{Chloroform}}{CHCl_3} \xrightarrow{(O)} \underset{\text{Phosgene}}{COCl_2} + HCl$$

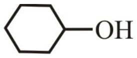
173. 

The product B is

(a) 

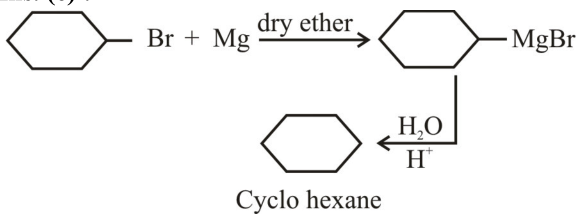
(b) 

(c) 

(d) 

Karnataka-CET-2015

Ans. (c) :



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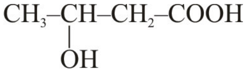
174. Iodoform reaction is answered by all, except

(a) 
$CH_3-CH(OH)-CH_2-COOH$

(b) CH_3CHO

(c) CH_3-CH_2-OH

(d) $CH_3-CH_2-CH_2OH$

Karnataka-CET-2014

Ans. (d) : Iodoform test is used in laboratories for the detection of aldehydes and ketones containing an alpha methyl group.

The compound CH_3-CH_2-OH does not have either CH_3CO non $CH_3CH(OH)$ group.

Therefore the compound which not show positive result in iodoform test.

175. Methane can be converted into ethane by the reactions

(a) Chlorination followed by the reaction with alcoholic KOH

(b) Chlorination followed by the reaction with aqueous KOH

(c) Chlorination followed by Wurtz reaction

(d) Chlorination followed by decarboxylation

Karnataka-CET-2013

Ans. (c) : Methane can be converted into ethane by the wurtz reaction.

$$\underset{\text{Mehhane}}{CH_4} + Cl_2 \rightarrow CH_3Cl + HCl$$

$$2CH_3Cl + Na \rightarrow \underset{\text{Ethane}}{C_2H_6}$$

CH_4 (Methane) is treated with chlorine gas in the presence of ultraviolet light to form chloromethane. Chloromethane is treated with sodium metal and dry ether to form the ethane.

This process is called wurtz synthesis.

176. Cycloalkane formed when 1, 4-dibromopentane is heated with sodium is

(a) Methyl cyclobutane

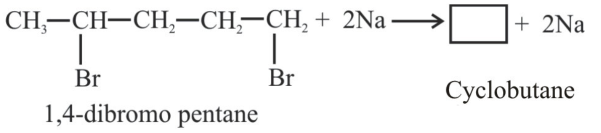
(b) Cyclopentane

(c) Cyclobutane

(d) Methyl cyclopentane

Karnataka-CET-2013

Ans. (a) :



1, 4-dibromopentane are treated with sodium or zinc then the product form cyclo alkane.

This reaction is undergoes free radical mechanism.

177. Which one of the following is not formed when a mixture of methyl bromide and bromobenzene heated with sodium metal in the presence of dry ether?

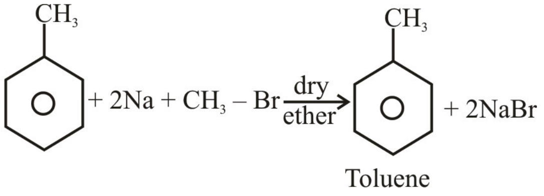
(a) Diphenyl (b) Propane

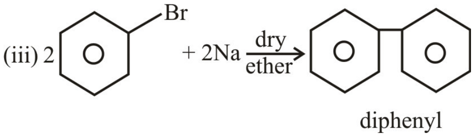
(c) Toluene (d) Ethane

Karnataka-CET-2012

Ans. (b) :

(i) $\underset{\text{Methy bromide}}{2CH_3-Br} + 2Na \xrightarrow[\text{ether}]{\text{dry}} \underset{\text{ethane}}{CH_3-CH_3} + 2NaBr$

(ii) 

(iii) 

Hence, Propane cannot be prepared from this reaction.

178. For preparing an alkane, a saturated solution of sodium or potassium salt of a carboxylic acid is subjected to

(a) Hydrolysis (b) Oxidation

(c) Hydrogenation (d) Hydration

(e) Electrolysis

Karnataka-CET-2017
Kerala-CEE-2011

Ans. (e) : When an concentrated aqueous solution of sodium or potassium salt of a mono carboxylic acid is electrolyzed an alkane is produced.

$$\underset{\text{Sodium ethanoate}}{2CH_3-COONa} + 2H_2O \xrightarrow{\text{Electrolysis}} \underset{\text{Ethane}}{CH_3-CH_3} + 2NaOH + H_2 + 2CO_2$$

179. n-butylamine (I), diethylamine (II) and N, N-dimethylethylamine (III) have the same molar mass. The increasing order of their boiling point is

(a) III < II < I (b) I < II < III

(c) II < III < I (d) II < I < III

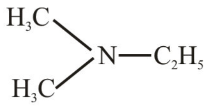
(e) III < I < II

Kerala-CEE-2011

Ans. (a) : The structure of the following amine are –

(i) $CH_3-CH_2-CH_2-CH_2-NH_2$
n–butylamine (1° amine)

(ii) $CH_3-CH_2-NH-CH_2-CH_3$
Diethylamine (2° amine)

(iii) 

N,N - dimethyl amine (3° amine)

The order of boiling point of amine depend on the no. of hydrogen atom attached to the amines.

Number of hydrogen increase on amine boiling point increases.

So, the order is – 1° > 2° > 3° amine.

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180. Chloroform reacts with oxygen in the presence of light to give

(a) Carbon tetrachloride
(b) Carbonyl chloride
(c) Methyl chloride
(d) Methylene dichloride
(e) Acetaldehyde

Kerala-CEE-2014

Ans. (b) : Chloroform reacts with the oxygen in the presence of light to give carbonyl chloride. Carbonyl chloride is a poisonous gas and also known as phosgene.

$$CHCl_3 + \frac{1}{2}O_2 \xrightarrow{hv} COCl_2 + HCl$$

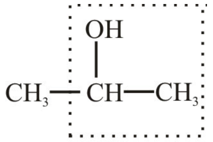
181. Which one of the following is not expected to undergo idoform reaction?

(a) Propan-2-ol
(b) 1-phenylethanol
(c) 2-butanol
(d) Ethanol
(e) Diphenyl methanol

Kerala-CEE-2014

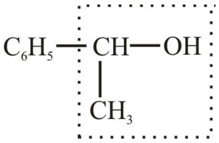
Ans. (e) : The compound having a methyl keto group to give iodoform reaction.

The structure of the following are –

(a) 

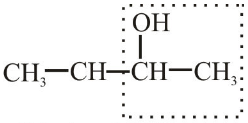
$CH_3-\underset{}{\overset{OH}{\overset{|}{C}H}}-CH_3$

Propen -2-ol

(b) 

$C_6H_5-\underset{CH_3}{\underset{|}{C}H}-OH$

1-phenyl ethanol

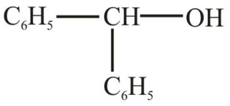
(c) 

$CH_3-CH_2-\overset{OH}{\overset{|}{C}H}-CH_3$

2-butanol

(d) CH_3-CH_2-OH

Ethanol

(e) 

$C_6H_5-\underset{C_6H_5}{\underset{|}{C}H}-OH$

diphenyl methanol (not present the methyl keto group)

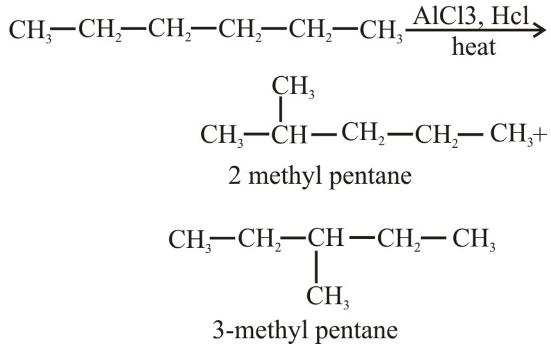
Hence, diphenyl methanol not give the iodoform reaction

182. When n=hexane is heated with anhydrous AlCl₃ and HCl gas, the major product obtained is

(a) 1-chlorohexane
(b) 2-chlorohexane
(c) 3-chlorohexane
(d) hex-3-ene
(e) mixture of 2-methylpentane and 3-methylpentane

Kerala-CEE-2014

Ans. (e) : When n-hexane is heated with anhydrous AlCl₃ and HCl gas, at 573 k and 30 – 35 atm to give a mixture of branched chain alkanex.



$$CH_3-CH_2-CH_2-CH_2-CH_2-CH_3 \xrightarrow[\text{heat}]{\text{AlCl3, Hcl}}$$

$$CH_3-\overset{CH_3}{\overset{|}{C}H}-CH_2-CH_2-CH_3 +$$

2 methyl pentane

$$CH_3-CH_2-\underset{CH_3}{\underset{|}{C}H}-CH_2-CH_3$$

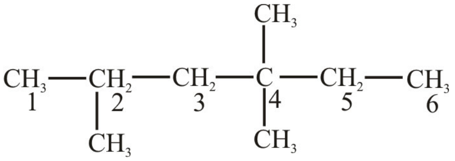
3-methyl pentane

183. The total number of monohalogenated products formed by halogenation of 2, 4, 4-trimethylhexane are,

(a) 5
(b) 7
(c) 6
(d) 8
(e) 9

Kerala-CEE-2016

Ans. (c) : The structure of 2, 4, 4 trimethyl hexane are -



$$\overset{1}{CH_3}-\underset{CH_3}{\underset{|}{\overset{2}{C}H_2}}-\overset{3}{CH_2}-\underset{CH_3}{\underset{|}{\overset{CH_3}{\overset{|}{C}}}}{}_4-\overset{5}{CH_2}-\overset{6}{CH_3}$$

In -2 monohalogenated product by replacing two CH_3 group at C_2 and C_4 Position and 4-monohalogenated product by replacing four CH_3 group by C_2, C_3, C_5, C_6 Position.

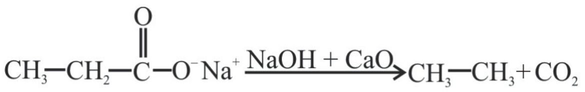
Thus, the total no. of monohalogenated product formed by halogenation of 2, 4, 4 trimethylhexane are 6.

184. Decarboxylation of sodium propionate leads to the formation of :

(a) Methane
(b) Ethene
(c) Propanone
(d) Ethane

Manipal-2017

Ans. (d) :

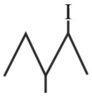


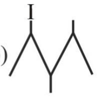
$$CH_3-CH_2-\overset{O}{\overset{||}{C}}-O^-Na^+ \xrightarrow{NaOH + CaO} CH_3-CH_3 + CO_2$$

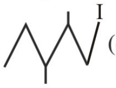
Ethane

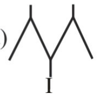
Hence, decarboxylation of sodium propionate leads to the formation of ethane.

185. The bond line formula of 1-iodo -2, 3-dimethyl pentane is

(a) 

(b) 

(c) 

(d) 

MHT CET-02.05.2019, SHIFT-III

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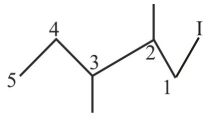
Ans. (c) : The bond line formula of 1-iodo -2, 3 – dimethyl pentane.



186. In the reaction,

$$2n\,R\text{-}X \xrightarrow[\text{Dry ether}]{+2n\,Na} \text{product}$$

The product obtained is

(a) 2n-alkene (b) n-sodium halide
(c) n-alcohol (d) n-alkane

MHT CET-02.05.2019, SHIFT-III

Ans. (d) : $2nR-X \xrightarrow[\text{dry ether}]{+2nNa} \underset{(n-\text{alkane})}{nR-R}$

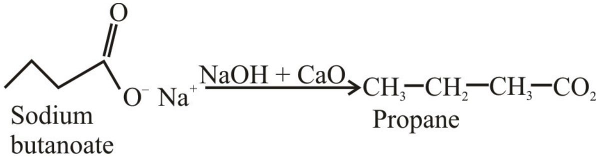
When alkyl halide react with sodium metal in the presence of dry ether to form a alkane this reaction is known as Wurtz reaction.

187. The alkane formed on heating sodium butanoate with sodaline is

(a) Methane (b) Ethane
(c) Propane (d) Butane

MHT CET-03.05.2019, SHIFT-I

Ans. (c) :



188. Which of the following compounds has lowest boiling point?

(a) n-butyl alcohol (b) Iso-butyl alcohol
(c) Tert-butyl alcohol (d) Sec-butyl alcohol

MHT CET-2017

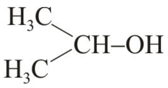
Ans. (c) : Boiling point of alkane increase as the hydrocarbon chain length or molecular weight increase or branching decrease tert-butyl alcohol has the most branched structure.
Hence, it has lowest boiling point.

189. Which of the following compound will give positive iodoform test?

(a) Isopropyl alcohol (b) Propionaldehyde
(c) Ethylphenyl ketone (d) Benzyl alcohol

MHT CET-2017

Ans. (a) : The structure of the isopropyl alcohol is –



Isopropyl alcohol will give a positive iodoform test because it has methyl keto group. Isopropyl alcohol easily oxidised to acetone.
Hence, the methyl ketone group gives a positive iodoform test.

190. The compound which is not formed when a mixture of n-butyl bromide and ethyl bromide treated with sodium metal in the presence of dry ether is

(a) Butane (b) Octane
(c) Hexane (d) Ethane

MHT CET-2016

Ans. (d) : The compound which is not formed when a mixture of n-butyl bromide and ethyl bromide treated with sodium metal in the presence of dry ether is ethane.

$$CH_3CH_2CH_2CH_2Br + CH_3CH_2Br + 2Na \xrightarrow[\text{ether}]{\text{Dry}}$$

$$\underset{\text{Octane}}{C_4H_9-C_4H_9} + \underset{\text{Hexane}}{C_4H_9-C_2H_5} + \underset{\text{Butane}}{C_2H_5-C_2H_5}$$

191. Which of the following compounds has highest boiling point?

(a) Propan-1-ol (b) n-butane
(c) Chloroethane (d) Propanal

MHT CET-2015

Ans. (a) : In propan -1-ol has the hydrogen bond have the potential to occur because strongly electronegative oxygen atom, intermolecular hydrogen bonding develop in propan-1-ol. It has the greatest boiling point.

192. Chlorination of ethane is carried out in the presence of

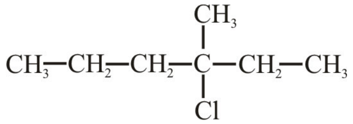
(a) Anhydrous $AlBr_3$ (b) Mercuric chloride
(c) Ultraviolet light (d) Zinc chloride

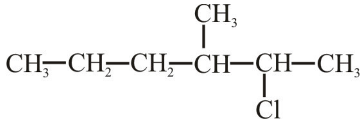
MHT CET-2015

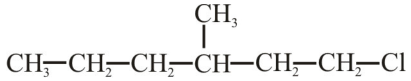
Ans. (c) : Chlorination of ethane is carried out in the presence of ultraviolet light resulting free radical reaction forming ethyl chloride.

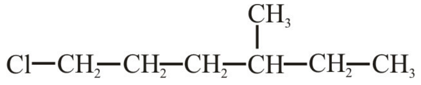
$C_2H_6 \xrightarrow[hv]{Cl_2} C_2H_5Cl$

193. 'X' is an optically active alkane having lowest molecular mass, Predict the structure of the major product obtained on monochlorination of 'X'.

(a)

$CH_3-CH_2-CH_2-\underset{Cl}{\overset{CH_3}{C}}-CH_2-CH_3$

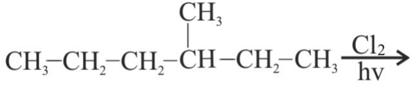
(b)

$CH_3-CH_2-CH_2-\overset{CH_3}{CH}-\underset{Cl}{CH}-CH_3$

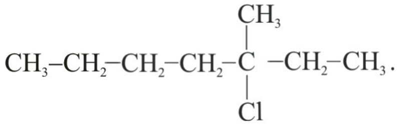
(c)

$CH_3-CH_2-CH_2-\overset{CH_3}{CH}-CH_2-CH_2-Cl$

(d)

$Cl-CH_2-CH_2-CH_2-\overset{CH_3}{CH}-CH_2-CH_3$

MHT CET-2014

Ans. (a) : The compound having carbon which has four different substituent attached to it is called asymmetric carbon or chiral carbon. This, it is optically active compound. 6-methyl-hexane is an optically actually active alkane having lowest molecular mass.


$CH_3-CH_2-CH_2-\overset{CH_3}{CH}-CH_2-CH_3 \xrightarrow[hv]{Cl_2}$


$CH_3-CH_2-CH_2-CH_2-\underset{Cl}{\overset{CH_3}{C}}-CH_2-CH_3.$

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194. Among the following select the alkane that is expected to have lowest boiling point

(a) Hexane (b) 2-methylpentane

(c) 3-methylpentane (d) 2,2-dimethylbutane

MHT CET-2014

Ans. (d) : The boiling point depend upon the number carbon atom increases and decrease when branching. Boiling point increase when molecular mass increase the 2, 2-dimethyl butane has the highest branching as compared to other structure. Hence, 2, 2-dimethyl butane has lowest boiling point.

195. The number of alkenyl groups possible from C_4H_7 are

(a) 7 (b) 5

(c) 3 (d) 8

MHT CET-2012

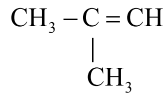
Ans. (b) : In C_4H_7 the possible number of alkenyl group are –

(i) $CH_3-CH_2-CH=CH-$

(ii) $CH_3-CH=CH-CH_2-$

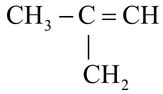
(iii) $CH_2=CH-CH_2-CH_2$

(iv)



$$\underset{\substack{|\\CH_3}}{CH_3-C=CH}$$

(v)



$$\underset{\substack{|\\CH_2}}{CH_3-C=CH}$$

So, the no. of alkenyl group in C_4H_7 is 5.

196. $C_6H_6+CH_3Cl\xrightarrow{\text{Anhy.AlCl}_3}C_6H_5CH_3+HCl$ the name of the above reaction is

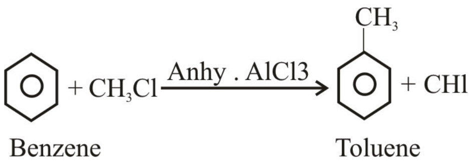
(a) Gattermann (b) Reimer-tiemann

(c) Friedel-Craft (d) Cannizzaro

MHT CET-2012, NEET-2009

Ans. (c) : The reaction of benzene react with alkyl halide in presence of anhy. $AlCl_3$ to give a toluene.

This reaction is known as Friedel-craft alkylation reaction.



197. Which of the following aromatic compound gives sulphonation reaction very easily?

(a) Chlorobenzene (b) Nitrobenzene

(c) Toluene (d) Benzene

MHT CET-2012

AIEEE-1982

Ans. (c) : Sulphonation reaction is an electrophilic substitution reaction. Toluene is more readily sulphonated among these because methyl group is electron donating (+I effect). Activate the benzene ring for electrophilic aromatic substitution. Methyl group activates the ring and it easier to undergo electrophilic substitution reaction.

198. The false statement regarding alkane is

(a) This does not perform polymerization reaction

(b) This does not gives elimination reaction

(c) It does not disappear the colour of dilute $KMnO_4$ solution

(d) It does not decolourise bromine water

MHT CET-2012

Ans. (b) : Alkane show the elimination reaction Higher alkane eliminate hydrogen and lower alkane on heating in the absence of air at 500 – 700°C.

$$CH_3-CH_2-CH_3\xrightarrow{600°C}\underset{\text{Propene}}{CH_3-CH=CH_2}+$$

$$\underset{\text{Ethene}}{CH_2=CH_2}+\underset{\text{Methane}}{CH_4}+H_2$$

199. By which of the following process hydrocarbons are found from petroleum?

(a) Combustion

(b) Fractional distillation

(c) Addition

(d) All of the above

MHT CET-2012

Ans. (b) : Fractional distillation is separate a mixture into a number of different parts called fractions. Crude oil is a mixture of hydrocarbons. The crude oil is evaporated and its vapours condense at different temperature in the fractionating column. Each fraction contains hydrocarbon molecule with a similar number of carbon atoms and a similar range of boiling points.

200. LPG mainly consist of the following

(a) Methane (b) Hydrogen

(c) Acetylene (d) Butane

MHT CET-2012

UPTU/UPSEE-2006

Ans. (d) : Liquefied petroleum gas (LPG) is a blend of light hydrocarbon compound. It is mainly consist of butane or propane or a mixture of both. At room temperature, both gases are colourless and odourless. LPG transforms into a liquid state. LPG in domestic cylinder used for cooking generally comparises more butane than propane, because the fuel value of per kilogram of butane is higher than propane.

201. Which of the following compounds do not give different isomers on monochlorination?

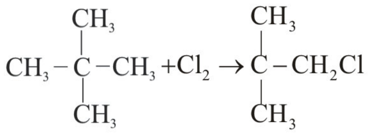
(a) Neo-pentane (b) n-butane

(c) Iso-butane (d) Iso-pentane

Odisha-NEET-2019

MHT CET-2011

Ans. (a) : The structure of neo pentane is –



$$CH_3-\overset{\substack{CH_3\\|}}{\underset{\substack{|\\CH_3}}{C}}-CH_3+Cl_2\rightarrow\overset{\substack{CH_3\\|}}{\underset{\substack{|\\CH_3}}{C}}-CH_2Cl$$

Neo pentane

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In neo pentane, the structure of neo pentane consist of two distinct carbon atom and all hydrogen atoms are equivalent, on monochlorination of neo-pentane give only one compound neo-pentyl chloride. Hence, it does not give a different isomers on monochlorination.

202. Ziegler-Natta catalyst catalyses preparation of which of the following compounds?

(a) Preparation of Ti-metal

(b) Preparation of low density plastic

(c) Preparation of high resistance plastic

(d) Preparation of high density plastic

MHT CET-2011

Ans. (d) : Ziegler-Natta catalyst preparation of high density polythene is prepared by heating ethylene at about 330 – 350 k under a pressure of 1 – 2 atm.

$$nCH_2=CH_2 \xrightarrow[330-350k,1,2\ atm]{Ziegler-Natta\ catalyst} \underset{Polythene}{\left(CH_2-CH_2\right)_n}$$

203. Chloroform on reduction with zinc dust and water gives

(a) Methyl chloride (b) Dichloro methane

(c) Chloro methane (d) Methane

MHT CET-2009

Ans. (d) : Chloroform $(CHCl_3)$ on reduction with zinc dust and water x give methane.

$$\underset{Chloroform}{CHCl_3} \xrightarrow[\substack{6[H] \\ -ZnCl_2 \\ -HCl}]{zn/H_2O} \underset{Methane.}{CH_4}$$

204. Iodoform test is not given by

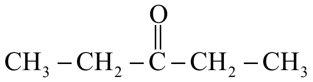
(a) 2-pentanone (b) ethanol

(c) ethanal (d) 3-pentanone

MHT CET-2008

Ans. (d) : The compound having a CH_3CO – or $\underset{OH}{\underset{|}{CH_3CH-}}$ group undergo iodoform reaction This test is performed by heating the substance with aqueous sodium hydroxide and iodine solution. On warming the mixture, a yellow precipitate of iodoform indicate positive iodofrom etc.

The structure of 3-pentanone are –



$$CH_3-CH_2-\overset{\overset{O}{||}}{C}-CH_2-CH_3$$

have not CH_3-CO- group and does not undergo the iodoform reaction.

$CH_3–CH_2–CO–CH_2–CH_3+3I_2+NaOH \rightarrow$ No reaction

205. The correct order of boiling point for primary (1°), secondary (2°) and tertiary (3°) alcohols is

(a) 1° > 2° > 3° (b) 3° > 2° > 1°

(c) 2° > 1° > 3° (d) 2° > 3° > 1°

MHT CET-2008

Ans. (a) : Alcohol which carries at least one function hydroxyl group (–OH) binding to a saturated carbon atom. The hydrogen bonds and the dipole-dipole interactions through out the series of alcohol will remain relatively the same. The boiling point of alcohol depend on the molecular weight are significant namely H – bonding and molecular surface area. The boiling order of alcohol is – 1° > 2° > 3°

206. 1-Chlorobutane on reaction with alcoholic potash gives

(a) but-1-ene (b) butan-1-ol

(c) but-2-ene (d) butan-2-ol

MHT CET-2007

Ans. (a) : 1-Chlorobutane on reaction with alcoholic potash give but -1-ene.

$$\underset{1-chlorobu\tan e}{CH_3-CH_2-CH_2-CH_2Cl} \xrightarrow[\Delta]{alc.KOH} \underset{butene-1}{CH_3-CH_2-CH=CH_2} +HCl$$

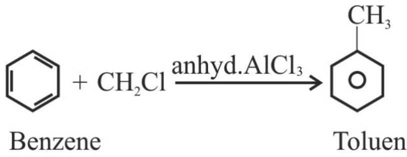
207. In Friedel-Crafts reaction, toluene can be prepared by

(a) C_6H_6+CH_3Cl (b) C_6H_5Cl + CH_4

(c) C_6H_6+CH_2Cl_2 (d) C_6H_6+CH_3COCl

NEET-2000,1999

Ans. (a) : In Friedel-Craft reaction, toluene can be prepared by methyl chloride on presence of anhydrous lewis is acid to give toulene.



208. Which one of the these is not compatible with arenes?

(a) Electrophilic additions

(b) Delocalisation of π-electrons

(c) Greater stability

(d) Resonance

NEET-1998

Ans. (a) : Arenes undergoes electrophilic substitution reaction. Arenes do not give electrophilic addition reaction in normal state due to resonance stabilization. Benzene is a resonance hydride of two structure and greater stability of benzene is due to delocalization of π-electron.

209. Using anhydrous $AlCl_3$ as catalyst, which one of the following reactions produces ethylbenzene (PhEt)?

(a) $H_3C-CH_2OH+C_6H_6$

(b) $CH_3-CH=CH_2+C_6H_6$

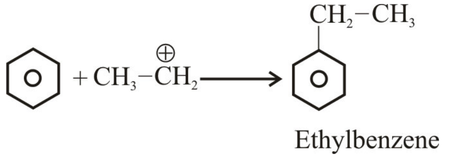
(c) $H_2C=CH_2+C_6H_6$

(d) $H_3C-CH_3+C_6H_6$

NEET-2004

Ans. (c): Using anhydrous $AlCl_3$ as catalyst, $CH_2=CH_2+C_6H_6$ react with to produces a ethylbenzene (PhEt).

$$CH_2=CH_2 \xrightarrow{AlCl_3/HCl} CH_3-\overset{+}{C}H_2+AlCl_4^-$$



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210. Among the following compounds the one that is most reactive towards electrophilic nitration is

(a) Benzoic acid (b) Nitrobenzene

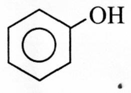
(c) Toluene (d) Benzene

NEET-2012, 1992

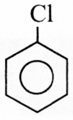
Ans. (c) : Toluene have most reactive towards electrophilic nitration because in toluene CH_3 group has +R effect on benzene is more reactive towards on benzene is more reactive towards electrophilic substitution reaction.

211. Which one of the following is most reactive towards electrophilic attack?

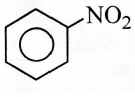
(a)



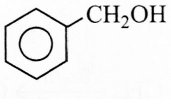
(b)



(c)



(d)



NEET-2008, 1998, 1999

Ans. (a) : The group having electron donating effect should have stablise the intermediate ion. i.e makes the ring more reactive towards electrophilic substitution on benzene and called activing group. Hence, phenol is more readily attacked by an electrophilc.

212. Which of the following compounds will not undergo Friedel-Crafts reaction easily?

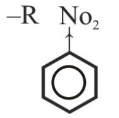
(a) Nitrobenzene (b) Toluene

(c) Cumene (d) Xylene

NEET-2013

WB-JEE-2012

Ans. (a) : In Friedel-Crafts reaction, involving an electrophilic aromatic substitution is used to attach a substituent to aromatic rings is Friedel-crafts reaction, which reaction are two type-alkylation and acylation. In this reaction aluminium chloride is used as a catalyst and involves the replacement of hydrogen atom with electrophile in an aromatic ring. Nitrobenzene does not undergo Friedel-Craft reaction because nitro group in nitro benzene is a strong withdrawing group and this group repels the electrophile from it.



Nitrobenezene

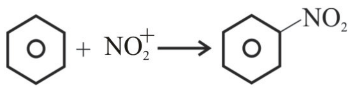
213. Consider the nitration of benzene using mixed conc, H_2SO_4 and HNO_3. If a large amount of $KHSO_4$ is added to the mixture, the rate of nitration will be

(a) Unchanged (b) Doubled

(c) Faster (d) Slower

NEET-I 2016

Ans. (d) : $HNO_3 + H_2SO_4 \rightleftharpoons NO_2^+ + HSO_4^- + H_2O$



In the nitration of benzene in the presence of conc, H_2SO_4 and HNO_3 benzene is formed. It large amount of $KHSO_4$ is added to this mixture more HSO_4^- in furnisnes and hence the concentration of electrophile decreases, rate of electrophilic aromatic reaction slow down.

214. The shortest C–C bond distance is found in

(a) Diamond (b) Ethane

(c) Benzene (d) Acetylene

NEET-1991

Ans. (d) : The distance between them shortens and bond length decreases. In acetylene has a triple bond between two adjacent carbon atoms and the bond length is even shorter. It is close to 120 pm.

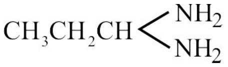
In diamond carbon atom is surrounded by four other carbon atoms and connected to them by strong single covalent bond Hence, the strongest type of chemical bond and bond length is 154 pm.

215. When $CH_3CH_2CHCl_2$ is treated with $NaNH_2$, the product formed is

(a) $CH_3-CH=CH_2$

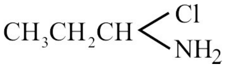
(b) $CH_3-C\equiv CH$

(c)



$CH_3CH_2CH\begin{cases}NH_2\\NH_2\end{cases}$

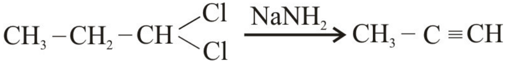
(d)



$CH_3CH_2CH\begin{cases}Cl\\NH_2\end{cases}$

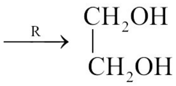
NEET-2002

Ans. (b) : When alkyl halide is treated with reducing agent like alc. KOH or sodamide to form alkyne as a product.



$CH_3-CH_2-CH\begin{cases}Cl\\Cl\end{cases} \xrightarrow{NaNH_2} CH_3-C\equiv CH$

216. In a reaction, $CH_2{=}CH_2 \xrightarrow[\text{acid}]{\text{Hypochlorous}} M$



$\xrightarrow{R} \begin{array}{c}CH_2OH\\|\\CH_2OH\end{array}$

Where, M = Molecule and R = Reagent, M and R are

(a) CH_3CH_2OH and HCl

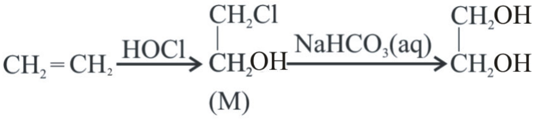
(b) $CH_2=CH_2$ and heat

(c) CH_3CH_2Cl and NaOH

(d) CH_2Cl-CH_2OH and aq. $NaHCO_3$

NEET-1997

Ans. (d) :



$CH_2=CH_2 \xrightarrow{HOCl} \underset{(M)}{\begin{array}{c}CH_2Cl\\|\\CH_2OH\end{array}} \xrightarrow{NaHCO_3(aq)} \begin{array}{c}CH_2OH\\|\\CH_2OH\end{array}$

So, M = CH_2Cl-CH_2OH and R = aq. $NaHCO_3$.

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217. Reactivity of hydrogen atoms attached to different carbon atoms in alkanes has the order

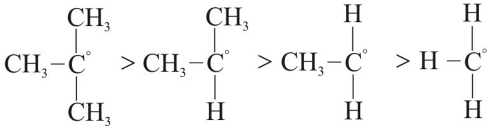
(a) teritary > primary > secondary
(b) primary > secondary > tertiary
(c) both (a) and (b)
(d) teritiary > secondary > primary

NEET-1993

Ans. (d) : The reactivity of H-atoms depend upon the stability of free radical follows the order-Tertiary > Secondary > Primary.

Therefore, reactivity of H – atom follows the same order i.e., tertiary > secondary > primary.

Tertiary alkanes are more reactive because they form tertiary free radical which is more stable.



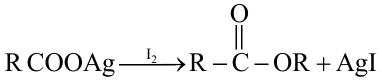
$$(CH_3)_3\overset{\circ}{C} > (CH_3)_2\overset{\circ}{C}H > CH_3\overset{\circ}{C}H_2 > H-\overset{\circ}{C}H_2$$

218. Which of the following reaction is expected to readily give a hydrocarbon product in good yields?

(a) $CH_3CH_3 \xrightarrow[hv]{Cl_2}$
(b) $(CH_3)_2CHCl \xrightarrow{C_2H_5OH}$
(c) $RCOOK \xrightarrow[Oxidation]{Electrolysis}$
(d) $RCOOAg \xrightarrow{I_2}$

NEET-1997

Ans. (c) : $CH_3-CH_3 \xrightarrow[hv]{Cl_2} CH_3-CH_2Cl + HCl$



$$RCOOAg \xrightarrow{I_2} R-\overset{\overset{O}{\|}}{C}-OR + AgI$$

Electrolysis of sodium or potassium salt of carboxylic acid gives good yield of hydrocarbon.

$$2RCOOK \xrightarrow[Oxidation]{Electrolysis} R-R+2CO_2$$

219. In the commercial gasolines, the type of hydrocarbons which are more desirable is

(a) Linear unsaturated hydrocarbon
(b) Toluene
(c) Branched hydrocarbon
(d) Straight-chain hydrocarbon

NEET-1997

Ans. (c) : The knocking property of engine related to with the nature of fuel. The branched hydrocarbons have more desirable. Branching increases the octane number of a fuel. Octane number of means better fuel. So, branched chain hydrocarbons have less knocking and more desirable.

220. Liquid hydrocarbons can be converted to a mixture of gaseous hydrocarbons by

(a) Oxidation
(b) Cracking
(c) Distillation under reduced pressure
(d) Hydrolysis

NEET-2010

Ans. (b) : Liquid hydrocarbons can be converted to a mixture of gaseous hydrocarbons by cracking. On cracking or pyralysis, the hydrocarbon with higher molecular mass gives a mixture of hydrocarbon having lower molecular mass. Lower hydrocarbon exists in a gaseous state while higher ones are in liquid state or solid state.

221. Hydrocarbon (A) reacts with bromine by substitution to form an alkyl bromide which by Wurtz reaction is converted to gaseous hydrocarbon containing less than four carbon atoms (A) is

(a) $CH \equiv CH$
(b) $CH_2 \equiv CH_2$
(c) CH_3-CH_3
(d) CH_4

NEET-2018

Ans. (d) : Hydrocarbon (A) reacts with bromine by substitution to form an alkyl bromide

$$\underset{\text{Methane}}{CH_4} + Br_2 \rightarrow \underset{\text{Alkyl bromide.}}{CH_3-Br} + HBr$$

Methyl bromide by wurtz reaction is converted into a gaseous hydrocarbon containing less than four carbon.

$$2CH_3Br + 2Na \rightarrow CH_3-CH_3 + 2NaBr$$

222. Freezing point is minimum for

(a) 0.1 M $Al_2(SO_4)_3$
(b) 0.1 M $BaCl_2$
(c) 0.1 M Urea
(d) 0.1 M NaCl

UP CPMT-2014

Ans. (a) : Depression in freezing point is a colligative property it depends upon the number of particles. Thus, as the number of particles increases, freezing point decreases.

Thus 0.1 M $Al_2(SO_4)_3$ shows minimum freezing point.

223. Which compound cannot be formed from Wurtz reaction ?

(a) Propane
(b) Butane
(c) Ethane
(d) Methane

AIIMS-2012
UP CPMT-2010

Ans. (d) : In Wurtz reaction, alkyl halides are combined and produce higher alkane and a metal hailide compound. Methane is simplest alkane, which is only one carbon atom, will not be formed by Wurtz reaction. Compounds containing two or more carbon atoms are prepared by Wurtz reaction. Thus, methane, CH_4, cannot be prepared by Wurtz reaction.

224. Iodoform gives a precipitate with $AgNO_3$ on heating but chloroform dose not because

(a) C — I bond in iodoform is weak and C — Cl bond in chloroform is strong
(b) Choroform is covalent
(c) iodoform is ionic
(d) None of the above

UP CPMT-2008

Ans. (a): On heating C — I bond in CHI_3 break, but C — Cl bond in $CHCl_3$ does not break. Thus, $AgNO_3$ gives precipitate AgI with iodoform.

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225. The compounds formed at anode in the electrolysis of an aqueous solution of potassium acetate, are

(a) C_2H_6 and CO_2 (b) C_2H_4 and CO_2
(c) CH_4 and H_2 (d) CH_4 and CO_2

UP CPMT-2008

Ans. (a): This is an example of Kolbe's electrolysis.

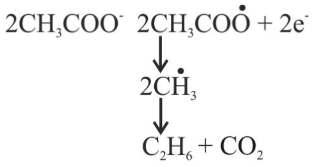
$$2CH_3COOK \xrightarrow{\text{electrolysis}} 2CH_3COO^- + 2K^+$$

At cathode:

$$2k^+ + 2e^- \rightarrow 2K$$

$$2K + 2H_2O \rightarrow 2KOH + H_2\uparrow$$

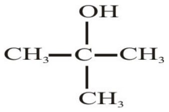
At anode:



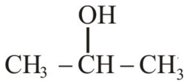
$$2CH_3COO^- \; 2CH_3CO\dot{O} + 2e^- \downarrow 2\dot{C}H_3 \downarrow C_2H_6 + CO_2$$

From above reaction it is clear that ethane formed anode.

226. Compound reacting with alkaline $KMnO_4$

(a) 

$CH_3-C(OH)(CH_3)-CH_3$

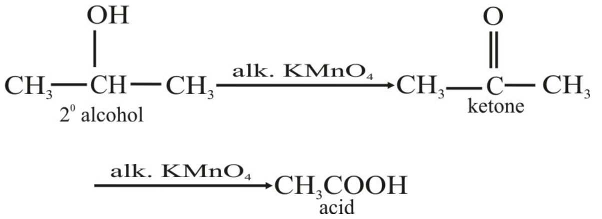
(b) 

$CH_3-CH(OH)-CH_3$

(c) $(CH_3)_3-C-CH_2OH$ (d) None of the above

UP CPMT-2005

Ans. (b) : Only 1° and 2° alcohol are oxidised by alkaline $KMnO_4$. 3° alcohols do not react with alkaline $KMnO_4$



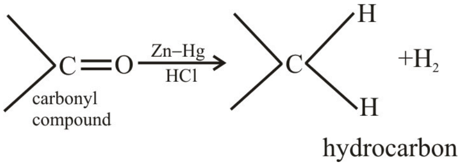
$$\underset{2^\circ\text{ alcohol}}{CH_3-CH(OH)-CH_3} \xrightarrow{\text{alk. }KMnO_4} \underset{\text{ketone}}{CH_3-\overset{O}{\overset{\|}{C}}-CH_3} \xrightarrow{\text{alk. }KMnO_4} \underset{\text{acid}}{CH_3COOH}$$

227. Which of the following converts carbonyl compounds into hydrocarbons?

(a) H_2/Pt (b) $LiAlH_4$
(c) $K_2Cr_2O_7/H_2SO_4$ (d) Zn–Hg/HCl

UP CPMT-2003

Ans. (d) :



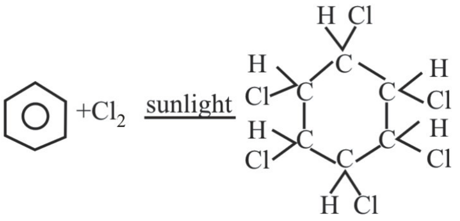
Carbonyl compounds are converted into hydrocarbon by reaction with Zn–Hg and HCl. This reaction is called Clemmensen's reduction.

228. The number of double bonds in gammexane is

(a) 0 (b) 1
(c) 2 (d) 3

UP CPMT-2002

Ans. (a) : Gammexane is commonly known as benzene hexachloride (BHC) It is used as insecticide.
Gammexane – $C_6H_6Cl_6$ (Lintaen)



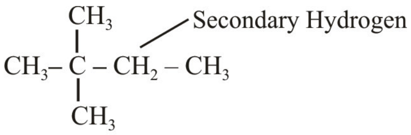
No. of sigma bond = 18
No .of double bond = 0

229. The number of secondary hydrogens in 2, 2-dimethyl butane is:

(a) 8 (b) 6
(c) 4 (d) 2

UPTU/UPSEE-2004

Ans. (d) : In 2, 2-dimethyl butane the secondary hydrogen is two.



$CH_3-C(CH_3)_2-CH_2-CH_3$

2, 2 dimetnyl-butane

230. Which of the following will not give iodoform test?

(a) Isopropyl alcohol (b) Ethanol
(c) Ethanal (d) Benzyl alcohol

UPTU/UPSEE-2004

Ans. (d) : Those compound which have $CH_3-\overset{O}{\overset{\|}{C}}-$ or $CH_3-\underset{OH}{\underset{|}{CH}}-$ group gives a iodoform test .

In Benzyl alcohol have no methyl keto group it does not give a iodoform test.

231. Which of the following is an anti-knocking compound?

(a) TEL (b) LTC
(c) Freon (d) Gasoline

UPTU/UPSEE-2014, 2009
NEET-1996

Ans. (a) : Tetra Ethyl lead is an organ metallic compound containing the toxic metal lead that for much of the 20th century was the chief anti-knocking compound for automotive gasoline or petrol. It is used for raising octane number of petrol. Tetraethyl lead in petrol was used as anti-knocking agent which creates lead pollution in order to avoid lead pollution. The substitute of TEL is used in unleaded petrol.

232. In the reaction.

$$CHCl_3 + 4OH^- \longrightarrow HCOO^- + 2H_2O$$

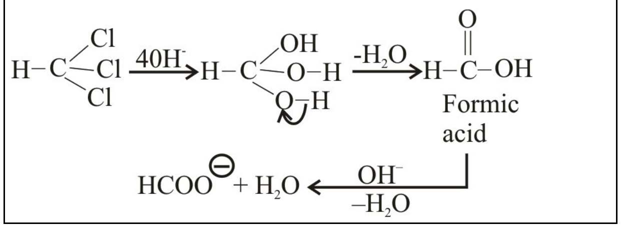
The intermediate species formed is/are

@apna_pdf

(a) CCl_2
(b) CCl_2^-
(c) Both (a) and (b)
(d) None of the above

UPTU/UPSEE-2014

Ans. (c) : $CHCl_3 + OH^- \rightarrow :CCl_3^{\ominus} \xrightarrow{-Cl^-} :CCl_2$



233. Octane number of petrol can be improved by admixing it with which of the following chemicals?
(a) Et_4Pb
(b) $CH_3OC(CH_3)_3$
(c) 1-methyl naphthalene
(d) Pyrene

UPTU/UPSEE-2011

Ans. (a,b) : Octane number of petrol can be increased by adding some small amount of certain chemicals known as anti-knock agent or compound. e.g – TEL or Et_4Pb. In the modern days some special types of antiknock agents are used to increase the octane number of petrol by increasing the number of carbons in the chain known as methyltert-butyl ether $CH_3OC(CH_3)_3$. Hence, the option A and B are correct.

234. The reaction of sodium ethoxide with iodoethane to form diethyl ether is termed as
(a) Electrophilic substitution
(b) Nucleophilic substitution
(c) Electrophilic addition
(d) Radical substitution

UPTU/UPSEE-2009

Ans. (b) : When sodium ethoxide with iodoethane to form a diethyl ether is termed as nucleophilic.

$$C_2H_5ONa + C_2H_5 - I \rightarrow C_2H_5OC_2H_5 + I^-$$

This reaction is known as William synthesis. It is an nucleophilic substitution reaction via SN_2 mechanism.

235. Which of the following compounds would have the highest boiling point?
(a) $CH_3CH_2CH_2CH_3$ (b) CH_3NH_2
(c) CH_3OH (d) CH_2F_2

UPTU/UPSEE-2009

Ans. (c) : CH_3OH (methanol) has highest boiling point because there is a intermolecular hydrogen bonding in methanol and high electronegative of O-atom, is strong. Therefore, CH_3OH has the highest boiling point.

236. Mustard gas is a
(a) Oil gas (b) Poisonous gas
(c) Fuel gas (d) Life gas

UPTU/UPSEE-2009

Ans. (b) : Sulfur mustard is more commonly as mustard gas. This name was first used when the chemical was sprayed durning the attacks of world war-I.
It yellow colour of mustard and may take on when mixed with other chemicals mustard gas are extremely poisonous gas and have powerful blistering effects on victims.

237. $CH_3CH_2CH_3 \xrightarrow{400-600^{o}C} X + Y$ Xand Y are
(a) Hydrogen (b) Methane
(c) Hydrogen (d) Ethylene

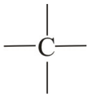
UPTU/UPSEE-2008

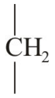
Ans. (b) :

$$CH_3 - CH_2 - CH_3 \xrightarrow{400-600°C} \underset{(X)}{CH_4} + \underset{(Y)}{CH_2 = CH_2}$$

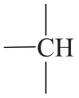
In this reaction X is methane and Y is ethylene. Hence, the option b and d are correct.

238. In cyclopropane, cyclobutane and cyclohexane, the common group is

(a) 
$-\overset{|}{\underset{|}{C}}-$

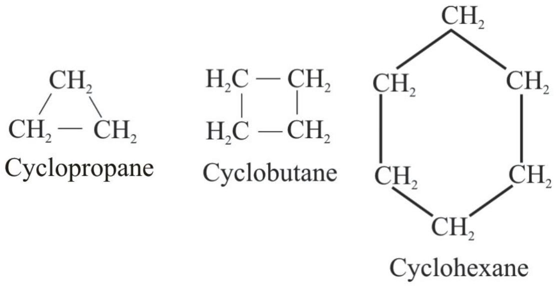
(b) 
$\overset{|}{\underset{|}{CH_2}}$

(c) $-CH_3$

(d) 
$-\overset{|}{\underset{|}{CH}}$

UPTU/UPSEE-2008

Ans. (b) : The structure of the cyclobutane, cyclobutane and cyclohexane are –



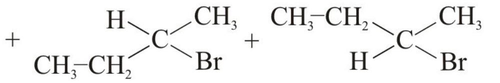
In this structure we can observe that common structure present in all hydrocarbon is $\overset{|}{\underset{|}{CH_2}}$.

239. How many monobriminated product (s) (including stereoisomers) would form in the free radical bromination of n-butane?
(a) 2 (b) 1
(c) 3 (d) 4

WB-JEE-30.04.2022

Ans. (c) :

$$CH_3-CH_2-CH_2-CH_3 + Br_2 \xrightarrow{hv} CH_3-CH_2-CH_2-CH_2-Br$$



In n-butane monobrominated of product will 3 (including stereoisomer's).

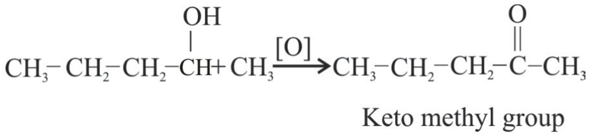
@apna_pdf

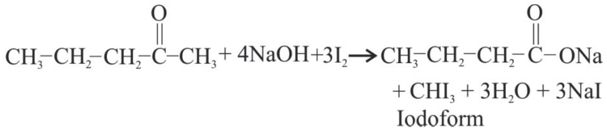
240. Upon treatment with I_2 and aqueous NaOH, which of the following compounds will form iodoform?

(a) $CH_3CH_2CH_2CH_2CHO$
(b) $CH_3CH_2COCH_2CH_3$
(c) $CH_3CH_2CH_2CH_2CH_2OH$
(d) $CH_3CH_2CH_2CH(OH)CH_3$

WB-JEE-2012

Ans. (d) :


$$CH_3-CH_2-CH_2-\overset{OH}{\overset{|}{CH}}-CH_3\xrightarrow{[O]}CH_3-CH_2-CH_2-\overset{O}{\overset{\|}{C}}-CH_3$$


$$CH_3-CH_2-CH_2-\overset{O}{\overset{\|}{C}}-CH_3+4NaOH+3I_2\rightarrow CH_3-CH_2-CH_2-\overset{O}{\overset{\|}{C}}-ONa+\underset{\text{Iodoform}}{CHI_3}+3H_2O+3NaI$$

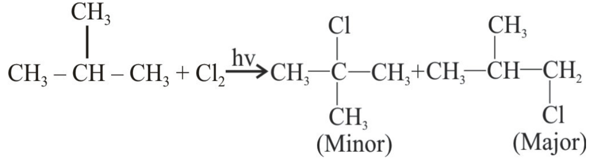
Those compound which have $\left(CH_3-\overset{O}{\overset{\|}{C}}-\right)$ group to give a iodoform reaction.

241. 2-methylpropane on monochlorination under photochemical condition give

(a) 2-chloro-2-methylopropane as major product
(b) (1:1) mixture of 1-chloeo-2-methylopropane and 2-chloro-2-methylpropane
(c) 1-chloro-2-methylpropane as a major product
(d) (1:9) mixture of 1-chloro-2-methylpropane and 2-cholro-2-methylpropane

WB-JEE-2013

Ans. (c) : 2-methyl propane on monochlorination under photochemical condition to give a 1-chloro -2-methyl propane.


$$CH_3-\overset{CH_3}{\overset{|}{CH}}-CH_3+Cl_2\xrightarrow{hv}\underset{\text{(Minor)}}{CH_3-\underset{\underset{CH_3}{|}}{\overset{\overset{Cl}{|}}{C}}-CH_3}+\underset{\text{(Major)}}{CH_3-\overset{\overset{CH_3}{|}}{CH}-\underset{\underset{Cl}{|}}{CH_2}}$$

242. The 4th higher homologue of ethane is

(a) Butane
(b) Pentane
(c) Hexane
(d) Heptane

WB-JEE-2014

Ans. (c) : We know that the molecular formula of ethane is C_2H_6.

The 4th higher homologue is –

$4\times CH_2=C_4H_8$

$\therefore$ The fourth 4th homologue of ethane is

$C_2H_6+C_4H_8=C_6H_{14}$ (Hexane).

Thus, hexane is the fourth higher homologue of ethane.

243. The major products obtained during ozonolysis of 2, 3-dimethyl-1- butane and subsequent reductions with Zn and H_2O are

(a) methanoic acid and 2- methyl -2-butanone
(b) methanal and 3- methyl -2-butanone
(c) methanol and 2,2- dimethyl -3-butanone
(d) methanoic acid and 2- methyl -3-butanone

WB-JEE-2016

Ans. (b) : 2, 3-dimethyl-1-butane react with O_3 and reduction with Zn and H_2O to give a methanol and 3-methyl-2-butanone.

244. Amongst the following compounds, the one which would not respond to iodofrom test is

(a) $CH_3CH(OH)CH_2CH_3$
(b) $ICH_2COCH_2CH_3$
(c) CH_3COOH
(d) CH_3CHO

WB-JEE-2016

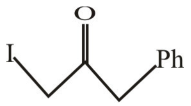
Ans. (c) : Those compound which have keto methyl group $\left(CH_3-\overset{O}{\overset{\|}{C}}-\right)$ to give a iodoform test.

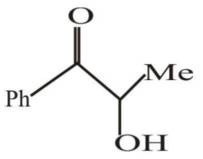
In acetic acid (CH_3COOH) would not respond to iodoform test.

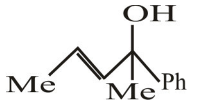
In first step base deprotonates most acidic alpha H atom. In acetic acid, the most acidic proton is attached to O atom

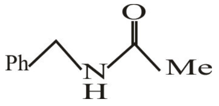
So, deprotonation of $\propto$-hydrogen does not occur so CH_3COOH not respond the iodoform test.

245. Haloform reaction with I_2 and KOH will be responded by

(a)


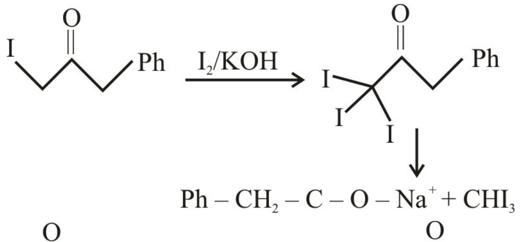
(b)


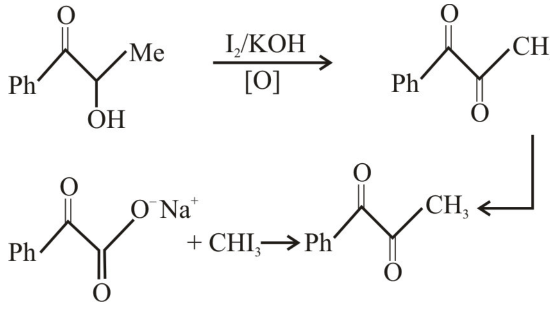
(c)


(d)


WB-JEE-2019

Ans. (a,b) :

(a)


(b)


Halo form reaction is oxidising in nature. It requires a methyl group near a carbonyl group near a carbonyl carbon to give a positive test.

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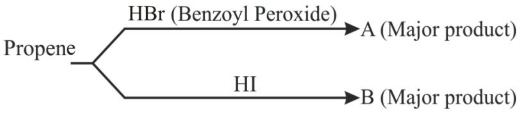
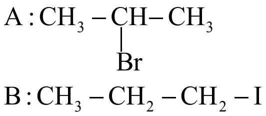
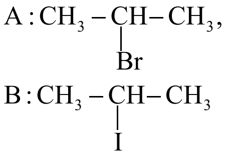
2. Alkenes

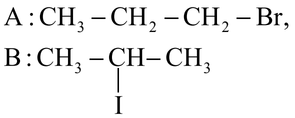
246. Identify A and B in the reaction



(a)

$A: CH_3-\underset{Br}{\underset{|}{C}}H-CH_3$
$B: CH_3-CH_2-CH_2-I$

(b)

$A: CH_3-\underset{Br}{\underset{|}{C}}H-CH_3,$
$B: CH_3-\underset{I}{\underset{|}{C}}H-CH_3$

(c) $A: CH_3-CH_2-CH_2-Br,$
$B: CH_3-CH_2-CH_2-I$

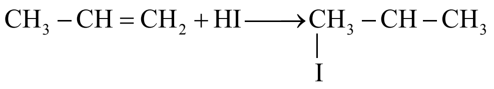
(d)

$A: CH_3-CH_2-CH_2-Br,$
$B: CH_3-\underset{I}{\underset{|}{C}}H-CH_3$

Karnataka CET-17.06.2022, Shift-II

Ans. (d) :

$$\underset{\text{Propene}}{CH_3-CH=CH_2}\xrightarrow[\text{(Peroxide)}]{\text{HBr}}\underset{\text{1–bromo propane}}{CH_3-CH_2-CH_2-Br}$$

(A)



$$CH_3-CH=CH_2+HI\longrightarrow CH_3-\underset{I}{\underset{|}{C}}H-CH_3$$

2 – Iodo Propane

(B)

247. Given below are two statements.

Statement I : The presence of weaker π - bonds make alkenes less stable than alkanes.

Statement II : The strength of the double bond is greater than that of carbon-carbon single bond.

In the light of the above statements, choose the correct answer from the options given below.

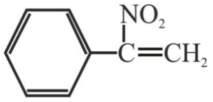
(a) Both statement I and Statement II are correct.
(b) Both Statement I and Statement II are incorrect.
(c) Statement I is correct but statement II is incorrect.
(d) Statement I is incorrect but statement II is correct.

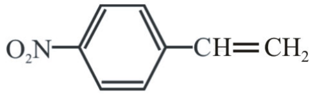
JEE Main-24.06.2022, Shift-II

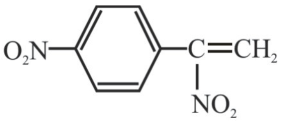
Ans. (a) : As π bond is weaker than σ bonds the presence of weaker π- bonds makes alkenes less stable than alkanes and the strength of the double bond is greater than C – C.

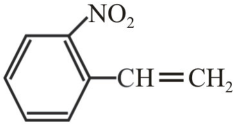
248. In the given reaction sequence, the major product 'C' is:

$$C_8H_{10}\xrightarrow[H_2SO_4]{HNO_3}A\xrightarrow[\Delta]{Br_2}B\xrightarrow[KOH]{\text{alcoholic}}C$$

(a)


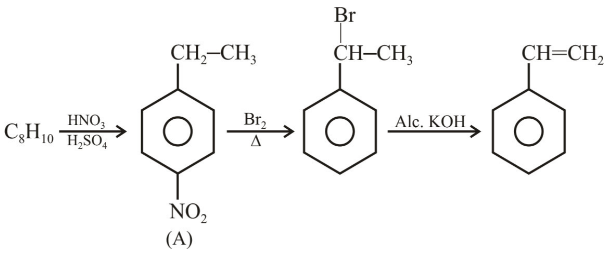
(b)


(c)


(d)


JEE Main-24.06.2022, Shift-I

Ans. (b) :



249. Calculate the number of σ and π bonds in 2-n-propylpent-1-ene.

(a) 22 σ bonds, 2π bonds
(b) 23 σ bonds, 1π bond
(c) 21 σ bonds, 1π bond
(d) 23 σ bonds, 2π bond
(e) 20 σ bonds, 1π bond

Kerala CEE -03.07.2022

Ans. (b) : There are 23 sigma covalent bonds and 1pi bond is present in the 2 – propylpent -1-ene.

250. The major product 'A' of the following given reaction has ________ sp^2 hybridized carbon atoms.

2,7- Dimethyl-2,6-octadiene $\xrightarrow{H^+}$ A Major Product.

JEE Main-24.06.2022, Shift-I

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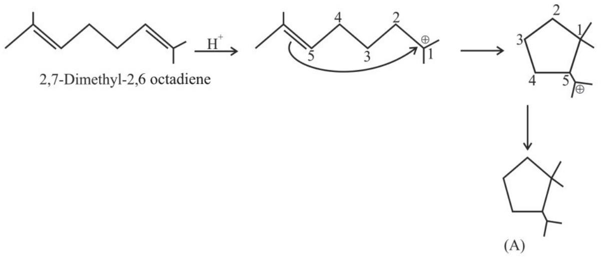
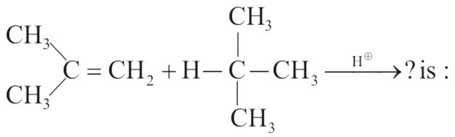
Ans. (2) :

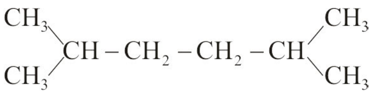


251. The product formed in the following reaction



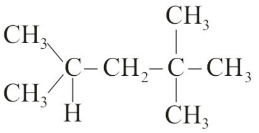
$(CH_3)_2C=CH_2 + H-C(CH_3)_3 \xrightarrow{H^{\oplus}}$? is :

(a)



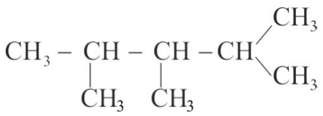
$(CH_3)_2CH-CH_2-CH_2-CH(CH_3)_2$

(b)



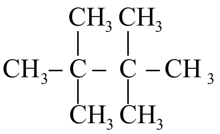
$(CH_3)_2CH-CH_2-C(CH_3)_3$

(c)



$CH_3-CH(CH_3)-CH(CH_3)-CH(CH_3)_2$

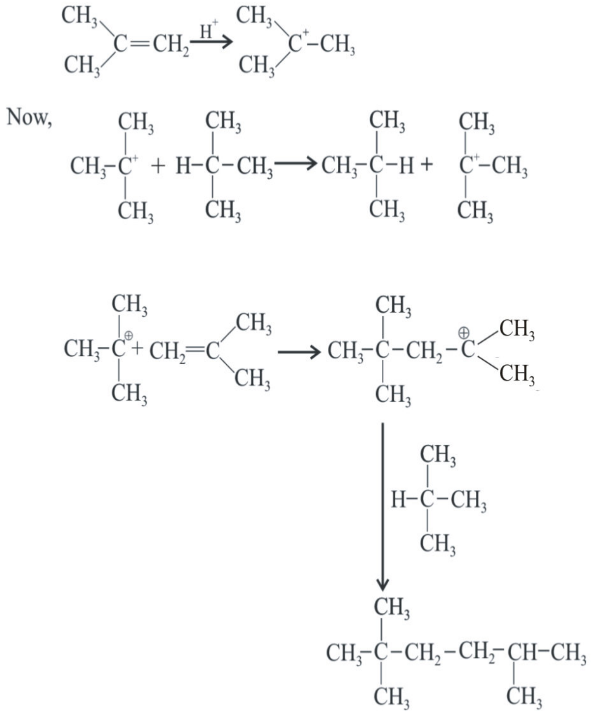
(d)



$CH_3-C(CH_3)_2-C(CH_3)_2-CH_3$

JEE Main-25.06.2022, Shift-I

Ans. (b) :



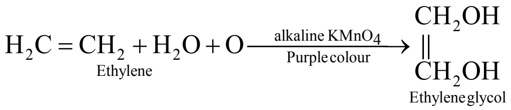
252. The test used for carbon-carbon double bond in an alkene is:

(a) Baeyer's (b) Carbyl amine

(c) Lassaignes (d) Silver mirror

AP-EAMCET (Med.)-1999

Ans. (a) : The unsaturation test performed by Baeyer's reagent. The alkaline $KMnO_4$ and Br_2 water known as Baeyer's reagent. When unsaturated compound reacts with Baeyer's reagent then the colour of Baeyer's reagent and Br_2 water is discharged.



$$\underset{\text{Ethylene}}{H_2C=CH_2} + H_2O + O \xrightarrow[\text{Purple colour}]{\text{alkaline } KMnO_4} \underset{\text{Ethylene glycol}}{CH_2OH-CH_2OH}$$

253. Consider the following statements:

Statement-I : 1- Butene reacts with HBr to give 1-bromobutane.

Statement-II : Reactive intermediate of the reaction is carbocation.

Which one of the following is correct in respect of the above statements?

(a) Both statement-I and statement-II are correct and statement-II is the correct explanation of statement-I

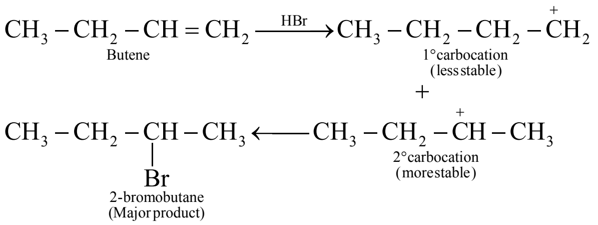
(b) Both statement-I and statement-II are correct but statement-II is not correct explanation of statement-I

(c) Statement-I is correct but statement-II is incorrect.

(d) Statement-I is incorrect but statement-II is correct.

SCRA 2012

Ans. (d) :



$$\underset{\text{Butene}}{CH_3-CH_2-CH=CH_2} \xrightarrow{HBr} \underset{\substack{1^\circ\text{carbocation}\\(\text{less stable})}}{CH_3-CH_2-CH_2-\overset{+}{C}H_2} + \underset{\substack{2^\circ\text{carbocation}\\(\text{more stable})}}{CH_3-CH_2-\overset{+}{C}H-CH_3} \longrightarrow \underset{\substack{\text{2-bromobutane}\\(\text{Major product})}}{CH_3-CH_2-CH(Br)-CH_3}$$

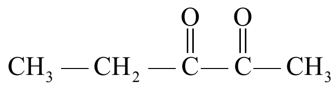
254. Compound *A* on ozonolysis yielded a mixture of propanoic acid and acetic acid The structure of compound *A* is

(a) $CH_3CH_2C\equiv C-H$

(b) $CH_3CH_2C\equiv C-CH_3$

(c) $CH_3CH_2CH=CH-CH_3$

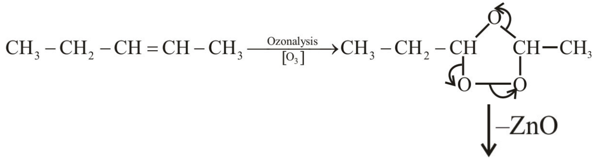
(d)



$CH_3-CH_2-\overset{O}{\overset{\|}{C}}-\overset{O}{\overset{\|}{C}}-CH_3$

SCRA-2015

Ans. (c):



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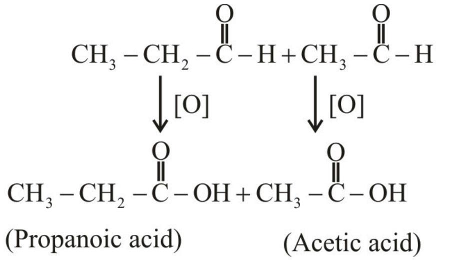


$$CH_3-CH_2-\overset{\overset{\displaystyle O}{\|}}{C}-H + CH_3-\overset{\overset{\displaystyle O}{\|}}{C}-H \xrightarrow{[O]} \underset{\text{(Propanoic acid)}}{CH_3-CH_2-\overset{\overset{\displaystyle O}{\|}}{C}-OH} + \underset{\text{(Acetic acid)}}{CH_3-\overset{\overset{\displaystyle O}{\|}}{C}-OH}$$

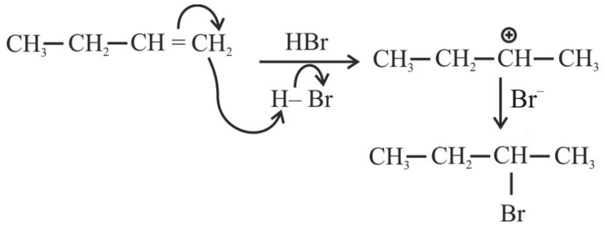
255. In the addition reaction of HBr to 1-butene, the first step involves the addition of

(a) H^+ (b) H^-

(c) $H^{\bullet}$ (d) $Br^{\bullet}$

SCRA-2015

Ans. (a):



In the addition reaction of HBr to 1-butene the first step involves the addition of H^+

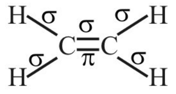
256. The number of σ bonds in the ethylene molecule is

(a) 4 (b) 5

(c) 6 (d) 7

A.P.EAMCET-1991

Ans. (b) :



Ethylene

Hence, the total no. of σ bonds = 5 and 1π bond are present in the ethylene molecule.

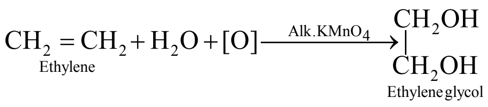
257. Baeyr's reagent reacts with which of the following compounds to give glycol?

(a) Methane (b) Ethane

(c) Ethylene (d) Acetylene

A.P.EAMCET-1991

Ans. (c) : Baeyr's reagent reacts with ethylene to give glycol.



$$\underset{\text{Ethylene}}{CH_2=CH_2}+H_2O+[O]\xrightarrow{\text{Alk.}KMnO_4}\underset{\text{Ethylene glycol}}{\begin{array}{l}CH_2OH\\ \vert\\ CH_2OH\end{array}}$$

258. Among the following the hydrocarbon which decolorises bromine water but does not give precipitate bromine water but does not give precipitate with ammonical $AgNO_3$ is

(a) CH_4 (b) C_2H_4

(c) C_2H_2 (d) C_6H_6

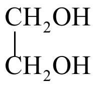
A.P.EAMCET-1994

Ans. (b) : Bromine water is decolourized by unsaturated compounds. Ammonical silver nitrate solution is also known as Toller's reagent. But ethene does not give any precipitate with ammonical silver nitrate.

259. The compound formed when 2-butene is treated with acidified $KMnO_4$, is

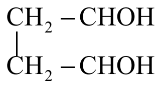
(a) acetaldehyde (b) acetic acid

(c)



$$\begin{array}{l}CH_2OH\\ \vert\\ CH_2OH\end{array}$$

(d)



$$\begin{array}{l}CH_2-CHOH\\ \vert\\ CH_2-CHOH\end{array}$$

A.P.EAMCET-1995

Ans. (b) : When 2-butene is treated with acidified $KMnO_4$ to give acetic acid.

$$\underset{\text{2-butene}}{CH_3-CH=CH-CH_3}\xrightarrow[KMnO_4]{\text{Acidified}}\underset{\text{Acetic acid}}{2CH_3COOH}$$

260. Among the following compounds which have more than one type of hybridisation for carbon atoms.

1. $CH_3CH_2CH_2CH_3$

2. $CH_3CH=CH\ CH_3$

3. $CH_2=CH-CH=CH_2$

4. $H-C\equiv C-H$

(a) 2 and 3 (b) 2

(c) 3 and 4 (d) 3

A.P.EAMCET-1998

Ans. (a) : (1) $CH_3-CH_2-CH_2-CH_3$

This compound having only one type of hybridization is sp^3

(2) $CH_3-CH=CH-CH_3$

This compound having two type of hybridization sp^3 and sp^2.

(3) $CH_2=CH-C\equiv CH$

This compound having three type of hybridization sp^3, sp^2 and sp.

(4) $H-C\equiv C-H$

This type of compound having only one type of hybridization sp.

261. The structural formula of 2-methyl-2-butene is

(a) $CH_3–CH(CH_3)–CH=CH_2$

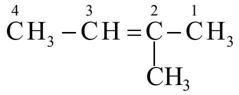
(b) $CH_3–CH_2–C(CH_3)=CH_2$

(c) $CH_3–CH=CH–CH_3$

(d) $CH_3–CH=C(CH_3)-CH_3$

A.P.EAMCET-2001

Ans. (d) :



$$\overset{4}{C}H_3-\overset{3}{C}H=\underset{\underset{\displaystyle CH_3}{\vert}}{\overset{2}{C}}-\overset{1}{C}H_3$$

2-methyl-2-butene

262. Identify 'B' in the following reaction

$$CH_2=CH_2+HCl\xrightarrow{\text{Anhy }AlCl_3}A+2[H]$$

$$\xrightarrow[C_2H_5OH]{Zn-Ca}B+HCI$$

(a) CH_4 (b) C_2H_6

(c) C_2H_5CI (d) C_2H_3OH

AP EAMCET (Engg.) -2007

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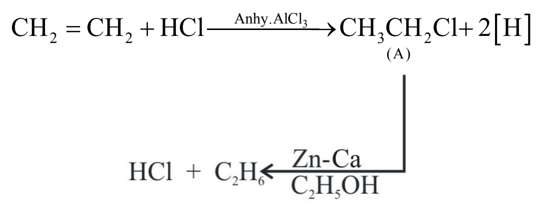
Ans. (b) :



$$\begin{tikzcd} CH_2=CH_2+HCl \arrow[r, "Anhy.AlCl_3"] & \underset{(A)}{CH_3CH_2Cl}+2[H] \arrow[d] \\ HCl + C_2H_6 & \arrow[l, "Zn\text{-}Ca"', "C_2H_5OH"] \end{tikzcd}$$

263. C_2H_5Br, on boiling with alcoholic solution of NaOH, forms

(a) Ethyl alcohol (b) Methyl alcohol

(c) Ethyne (d) Ethene

A.P. EAMCET-1992

Ans. (d) : $\underset{\text{Ethyl bromide}}{CH_3CH_2Br} \xrightarrow{alc\cdot NaOH} \underset{\text{ethene}}{CH_2=CH_2} + HBr$

264. Chloroethane is treated with alc KOH. The product formed, is

(a) C_2H_6O (b) C_2H_6

(c) C_2H_4 (d) C_2H_4O

A.P. EAMCET-1999

Ans. (c) :

$\underset{\text{Chloroethane}}{C_2H_5Cl} + KOH \xrightarrow{\text{Dehydrohalogenation}} \underset{\text{Ethene}}{C_2H_4} + H_2O + KCl$

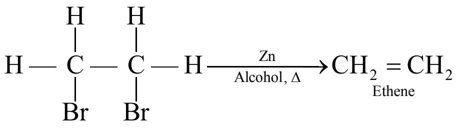
265. The reaction conditions used for converting 1, 2-dibromoethane to ethylene are

(a) Zn, alcohol, Δ (b) KOH, alcohol, Δ

(c) KOH, water, Δ (d) Na, alcohol, Δ

A.P. EAMCET-2002

Ans. (a) :



$$H-\overset{H}{\underset{Br}{C}}-\overset{H}{\underset{Br}{C}}-H \xrightarrow[\text{Alcohol, }\Delta]{Zn} \underset{\text{Ethene}}{CH_2=CH_2}$$

1, 2 – dibromoethane

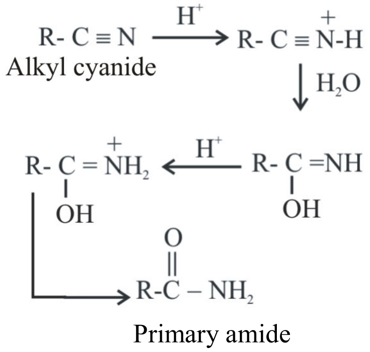
266. What is the initial product of the acidic hydrolysis of cyanide

(a) A primary amide (b) An isocyanide

(c) An isocyanate (d) A nitrile

MPPET- 2009

Ans. (a) :



$$\underset{\text{Alkyl cyanide}}{R\text{-}C\equiv N} \xrightarrow{H^+} R\text{-}C\equiv \overset{+}{N}\text{-}H \xrightarrow{H_2O} R\text{-}\underset{OH}{C}=NH \xrightarrow{H^+} R\text{-}\underset{OH}{C}=\overset{+}{N}H_2 \longrightarrow \underset{\text{Primary amide}}{R\text{-}\overset{O}{\overset{\|}{C}}-NH_2}$$

267. In the following reaction :

$2CH_2 = CH_2 + S_2Cl_2 \rightarrow$ Product. The product is.

(a) Mustard gas (b) Lewisite

(c) Polythene (d) Teflon

MPPET- 2009

Ans. (a) : $2CH_2 = CH_2 + S_2Cl_2 \rightarrow (ClCH_2CH_2)_2\,S + S$

Mustard gas is intesized by treating sulfur dichloride with ethylene.

- It is called mustard gas because impure forms of the gas have an odor that resembles of mustard.

268. Towards electrophilic reagents

(a) Ethene is more reactive than ethyne

(b) Ethene is less reactive than ethyne

(c) Both have equal reactivity

(d) The reactivity of both cannot be predicted

MPPET- 2009

Ans. (a) : Towards electrophilic addition reaction, ethene is more reactive than ethyne because ethene has less percent S character than ethyne due to which ethene donate our pi-cloud more than that to ethyne.

269. Which of the following reactions can be used for the synthesis of an alkene

(a) Chugaev reaction

(b) Dakin reaction

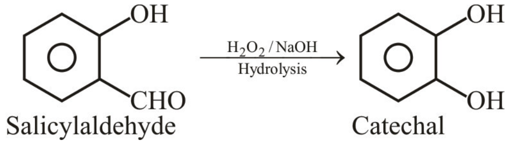
(c) Reimer-Tiemann reaction

(d) Wurtz fitting reaction

MPPET- 2009

Ans. (a) : The Chugaev elimination is a chemical reaction that involves the elimination of water from alcohols to produce alkene.

- The replacement of the aldehyde or acetyl group in phenolic aldehydes or ketone by a hydroxyl group on reaction with alkaline hydrogen peroxide is known as Dakin reaction.



- The Reimer-Tiemann reaction is a chemical reaction used for the ortho-formylation of phenols with the simplest example being the conversion of phenol to salicylaldehyde.
- Wurtz-Fitting reaction is a chemical reaction of aryl halides with alkyl halides and sodium metal in the presence of dry ether to give substituted aromatic compound.

270. The product Z of the following reaction is

$$H_3CC\equiv CH \xrightarrow{2HBr} Z$$

(a) $H_3CCH_2CHBr_2$ (b) $H_3CCBr_2CH_3$

(c) $H_3CCHBrCH_2Br$ (d) $BrCH_2CH_2CH_2Br$

TS-EAMCET-2016

Ans. (b) : $H_3C-C\equiv CH \xrightarrow{2HBr} H_3C-CBr_2-CH_3$

This reaction is followed as Markovnikovs addition.

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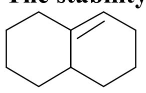
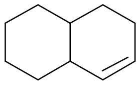
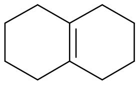
271. The stability order of the given alkenes is


(I)

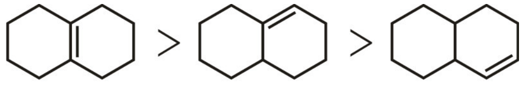

(II)


(III)

(a) (I) > (II) > (III) (b) (I) > (III) > (II)
(c) (III) > (II) > (I) (d) (III) > (I) > (II)

TS-EAMCET (Engg.), 05.08.2021 Shift-II

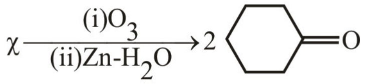
Ans. (d) : The stability order of alkenes will be –

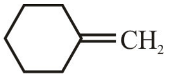


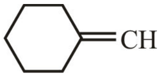
(III) (I) (II)

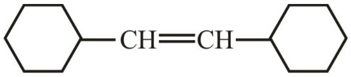
The stability of alkene depends upon the number of carbon atom substituted with the double bond. More substitution, more will be stability of alkenes. Hence, the correct option is (d).

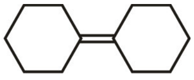
272. Identify 'X' in the following reaction.



(a) 

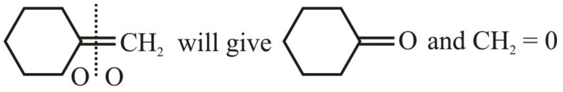
(b) 

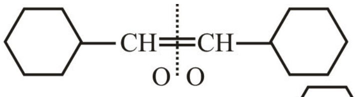
(c) 

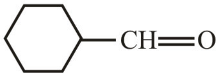
(d) 

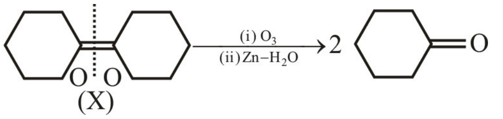
AP EAMCET (Engg.) 17.09.2020, Shift-II

Ans. (d) :

(a) 

(c) 

will give 

(d) 

(X)

273. The gaseous substance which decolourises bromine but does not give a precipitate with ammoniacal silver nitrate is :

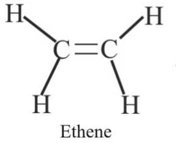
(a) C_2H_6 (b) C_2H_4
(c) C_2H_2 (d) CH_4

AP EAMCET (Medical) -1998

Ans. (b): Ethylene and acetylene decolourise Br_2 water. Acetylene gives precipitate with ammonical $AgNO_3$ but with ammonical $AgNO_3$, ethylene do not give any reaction.

$$C_2H_2 \xrightarrow{Ag(NH_3)_2NO_3} CH \equiv C.Ag \xrightarrow{Ag(NH_3)_2NO_3} Ag \cdot C \equiv C \cdot Ag$$

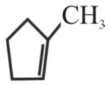
(White ppt)
Disilver acetylide

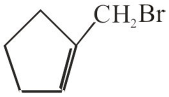


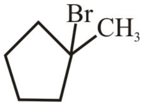
Ethene

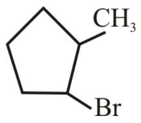
$\xrightarrow{Ag(NH_3)_2NO_3}$ No reaction

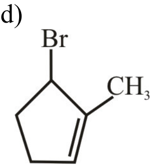
274. What is the major product obtained from the addition of HBr to the following compound?



(a) 

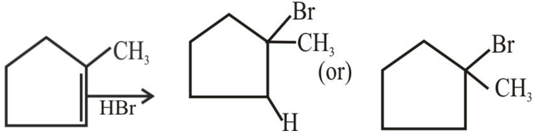
(b) 

(c) 

(d) 

TS EAMCET 10.08.2021, Shift-I

Ans. (b) :

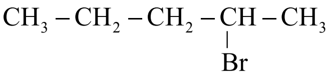


275. Indentify the statement which is not correct?

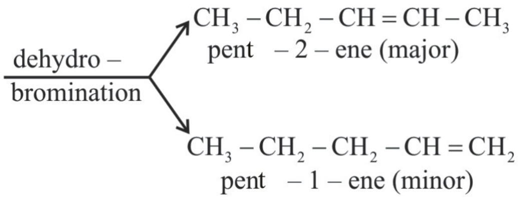
(a) Dehydrobromination of 2-bromopentane gives pent-1-ene as the major product
(b) Freon 12 is manufactured by Swarts reaction
(c) $CHCl_3$ is stored in closed, dark coloured bottles
(d) Chronic exposure to $CHCl_3$ cases liver damage

AP EAMCET-2017

Ans. (a):



$$CH_3-CH_2-CH_2-\underset{\underset{Br}{|}}{CH}-CH_3$$



$CH_3-CH_2-CH=CH-CH_3$
pent – 2 – ene (major)

$CH_3-CH_2-CH_2-CH=CH_2$
pent – 1 – ene (minor)

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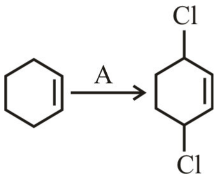
276.

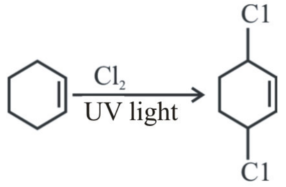


Identify the reagent(s) 'A' and condition(s) for the reaction

(a) A = Cl_2 ; dark, Anhydrous $AlCl_3$
(b) A = HCl, $ZnCl_2$
(c) A = Cl_2 ; UV light
(d) A = HCl ; Anhydrous $AlCl_3$

JEE Main 16.03.2021, Shift-II

Ans. (c) : This reaction is free radical halogenations in which substitution of Cl_2 take place at allylic position



277. Consider the following statements :

1. Alkenes are more reactive than alkynes for electrophilic addition.

2. Benzaldehyde is more reactive than acetaldehyde for nucleophilic addition.

Which of the statements given above is/are correct ?

(a) 1 only
(b) 2 only
(c) Both 1 and 2
(d) Neither 1 nor 2

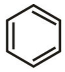
SCRA - 2009

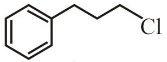
Ans. (a) : (i) In electrophilic addition reaction, alkenes are more reactive than alkynes due to in this case, π electrons are more tightly in –C≡C bond than –C=C– bonds. It is also more sterically difficult to form a bromonium ion from an alkyne than from an alkene.

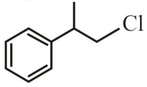
(ii) Benzaldehyde is less reactive than acetaldehyde for nucleophilic addition. C-atom of carbonyl group in benzaldehyde is less electrophilic due to resonance while in case of acetaldehyde, it as more electrophilic center for nucleophilic addition.

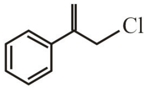
So, only (i) option correct.

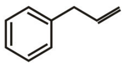
278. What is the major product [Y] of the reaction

 $+ CH_2=CH-CH_2Cl \xrightarrow{AlCl_3} [Y]$?

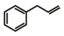
(a) 

(b) 

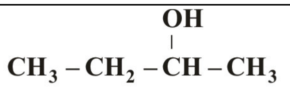
(c) 

(d) 

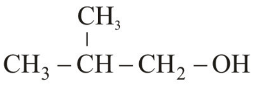
SCRA - 2009

Ans. (d) : When benzene reacts with Allyl chloride in the presence of anhydrous $AlCl_3$,  formed.

279. Optically active

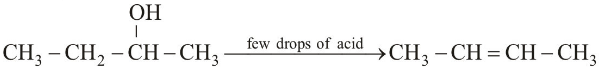

$CH_3-CH_2-\overset{\overset{\displaystyle OH}{|}}{CH}-CH_3$

was found to have lost its optical activity after standing in water containing a few drops of acids, mainly due to the formation of

(a) $CH_3-CH_2-CH=CH_2$
(b) $CH_3-CH=CH-CH_3$
(c) 
$CH_3-\underset{}{\overset{\overset{\displaystyle CH_3}{|}}{CH}}-CH_2-OH$
(d) $CH_3-CH_2-CH_2-CH_2-OH$

TS EAMCET-2017

Ans. (b) :


$CH_3-CH_2-\overset{\overset{\displaystyle OH}{|}}{CH}-CH_3 \xrightarrow{\text{few drops of acid}} CH_3-CH=CH-CH_3$

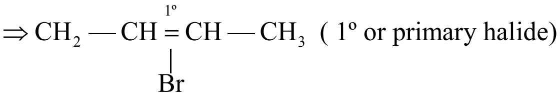
On adding a few drops of optically active compound undergo dehydration to form a stable alkene.

280. Identify the primary halide among the following compounds.

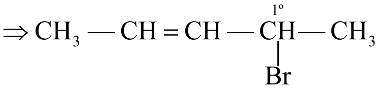
(a) 1-bromo-but-2-ene
(b) 4-bromo-pent-2-ene
(c) 2-bromo-2-methyl propane
(d) t-butyl bromide

AP EAMCET (Engg.) 18.9.2020 Shift-I

Ans. (a) : 1 - bromo- but - 2 - ene

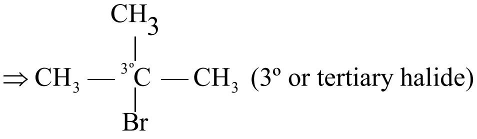

$\Rightarrow \underset{\underset{\displaystyle Br}{|}}{CH_2}-\overset{1^o}{CH}=CH-CH_3$ (1° or primary halide)

(b) 4- bromo-pent-2ene

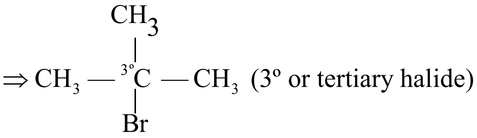

$\Rightarrow CH_3-CH=CH-\underset{\underset{\displaystyle Br}{|}}{\overset{1^o}{CH}}-CH_3$

(2° or secondary halide)

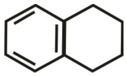
(c) 2-bromo- 2 - methyl - propane


$\Rightarrow CH_3-\underset{\underset{\displaystyle Br}{|}}{\overset{\overset{\displaystyle CH_3}{|}}{{}^{3^o}C}}-CH_3$ (3° or tertiary halide)

(d) t-bulyl bromide


$\Rightarrow CH_3-\underset{\underset{\displaystyle Br}{|}}{\overset{\overset{\displaystyle CH_3}{|}}{{}^{3^o}C}}-CH_3$ (3° or tertiary halide)

281. Number of hydrogen atoms in the given compound is



(a) 10
(b) 12
(c) 14
(d) 16

AP EAMCET (Engg.) 18.9.2020 Shift-I

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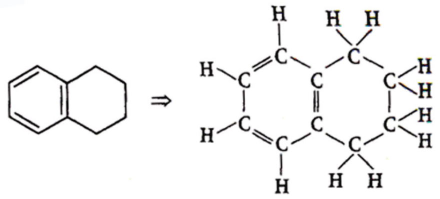
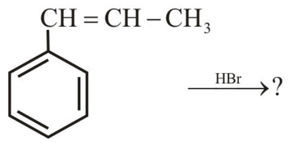
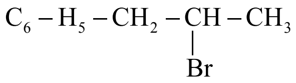
Ans. (b) :

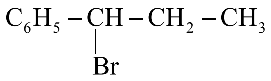


Total number of H-atoms in the hydrocarbon = 12

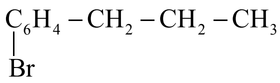
282. Identify the product of the following reaction



(a)

$C_6 - H_5 - CH_2 - \underset{Br}{CH} - CH_3$

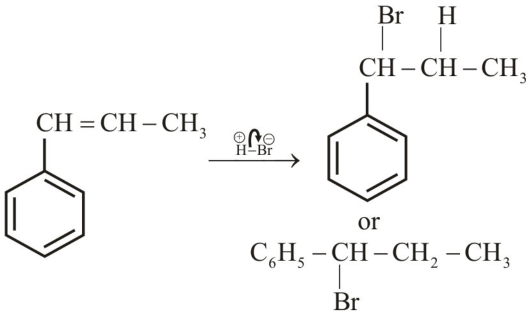
(b)

$C_6H_5 - \underset{Br}{CH} - CH_2 - CH_3$

(c) $C_6H_5 - CH_2 - CH_2 - CH_3 - Br$

(d)

$\underset{Br}{C_6H_4} - CH_2 - CH_2 - CH_3$

AP EAPCET 20.08.2021 Shift-I

Ans. (b) :

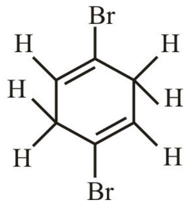


283. An organic compound of molecular formula $C_6H_6Br_2$ has six carbon atoms in a ring system two non-conjugate double bonds and two bromo groups at 1, 4 positions. Then the compound is —

(a) Aromatic but non-homo-cyclic
(b) Aromatic and hetero-cyclic
(c) Homo-cyclic but not aromatic
(d) Neither homo-cyclic nor hetero-cyclic

AP EAPCET 20.08.2021 Shift-I

Ans. (c) :



Compound is homo-cyclic but not aromatic.

284. Consider the following reactions,

$C_2H_2 \xrightarrow[500^\circ C]{\text{red hot iron tube}} A$

$A \xrightarrow[70^\circ C]{\text{conc. } HNO_3\text{, conc. } H_2SO_4} B$

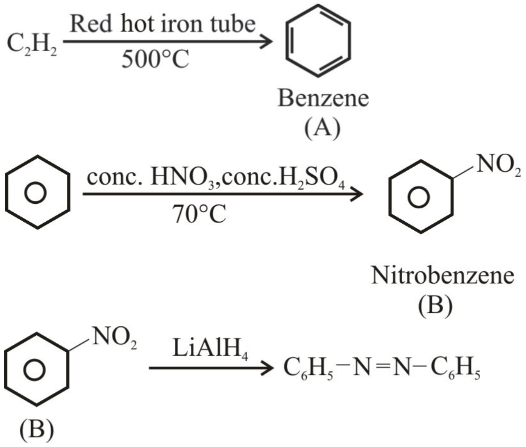
$B \xrightarrow{LiAlH_4} C_6H_5 - N = N - C_6N_5$

A and B are

(a) $A=C_2H_4, B=C_6H_6$
(b) $A=C_2H_6, B=C_6H_5NH_2$
(c) $A=C_2H_4, B=C_6H_5NH_2$
(d) $A=C_6H_6, B=C_6H_5NO_2$

AP EAMCET (Engg.) 2001

Ans. (d) :



285. Identify the substrate in this reaction:

$$? \xrightarrow[443K]{H_2SO_4} H_2C{=}CH_2$$

(a) Isopropyl alcohol
(b) Methyl alcohol
(c) Ethyl alcohol
(d) n-propyl alcohol

AP EAPCET-6 Sep. 2021, Shift-II

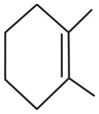
Ans. (c) : When ethanol is heated with concentrated sulphuric acid at 443 K, dehydration takes place and ethane is formed. In this reaction concentrated sulphuric acid (H_2SO_4) acts as a dehydrating agent.

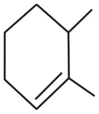
The balanced chemical equation is given by.

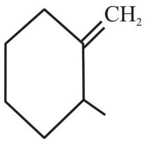
$$CH_3CH_2OH \xrightarrow[\text{Conc.}H_2SO_4]{443K} CH_2 = CH_2 + H_2O$$

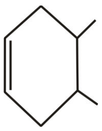
Therefore, concentrated sulphuric acid removes water from ethanol, thereby act as a dehydrating agent.

286. The order of stability among the following alkenes is:

(i)


(ii)


(ii)


(iv)


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(a) (i)>(iv)>(ii)>(iii)
(b) (ii)>(i)>(iii)>(iv)
(c) (i)>(ii)>(iv)>(iii)
(d) (iii)>(iv)>(ii)>(i)

AP EAPCET-6 Sep. 2021, Shift-II

Ans. (c): Alkenes with higher number of alkyl groups connected with it are more stable. Alkenes that have higher number of hyper conjugation are more stable. Conjugated alkenes are more stable.

287. Which one of the following gives sooty flame on combustion?

(a) C_2H_4
(b) CH_4
(c) C_2H_6
(d) C_6H_6

AP EAMCET (Engg.) -2014

Ans. (d) : Unsaturated hydrocarbon undergoes burn with sooty flame which is yellow in colour. Saturated hydrocarbons undergo complete combustion with oxygen to produce a clean blue flame.

Hydrocarbon having double or triple bond do not burn completely in air and have burnt carbon which result in blackish smoky flame.

Unsaturated Hydrocarbon like C_2H_5 and C_6H_6 have relatively more hydrocarbon.

Benzene is aromatic compound having relatively more carbon content.

So it does not completely oxidized durning combustion and give a sooty flames.

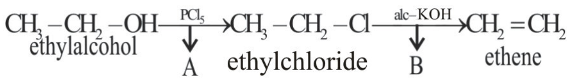
288. $$CH_3-CH_2-OH \xrightarrow{A} CH_3-CH_2-Cl \xrightarrow{B} CH_2=CH_2$$

A and B in this sequence of reaction are

(a) $KOH_{(aq.)}$ and PCl_5
(b) PCl_5 and $KOH_{(aq.)}$
(c) Cl_2 and $KOH_{(alc.)}$
(d) PCl_5 and $KOH_{(alc.)}$

COMEDK 2012

Ans. (d) : Ethanol reacts with phosphorus tetrachloride to give the ethylchloride . Now, ethyl chloride reacts with alcoholic KOH to form the alkene followed by elimination reaction.



$CH_3-CH_2-OH \xrightarrow{PCl_5} CH_3-CH_2-Cl \xrightarrow{alc-KOH} CH_2=CH_2$
ethylalcohol
A
ethylchloride
B
ethene

289. Markovnikov's rule is applicable to

(a) C_3H_6+HBr
(b) C_2H_4+HCl
(c) $C_3H_6+Cl_2$
(d) C_2H_4+HBr

COMEDK 2012

Ans. (a) : Markovnikov's rule is applicable to addition of unsymmetrical reagents like HX, H_2O to unsymmetrical alkene.

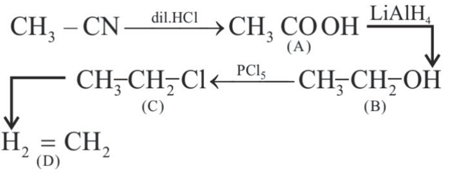
290. $$\begin{array}{l} CH_3-CN \xrightarrow{dil.HCl} A \xrightarrow{LiAlH_4} B \xrightarrow{PCl_5} C \\ \qquad\qquad\qquad\qquad\qquad\qquad\qquad D \xleftarrow{alc.KOH} \end{array}$$

The product 'D' in the above sequence of reaction is

(a) acetaldehyde
(b) ethene
(c) ethyne
(d) acetyl chloride.

COMEDK 2011

Ans. (b) :



$CH_3-CN \xrightarrow{dil.HCl} CH_3COOH$
(A)
$LiAlH_4$
$CH_3-CH_2-Cl \xleftarrow{PCl_5} CH_3-CH_2-OH$
(C)
(B)
$CH_2=CH_2$
(D)

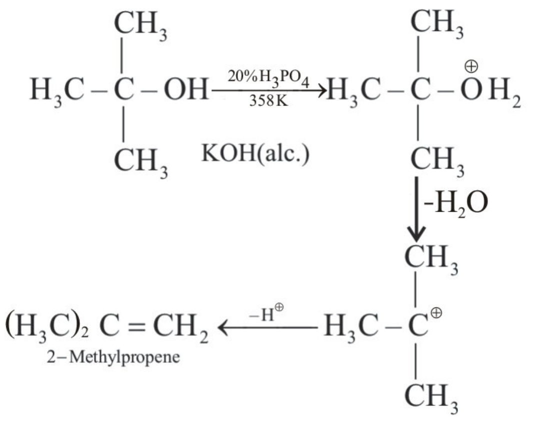
291. Identify the main product in the reaction

$$C(CH_3)_3OH \xrightarrow[358K]{20\%H_3PO_4} ?$$

(a) $(CH_3)_2C=CH_2$
(b) $(CH_3)_2CHOH$
(c) $CH_3CH=CHCH_3$
(d) $CH_3CH_2CH=CH_2$

COMEDK 2015

Ans. (a) :



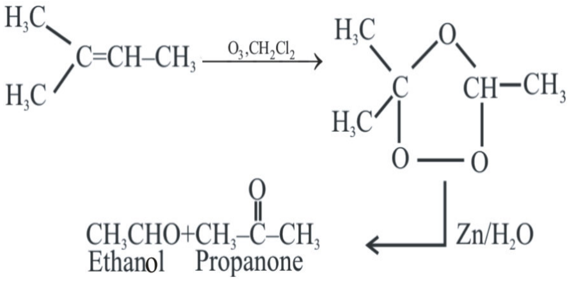
20%H_3PO_4
358K
KOH(alc.)
$-H_2O$
$-H^\oplus$
2–Methylpropene

292. The compound which on ozonolysis produces a mixture of propanone and ethanal is

(a) 2-methylbut-1-ene
(b) 2-pentene
(c) 2-pentyne
(d) 2-methylbut-2-ene.

COMEDK 2014

Ans. (d) :



O_3,CH_2Cl_2
Zn/H_2O
$CH_3CHO+CH_3-\overset{O}{\overset{\|}{C}}-CH_3$
Ethanol
Propanone

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293. Which of the following is the most stable alkene?

(a) $RCH=CH_2$
(b) $CH_2=CH_2$
(c) $RCH=CHR$
(d) $R_2C=CR_2$

COMEDK 2018

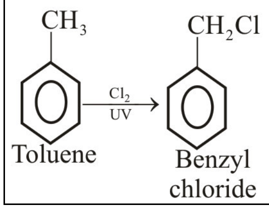
Ans. (d) : Greater the number of alkyl groups attached to double bonded carbon atoms, more stable is the alkene (Satyzeff's rule). Hence the $R_2C=CR_2$ more stable alkene

294. When chlorine is passed through boiling toluene we get

(a) o-chlorotoluene
(b) p-chlorotoluene
(c) mixture of O and p-chlorotoluene
(d) benzyl chloride.

COMEDK 2017

Ans. (d) :



295. One mole of a symmetrical alkene on ozonolysis gives two moles of an aldehyde having a molecular mass of 44 u. The alkene is

(a) Ethene
(b) Propene
(c) 1-butene
(d) 2-butene

COMEDK-2017

Ans. (d) :

$$\underset{\text{2-Butene}}{CH_3CH=CH-CH_3}\xrightarrow[\text{(ii) Zn/H}_2\text{O}]{\text{(i) O}_3}2\underset{\text{Acetaldehyde}}{CH_3CHO}$$

(Symm alkene)
The aldehyde with molecular mass 44u is CH_3CHO (acetaldehyde).
Therefore, the symmetrical alkene is 2-butene.

296. A reagent used to test for unsaturation in alkenes is

(a) Ammonical $AgNO_3$
(b) conc. H_2SO_4
(c) Solution of Br_2 in CCl_4
(d) Ammoniacal Cu_2Cl_2.

COMEDK 2018

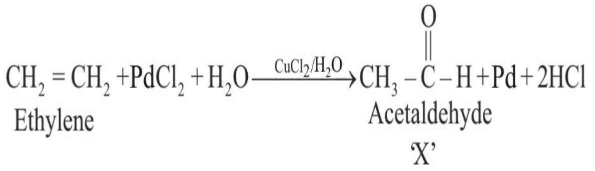
Ans. (c) : The solution of bromine (Br_2) in carbon tetrachloride (CCl_4) as solvent is used to test for unsaturation in alkene, because alkene will turn brown bromine water colourless as the bromine reacts with the carbon-carbon double bond.

297. Ethylene is converted to X on passing through a mixture of an acidified aqueous solution of palladium chloride and cupric chloride. Which of the following reagents readily take part in addition reaction with X?

(a) Br_2 (b) HBr
(c) HCl (d) HCN

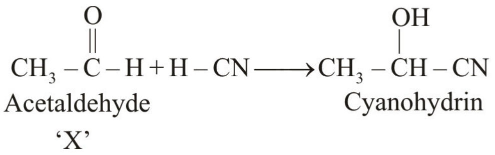
AP-EAMCET (Medical), 2003

Ans. (d) : Ethylene (C_2H_4) is converted to acetaldehyde on passing through a mixture of an acidified aqueous solution of palladium chloride and cupric chloride. This process is called Wacker process. The reaction is given below –



$$\underset{\text{Ethylene}}{CH_2=CH_2}+PdCl_2+H_2O\xrightarrow{CuCl_2/H_2O}\underset{\substack{\text{Acetaldehyde}\\ \text{'X'}}}{CH_3-\overset{\overset{\displaystyle O}{||}}{C}-H}+Pd+2HCl$$

Acetaldehyde on addition with hydrogen cyanide (HCN) gives the cyanohydrins.



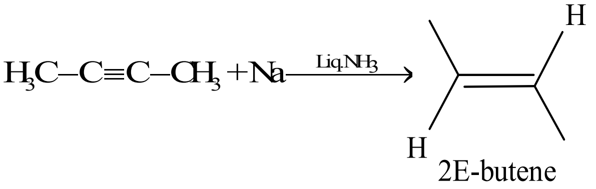
$$\underset{\substack{\text{Acetaldehyde}\\ \text{'X'}}}{CH_3-\overset{\overset{\displaystyle O}{||}}{C}-H}+H-CN\longrightarrow\underset{\text{Cyanohydrin}}{CH_3-\overset{\overset{\displaystyle OH}{|}}{CH}-CN}$$

298. Which one of the following reactions yield 2E-butene as the major product?

(a) $CH_3-C\equiv C-CH_3+Na/NH_3(\text{liq.})$
(b) $CH_3-CH=CH-CH_3+Li/NH_3(\text{liq.})$
(c) $CH_3-CH=CH-CH_3+Na/NH_4OH$
(d) $CH_3-C\equiv C-CH_3+Pd/BaSO_4$

AP-EAMCET (Medical), 2008

Ans. (a) : At low temperature, when alkynes are reacted with Li or Na metal in NH_3 then anti addition of hydrogen atoms take place and E product is obtained.



299. Acetylene has ...... bonds:

(a) 2σ, 2π (b) 2σ, 3π
(c) 3σ, 2π (d) 3σ, 3π

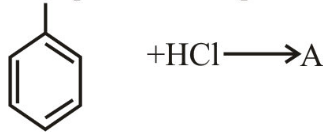
AP-EAMCET (Medical), 2001

Ans. (c) : The chemical formula of acetylene is given below-

$$\underset{\text{Acetylene}}{H-C\equiv C-H}$$

So, acetylene have 3σ and 2π bonds.

300. What is A in following reaction?



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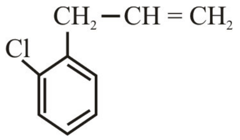
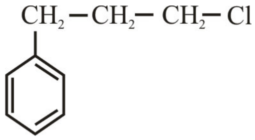
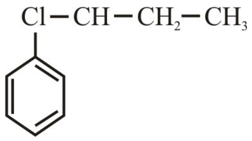
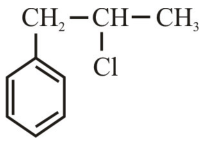
(a) 
CH2–CH=CH2
Cl

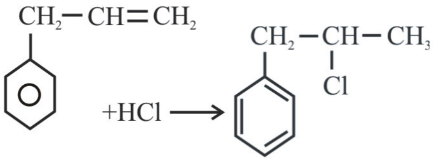
(b) 
CH2–CH2–CH2–Cl

(c) 
Cl–CH–CH2–CH3

(d) 
CH2–CH–CH3
Cl

GUJCET-2021

Ans. (d) :


CH2–CH=CH2
+HCl
CH2–CH–CH3
Cl

In this reaction addition of HCl take place on doubly bonded carbons in accordance with **MarkovniKov's rule**.

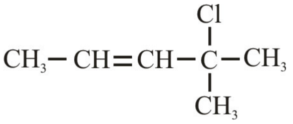
301. $CH_3CH = CHC(Cl)(CH_3)_2$ is which type of halide based on position of - Cl?

(a) Allylic (b) Secondary

(c) Vinylic (d) Aryl

GUJCET-2021

Ans. (a) :



$$CH_3-CH=CH-\overset{\overset{\displaystyle Cl}{|}}{\underset{\underset{\displaystyle CH_3}{|}}{C}}-CH_3$$

Position of — Cl is attached at allylic.

302. The reaction

$$CH_2 = CH_2 + H_2 \xrightarrow[300^\circ C]{Ni} CH_3 - CH_3$$

(a) Wurtz reaction

(b) Kolbe reaction

(c) Sabatier – Sender's reaction

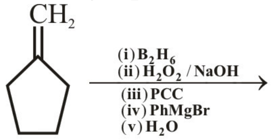
(d) Dow's reaction

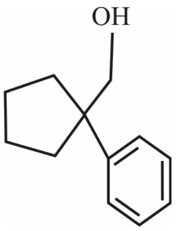
TS EAMCET 05.08.2021, Shift-I

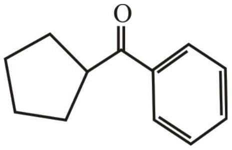
Ans. (c) : $CH_2 = CH_2 + H_2 \xrightarrow[300^\circ C]{Ni} CH_3 - CH_3$

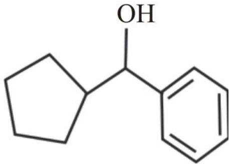
Sabatier-Sender's reaction is the reaction in which preparation of ethane is done by the catalytic hydrogenation of ethene. This reduction is carried out in the presence of catalyst like nickel.

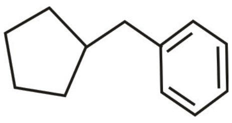
303. The major product of the following reaction is


CH2
(i) B2H6
(ii) H2O2 / NaOH
(iii) PCC
(iv) PhMgBr
(v) H2O

(a) 

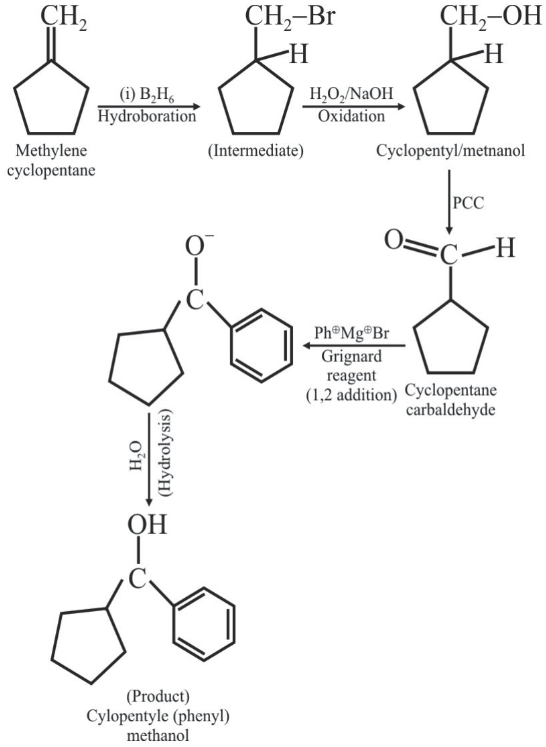
(b) 

(c) 

(d) 

TS EAMCET 04.08.2021, Shift-I

Ans. (c) : In given reaction, first two step is hydroboration-oxidation reaction which form alcohol. PCC is used for oxidation of alcohol into aldehyde. PhMgBr is used as a Grignard reagent to attack in a carbonyl carbon.


CH2
Methylene cyclopentane
(i) B2H6
Hydroboration
CH2–Br
H
(Intermediate)
H2O2/NaOH
Oxidation
CH2–OH
H
Cyclopentyl/metnanol
PCC
O=C–H
Cyclopentane carbaldehyde
Ph⊕Mg⊕Br
Grignard reagent
(1,2 addition)
O−
C
H2O
(Hydrolysis)
OH
C
(Product)
Cylopentyle (phenyl) methanol

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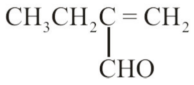
304. The major product of the following reaction is:

$$CH_3CH_2CH = CH_2 \xrightarrow[\text{Rh catalyst}]{H_2/CO}$$

(a) $CH_3CH_2CH_2CH_2CHO$

(b) $CH_3CH_2CH_2CHO$

(c) $CH_3CH_2CH = CH - CHO$

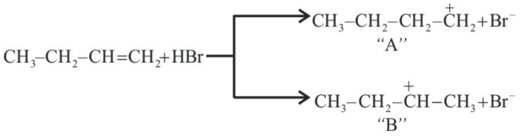
(d) 
$CH_3CH_2\underset{\underset{CHO}{|}}{C} = CH_2$

JEE Main 25.02.2021, Shift-II

Ans. (b) : Reaction of alkene with H_2/CO in the presence of Rhodium as catalyst is given below:–

$$CH_3 - CH_2 - CH = CH_2 \xrightarrow[\text{Rh catalyst}]{H_2/CO} CH_3CH_2CH_2CHO$$

305. Choose the correct statement regarding the formation of carbocations A and B given.



(a) Carbocation A is more stable and formed relatively at slow rate

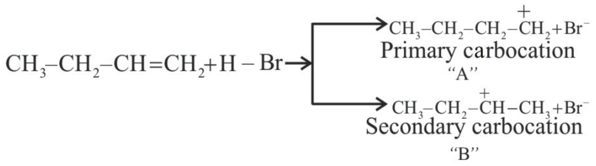
(b) Carbocation B is more stable and formed relatively at slow rate

(c) Carbocation A is more stable and formed relatively at faster rate

(d) Carbocation B is more stable and formed relatively at faster rate.

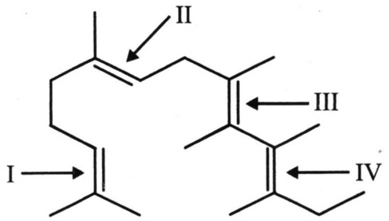
JEE Main 17.03.2021, Shift-II

Ans. (d) :



The above reaction is an example of Marcovnicoff's rule. As we know secondary carbocation is more stable than primary carbocation and stable intermediate follow the fast rate of the reaction.

306. In the following structure, the double bonds are marked as I, II, III and IV



Geometrical isomerism is not possible at site (s):

(a) III (b) I

(c) I and III (d) III and IV

AIIMS 25 May 2019 (Evening)

Ans. (b) : The geometrical isomerism is not possible at site I as two identical methyl group are attached to same carbon atom bearing double bond.

307. Assertion: Propene reacts with HI in presence of peroxide to give 1-iodopropane.

Reason: 1º free radical is more stable than 2º free radical.

(a) If both Assertion and Reason are correct and Reason is the correct explanation of Assertion.

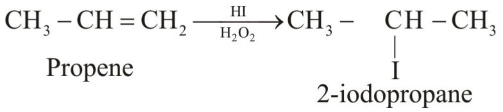
(b) If both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.

(c) If Assertion is correct but Reason is incorrect.

(d) If both the Assertion and Reason are incorrect.

AIIMS 26 May 2019 (Evening)

Ans. (d):


$CH_3 - CH = CH_2 \xrightarrow[H_2O_2]{HI} CH_3 - \underset{\underset{I}{|}}{CH} - CH_3$

Propene 2-iodopropane

In presence of peroxide, the addition of HBr on alkene follows the anti-Markovnikov's rule.

The stability of radical is –

3° > 2° > 1°

Hence, both assertion and reason are false.

308. The formation of 2-butene as a major product by dehydration of 2-butanol is in accordance with

(a) Blanc rule

(b) Huckel rule

(c) Markiownikoff's rule

(d) Saytzeff's rule

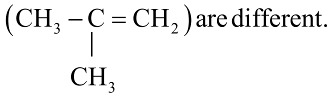
AIIMS-1994

CGPET-2005, 2007

Ans. (d): The formation of 2-butene as a major product by dehydration of 2-butanol is according to saytzeff rule. The minor product is 1-butene.

According to satyzeff rule in the dehydration of secondary and tertiary alcohols when there is a possibility of formation of two isomers the hydrogen atom is preferentially eliminated from the adjacent carbon atom with the fewer number of hydrogen atom.

309. Assertion: All C–C–C bond angles in isobutene


$\left(CH_3 - \underset{\underset{CH_3}{|}}{C} = CH_2\right)$ are different.

Reason: CH_3 (Methyl group) show steric crowding.

(a) If both Assertion and Reason are correct and the reason is the correct explanation of Assertion.

(b) If both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.

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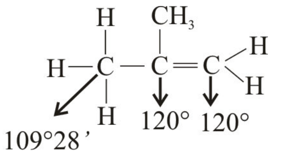
(c) If Assertion is correct but Reason is incorrect.
(d) If both the Assertion and Reason are incorrect.

[AIIMS-27 May, 2018 (M)]

Ans. (a): In isobutene, all the bond angle are different due to CH_3 (methyl group) show steric crowding.

The structure of isobutene.



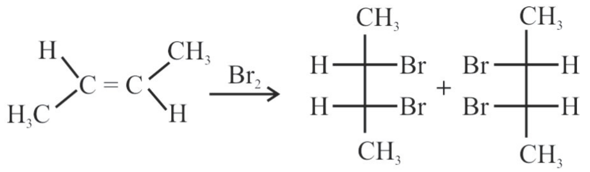
310. Assertion: Trans-2-butene on reaction with Br_2 gives meso-2, 3-dibromobutane.

Reason: The reaction involves syn-addition of bromine.

(a) If both Assertion and Reason are correct and the reason is the correct explanation of Assertion.
(b) If both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.
(c) If Assertion is correct but Reason is incorrect.
(d) If both the Assertion and Reason are incorrect.

[AIIMS-2014, 2009, 2003]

Ans. (c): j



Trans-2-butene

Meso compound

Trans-2-butene on reaction with Br_2 gives meso-2, 3-dibromobutane.

311. Assertion: 1-Butene on reaction with HBr in the presence of a peroxide produces 1-bromo-butane.

Reason: It involves the free radical mechanism.

(a) If both Assertion and Reason are correct and the reason is the correct explanation of Assertion.
(b) If both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.
(c) If Assertion is correct but Reason is incorrect.
(d) If both the Assertion and Reason are incorrect.

[AIIMS-2009]

Ans. (a): The reaction of 1-butene react with HBr in the presence of a peroxide produces 1-bromo-butane. This reaction is antimarkovnikov's addition and involves the free radical mechanism.

$$CH_3-CH_2-CH=CH_2+HB_r\xrightarrow{\text{Peroxide}}CH_3-CH_2-CH_2-CH_2-Br$$

1-butane 1-bromo-butane

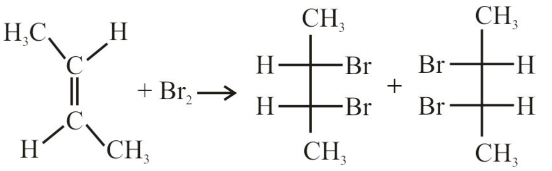
312. Asertion: trans-butene-2 on reaction with bromine forms racemic mixture.

Reason: trans-Compound in trans addition forms two types of stereoisomers.

(a) If both Assertion and Reason are correct and the Reason is a correct explanation of the Assertion.
(b) If both Assertion and Reason are correct but Reason is not a correct explanation of the Assertion.
(c) If the Assertion is correct but Reason is incorrect.
(d) If both the Assertion and Reason are incorrect.
(e) If the Assertion is incorrect but the Reason is correct.

[AIIMS-2007]

Ans. (d):



In trans - compound in trans addition forms a racemic mixture

Hence, the assertion and reason both are false.

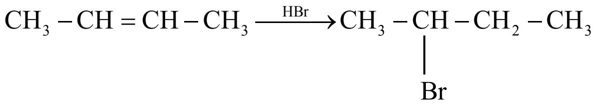
313. Assertion: Addition of HBr on 2-butene give two isomeric products.

Reason: Addition of HBr on 2-butene follows Markovnikov rule.

(a) If both Assertion and Reason are correct and the Reason is a correct explanation of the Assertion.
(b) If both Assertion and Reason are correct but Reason is not a correct explanation of the Assertion.
(c) If the Assertion is correct but Reason is incorrect.
(d) If both the Assertion and Reason are incorrect.
(e) If the Assertion is incorrect but the Reason is correct.

[AIIMS-2006]

Ans. (c):



$$CH_3-CH=CH-CH_3\xrightarrow{HBr}CH_3-\underset{\substack{|\\Br}}{CH}-CH_2-CH_3$$

2-butane 2-bromobutane

2-butene is a symmetrical and not follow the Markovnikov rule. 2-butane react with HBr to give a one product.

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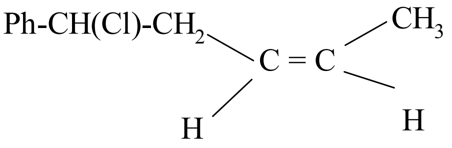
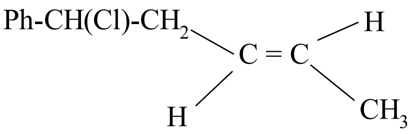
314. In the reaction, Ph –CH$_2$ – CH$_2$–C ≡ C–CH$_3$ $\xrightarrow{Na/NH_3}$ A $\xrightarrow{Cl_2/hv}$ B, B is

(a)


Ph-CH(Cl)-CH2
CH3
C = C
H
H

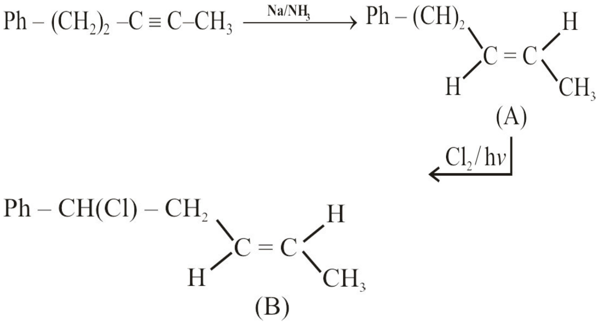
(b)


Ph-CH(Cl)-CH2
H
C = C
H
CH3

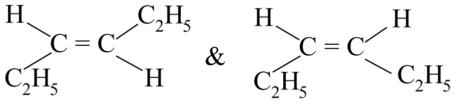
(c) Ph–CH$_2$–CH(Cl)–CH=CH–CH$_3$
(d) None of these

[AIIMS-26 May, 2018 (E)]

Ans. (b):


Ph – (CH2)2 –C ≡ C–CH3
Na/NH3
Ph – (CH)2
H
C = C
H
CH3
(A)
Cl2/hν
Ph – CH(Cl) – CH2
H
C = C
H
CH3
(B)

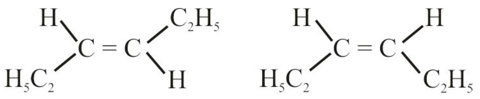
315. For geometrical isomers of 3–hexene:


H
C2H5
C = C
C2H5
H
&
H
H
C = C
C2H5
C2H5

(a) M.P. is high and dipole moment high for trans.
(b) M.P. is low and dipole moment low for trans.
(c) M.P. is high and dipole moment low for trans.
(d) M.P. is low and dipole moment high for trans.

[AIIMS-26 May, 2018 (E)]

Ans. (c): The geometrical isomers of 3–hexane

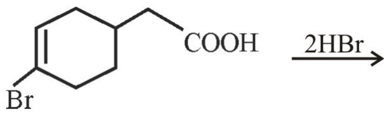

H
C2H5
C = C
H5C2
H
H
H
C = C
H5C2
C2H5

Trans -3- hexane $\mu = 0$

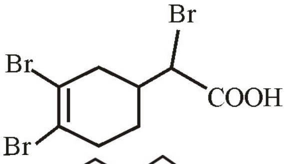
Cis-3- hexane $\mu \neq 0$

In trans 3-hexane dipole moment is zero and cis 3-hexene dipole moment is zero so melting point is high and dipole moment low for trans.

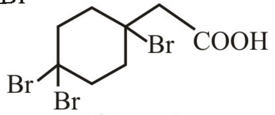
316.


COOH
2HBr
Br

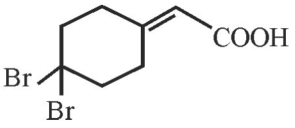
(a)


Br
Br
COOH
Br

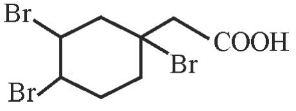
(b)


Br
COOH
Br
Br

(c)

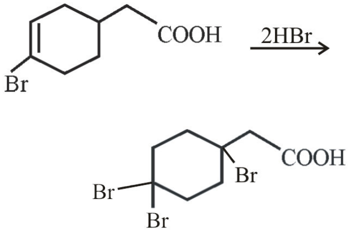


(d)


Br
COOH
Br
Br

[AIIMS-27 May, 2018 (M)]

Ans. (b):


COOH
2HBr
Br
COOH
Br
Br
Br

317. In the given reaction

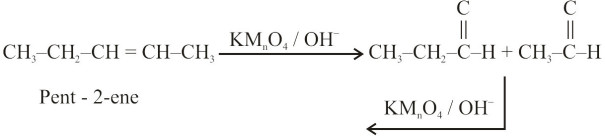
$$CH_3CH_2CH = CHCH_3 \xrightarrow{x} CH_3CH_2COOH + CH_3COOH$$

The X is

(a) C$_2$H$_5$ONa
(b) Conc. HCl + Anhy. ZnCl$_2$
(c) Anhyd. AlCl$_3$
(d) KMnO$_4$/ OH$^-$

[AIIMS-2017]

Ans. (d):



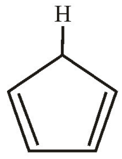
$CH_3–CH_2–CH = CH–CH_3 \xrightarrow{KM_nO_4 / OH^-} CH_3–CH_2–\overset{\overset{C}{||}}{C}–H + CH_3–\overset{\overset{C}{||}}{C}–H$

Pent - 2-ene

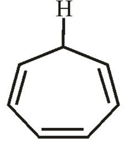
$\xleftarrow{KM_nO_4 / OH^-}$

CH$_3$ – CH$_2$ – COOH + CH$_3$COOH
This reaction is oxidative cleavage KMnO$_4$ / OH$^-$ act as an oxidizing agent.
Hence, pent-2-ene react and ethanoic acid.

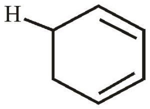
318. The correct order of increasing acidic strength for the following compounds is



(i)



(ii)



(iii)

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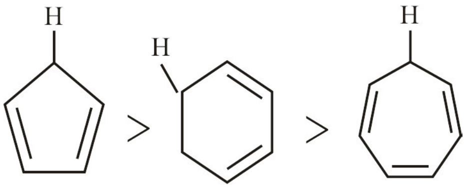
(a) 1 > II > III (b) II > III > I

(c) I > III > II (d) III > II > I

[AIIMS-26 May, 2018(M)]

Ans. (c): Acidic strength depend upon the negative inductive effect (–I) –I effect increase then the acidity increase. Acidic strength depend on the size of ring increase then acidic strength decreases.

So, the acidic strength order is –



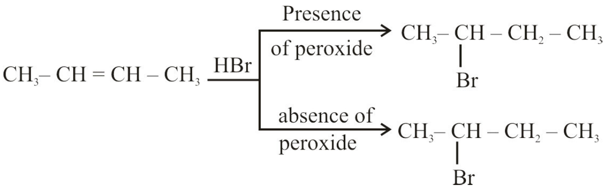
319. The alkene that will give the same product with HBr in the absence as well as in the presence of peroxide is

(a) 2-butene (b) 1-butene

(c) propene (d) 1-hexene

[AIIMS-2016]

Ans. (a): When an unsymmetrical alkene is treated with the unsymmetrical reagent in the presence of peroxide, then addition takes place against the markownikoff's rule i.e negative part of reagent adds to that carbon to carbon-carbon double bond which carries more number of hydrogen atoms. In 2-butene will give the same product with HBr in the absence as well as presence of peroxide when treated with HBr.



$CH_3-CH=CH-CH_3$
HBr
Presence of peroxide
$CH_3-CH-CH_2-CH_3$
Br
absence of peroxide
$CH_3-CH-CH_2-CH_3$
Br

320. Consider the following statements : A hydrocarbon of molecular formula C_5H_{10} is a

I. Monosubstituted alkene

II. disubstituted alkene

III. trisubstituted alkene

Which of the following statement (s) is (are) correct?

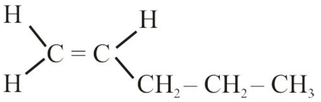
(a) I, II and III (b) I and II

(c) II and III (d) I and III

[AIIMS-2012]

Ans. (a): Given a hydrocarbon of molecular formula C_5H_{10} is an alkene. The general formula of alkene is C_nH_{2n}.

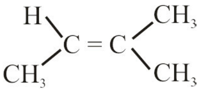
(I) Monosubstituted alkene



(II) Disubstituted alkene

$H_3C-CH=CH-CH_2-CH_3$

(III) Trisubstituted



Hence, the isomer of hydrocarbon of molecular formula C_5H_{10} are correct.

321. Compound X of molecular formula C_4H_6 takes up one equivalent of hydrogen in presence of Pt to form another compound Y which on ozonolysis gives only ethanoic acid. The compound X can be

(a) $CH_2=CH-CH=CH_2$

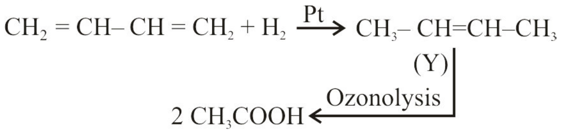
(b) $CH_2=C=CHCH_3$

(c) $CH_3C\equiv CCH_3$

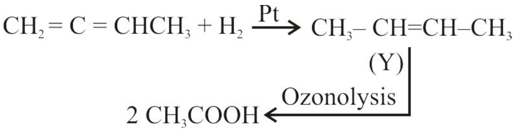
(d) All of these

[AIIMS-2011]

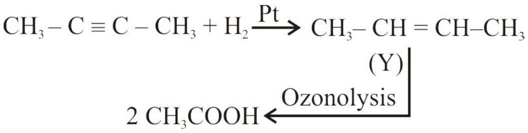
Ans. (d):

(i) 

$CH_2=CH-CH=CH_2+H_2\xrightarrow{Pt}CH_3-CH=CH-CH_3$
(Y)
Ozonolysis
$2\,CH_3COOH$

(ii) 

$CH_2=C=CHCH_3+H_2\xrightarrow{Pt}CH_3-CH=CH-CH_3$
(Y)
Ozonolysis
$2\,CH_3COOH$

(iii) 

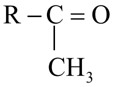
$CH_3-C\equiv C-CH_3+H_2\xrightarrow{Pt}CH_3-CH=CH-CH_3$
(Y)
Ozonolysis
$2\,CH_3COOH$

So, but-1,3 diene , but 1,2 diene and but-2- yne to give ethanoic acid on under Ozonolysis -

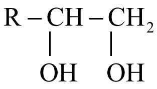
322. The alkene R–CH=CH$_2$ reacts readily with B_2H_6 and formed the product B which on oxidation with alkaline hydrogen peroxide produces

(a) $R-CH_2-CHO$

(b) $R-CH_2-CH_2-OH$

(c) 

$R-\underset{\displaystyle CH_3}{\underset{|}{C}}=O$

(d) 

$R-\underset{\displaystyle OH}{\underset{|}{CH}}-\underset{\displaystyle OH}{\underset{|}{CH_2}}$

AIIMS-2010, 1995

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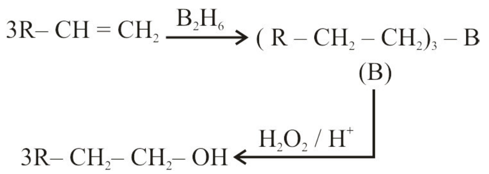
Ans. (b):



$$3R-CH=CH_2 \xrightarrow{B_2H_6} (R-CH_2-CH_2)_3-B \ (B) \xrightarrow{H_2O_2\,/\,H^+} 3R-CH_2-CH_2-OH$$

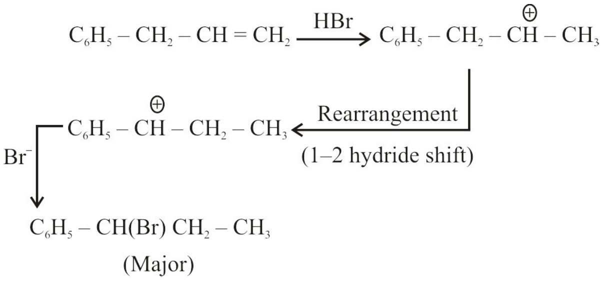
When (R–CH=CH$_2$) alkene react with B_2H_6 and formed a alkyl borane which on oxidation with alkaline hydrogen peroxide to give R – CH$_2$ – CH$_2$ – OH

323. 3-Phenylpropene on reaction with HBr gives (as a major product) :

(a) $C_6H_5CH(Br)CH_2CH_3$
(b) $C_6H_5CH(Br)CH_2CH_2OCH_3$
(c) $C_6H_5CH_2CH_2CH_2Br$
(d) $C_6H_5CH(Br)CH=CH_2$

[AIIMS-2005]

Ans. (a):



$$C_6H_5-CH_2-CH=CH_2 \xrightarrow{HBr} C_6H_5-CH_2-\overset{\oplus}{C}H-CH_3$$

$$\xrightarrow[\text{(1–2 hydride shift)}]{\text{Rearrangement}} C_6H_5-\overset{\oplus}{C}H-CH_2-CH_3 \xrightarrow{Br^-} C_6H_5-CH(Br)\,CH_2-CH_3$$

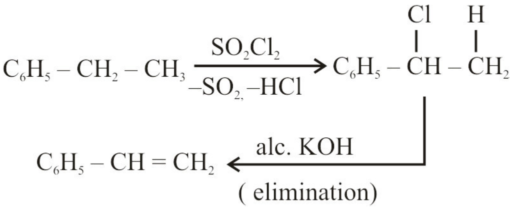
(Major)

324. Which of the following sequence of reactions (reagents) can be used for the conversion of $C_6H_5CH_2CH_3$ into $C_6H_5CH=CH_2$?

(a) $SOCl_2:H_2O$ (b) SO_2Cl_2 : alc. KOH
(c) $Cl_2/h\nu:H_2O$ (d) $SOCl_2$:alc. KOH

[AIIMS-2006]

Ans. (b):



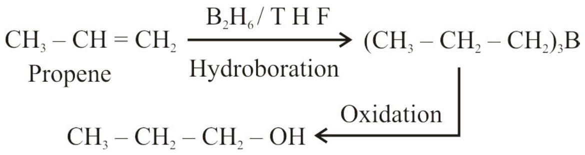
$$C_6H_5-CH_2-CH_3 \xrightarrow[-SO_2,\,-HCl]{SO_2Cl_2} C_6H_5-\overset{Cl}{\overset{|}{C}H}-\overset{H}{\overset{|}{C}H_2} \xrightarrow[\text{(elimination)}]{\text{alc. KOH}} C_6H_5-CH=CH_2$$

325. Propene on hydroboration and oxidation produces

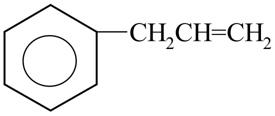
(a) $CH_3CH_2CH_2OH$ (b) $CH_3CHOHCH_3$
(c) $CH_3CHOHCH_2OH$ (d) CH_3CH_2CHO

[AIIMS-2007]

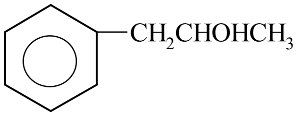
Ans. (a):
Propene (CH$_3$ – CH = CH$_2$) on hydroboration and oxidation produces a propane.

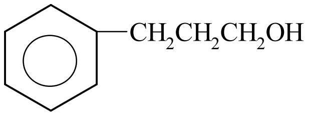


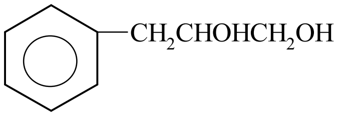
$$\underset{\text{Propene}}{CH_3-CH=CH_2} \xrightarrow[\text{Hydroboration}]{B_2H_6\,/\,THF} (CH_3-CH_2-CH_2)_3B \xrightarrow{\text{Oxidation}} CH_3-CH_2-CH_2-OH$$

326. 

On mercuration and demercuration produces

(a) 

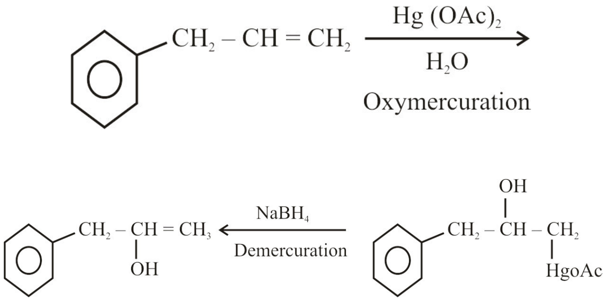
(b) 

(c) 

(d) none of these

[AIIMS-2007]
JEE Main-2014

Ans. (a): In oxymercuration demercuration of alkene in an alcohol as the solvent, the product is an ether.

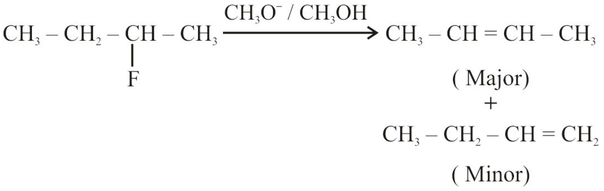


327. The major product obtained on treatment of $CH_3CH_2CH(F)CH_3$ with CH_3O^-/CH_3OH is:

(a) $CH_3CH_2CH(OCH_3)CH_3$
(b) $CH_3CH = CHCH_3$
(c) $CH_3CH_2CH = CH_2$
(d) $C_6H_5CH(Br)CH=CH_2$

[AIIMS-2005]

Ans. (b): According to satyzeff rule, the major product will be that one which contain more number of substituent's around the double bond.



$$CH_3-CH_2-\underset{F}{\underset{|}{C}H}-CH_3 \xrightarrow{CH_3O^-\,/\,CH_3OH} \underset{\text{(Major)}}{CH_3-CH=CH-CH_3} + \underset{\text{(Minor)}}{CH_3-CH_2-CH=CH_2}$$

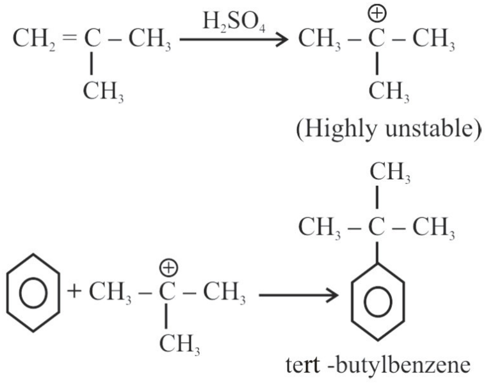
328. The treatment of benzene with isobutene in the presence of sulphuric acid gives:

(a) iso-butylbenzene (b) tert-butylbenzene
(c) n-butylbenzene (d) no reaction

VITEEE-2019
AIIMS-2003

@apna_pdf

Ans. (b): The reaction of benzene with isobutene in the presence of sulphuric acid give test – butylbenzene.



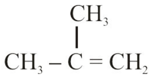
329. **The compound having only primary hydrogen atoms is:**

(a) Isobutene
(b) 2, 3-dimethylbutene-1
(c) Cyclohexane
(d) propane

[AIIMS-2004]

Ans. (a): The given compound are –

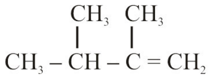
(i)



$CH_3-\overset{CH_3}{\overset{|}{C}}=CH_2$

Isobutene
8- Primary hydrogen

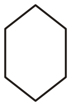
(ii)



$CH_3-\overset{CH_3}{\overset{|}{CH}}-\overset{CH_3}{\overset{|}{C}}=CH_2$

2-3, dimethyl
butene - 1.
II - Primary and 1 test hydrogen

(iii)



Cyclohexane
12 – secondary hydrogen.

(iv) $CH_3-CH_2-CH_3$
Propane 6- primary, 2 secondary hydrogen

Hence, isobutene has only primary hydrogen atom.

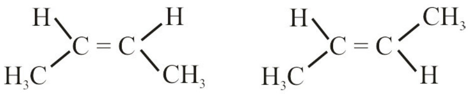
330. **Geometrical isomerism is possible in case of:**

(a) tartaric acid
(b) 1-butene
(c) 2-butene
(d) propene

[AIIMS-1999]

Ans. (c): Those compound have same structural formula but differ in the spatial arrangement of the groups around the double bond are called geometrical isomers.

In 2-butene, cis and trans isomers can exist because free rotation of the substituent's is restricted by C = C

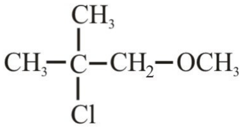


Cis-2- butene Trans-2-butene

Hence, 2-butene exhibits geometrical isomerism

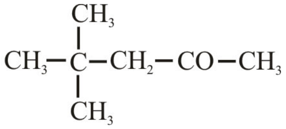
331. **Indicate the structure of the product expected when 2-methyl-propene is heated with acetyl chloride in presence of anhydrous $ZnCl_2$.**

(a)



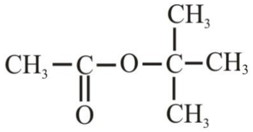
$CH_3-\overset{CH_3}{\overset{|}{\underset{Cl}{\underset{|}{C}}}}-CH_2-OCH_3$

(b)



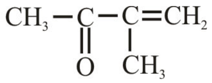
$CH_3-\overset{CH_3}{\overset{|}{\underset{CH_3}{\underset{|}{C}}}}-CH_2-CO-CH_3$

(c)



$CH_3-\underset{O}{\underset{||}{C}}-O-\overset{CH_3}{\overset{|}{\underset{CH_3}{\underset{|}{C}}}}-CH_3$

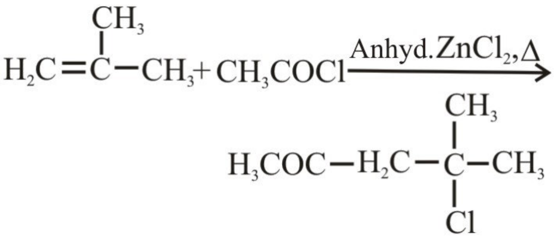
(d)



$CH_3-\underset{O}{\underset{||}{C}}-\underset{CH_3}{\underset{|}{C}}=CH_2$

SRMJEEE – 2008

Ans. (a) :



$H_2C=\overset{CH_3}{\overset{|}{C}}-CH_3+CH_3COCl\xrightarrow{Anhyd.ZnCl_2,\Delta}H_3COC-H_2C-\overset{CH_3}{\overset{|}{\underset{Cl}{\underset{|}{C}}}}-CH_3$

332. **Geomtrical isomerism is exhibited by (i) 1-pentene (ii) 2-pentene (iii) 2-chloro-2-pentene (iv) 3-methyl-2-pentene**

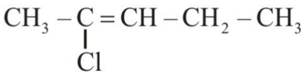
(a) (i) and (ii)
(b) (ii) and (iii)
(c) (iii) and (iv)
(d) (ii), (iii) and (iv),

SRMJEEE – 2015

Ans. (d) :

(ii) $CH_3-CH=CH-CH_2-CH_3$
2–Pentene

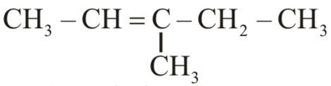
(iii)



$CH_3-\underset{Cl}{\underset{|}{C}}=CH-CH_2-CH_3$

2-chloro-2-pentene

(iv)



$CH_3-CH=\underset{CH_3}{\underset{|}{C}}-CH_2-CH_3$

3-methyl 2-pentene.

Will show geometrical isomerism

333. **In the following reactions; A and B respectively are**

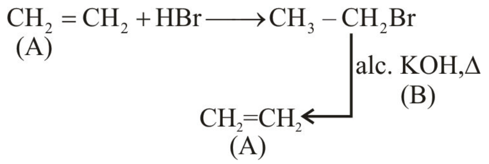
$$A\xrightarrow{HBr}C_2H_5Br\xrightarrow{B}A$$

(a) C_2H_4, alc. KOH/Δ
(b) C_2H_5Cl; aq. KOH/Δ
(c) CH_3OH; aq. KOH/Δ
(d) C_2H_2; PBr_3

SRMJEEE – 2014

@apna_pdf

Ans. (a) :



$$CH_2=CH_2 + HBr \longrightarrow CH_3-CH_2Br \xrightarrow[\text{(B)}]{\text{alc. KOH},\Delta} \underset{\text{(A)}}{CH_2=CH_2}$$

334. **$C_6H_6 + CCl_4 \xrightarrow{AlCl_3} X \xrightarrow{H_2O} Z$**

The product Z is

(a) C_6H_5COOH

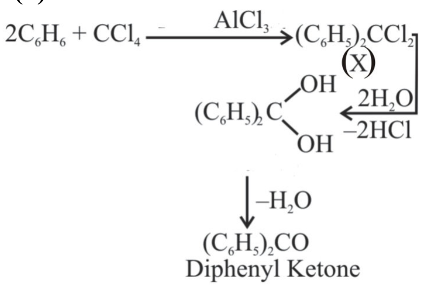
(b) C_6H_5CHO

(c) $C_6H_5CCl_2C_6H_5$

(d) $C_6H_5COC_6H_5$

SRMJEEE – 2014

Ans. (d) :



$$2C_6H_6 + CCl_4 \xrightarrow{AlCl_3} \underset{(X)}{(C_6H_5)_2CCl_2} \xrightarrow[-2HCl]{2H_2O} (C_6H_5)_2C(OH)_2 \xrightarrow{-H_2O} (C_6H_5)_2CO$$

Diphenyl Ketone

335. **Select the substance which has only one pi (π) bond in its molecule.**

(a) Acetylene

(b) Acrolein

(c) Propene

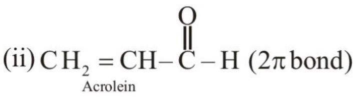
(d) 2-Butenoic acid

SRMJEEE – 2013

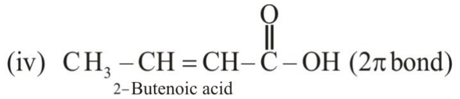
Ans. (c) :

(i) $\underset{\text{Acetylene}}{H-C\equiv C-H}\ (2\pi\,\text{bond})$

(iii) $\underset{\text{Propene}}{CH_2=CH-CH_3}\ (1\pi\,\text{bond})$

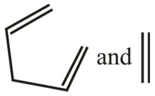


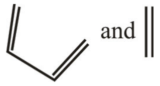
(ii) $\underset{\text{Acrolein}}{CH_2=CH-\overset{\overset{O}{\|}}{C}-H}\ (2\pi\,\text{bond})$

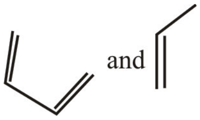


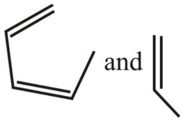
(iv) $\underset{\text{2-Butenoic acid}}{CH_3-CH=CH-\overset{\overset{O}{\|}}{C}-OH}\ (2\pi\,\text{bond})$

336. **Diels-Alder reaction will not take place with which of the following reactants?**

(a) 

(b) 

(c) 

(d) 

AP-EAMCET- (Engg.) - 2010

Ans. (a) : In Diels-Alder reaction conjugated dienes react with enes or olefinic compounds and gives cycloalkenes. Penta-1,4-diene is not conjugated alkene. So, it will not take part in Diels-Alder's reaction.

337. **$C_2H_6 \xrightarrow{450^\circ C} C_2H_4 + H_2$**

Above reaction is called as

(a) combustion

(b) rearrangement

(c) pyrolysis

(d) cleavage

AP-EAMCET (Engg.) 2013

Ans. (c) : $\underset{\text{Ethane}}{C_2H_6} \xrightarrow{450°C} \underset{\text{Ethene}}{C_2H_4} + H_2$

Decomposition of a compound of heat is called pyrolysis. Pyrolysis of higher alkane convert into lower alkane, alkene etc.

It is different from combustion. It happens in the absence of air and hence oxidation of compounds does not take place. Generally pyrolysis of alkanes is also named as cracking.

338. **An alkene of molecule formula C_9H_{18} on ozonolysis gives 2, 2-dimethylpropanal & 2-butanone, then the alkene is**

(a) 2, 2, 4-trimethyl-3-hexene

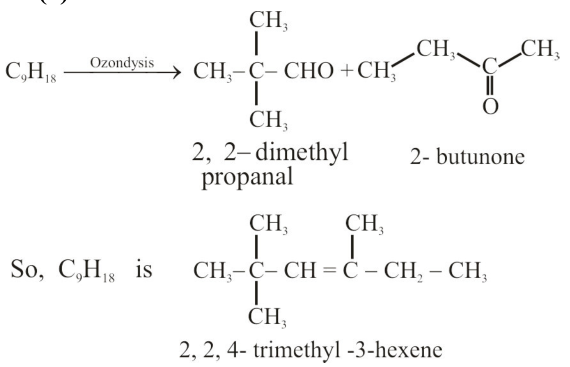
(b) 2, 2, 6-trimethyl-3-hexene

(c) 2, 3, 4-trimethyl-2-hexene

(d) 2, 2,-dimethyl-2-hexene

VITEEE-2019

Ans. (a) :



$$C_9H_{18} \xrightarrow{\text{Ozondysis}} \underset{\text{2, 2– dimethyl propanal}}{CH_3-\underset{CH_3}{\overset{CH_3}{C}}-CHO} + \underset{\text{2- butunone}}{CH_3-\overset{\overset{}{}}{\underset{\underset{O}{\|}}{C}}-CH_2-CH_3}$$

$$\text{So, } C_9H_{18} \text{ is } \underset{\text{2, 2, 4- trimethyl -3-hexene}}{CH_3-\underset{CH_3}{\overset{CH_3}{C}}-CH=\overset{CH_3}{C}-CH_2-CH_3}$$

339. **HBr reacts with $CH_2 = CH – OCH_3$ under anhydrous conditions at room temperature to give**

(a) $BrCH_2 – CH_2 – OCH_3$

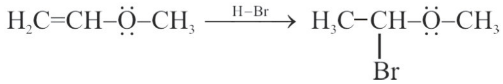
(b) $H_3C – CHBr – OCH_3$

(c) CH_3CHO and CH_3Br

(d) $BrCH_2CHO$ and CH_3OH

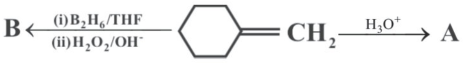
AIEEE-2006

Ans. (b) : HBr protanates the double bonded C of alkene which make a resonance - stabilized cation–

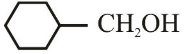


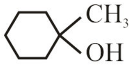
$$H_2C=CH-\ddot{\underset{..}{O}}-CH_3 \xrightarrow{H-Br} H_3C-\underset{Br}{CH}-\ddot{\underset{..}{O}}-CH_3$$

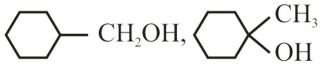
@apna_pdf

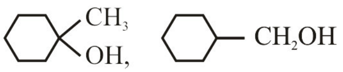
340. 
B
(i) B_2H_6/THF
(ii) H_2O_2/OH^-
CH_2
H_3O^+
A

A and B respectively are

(a) Both 

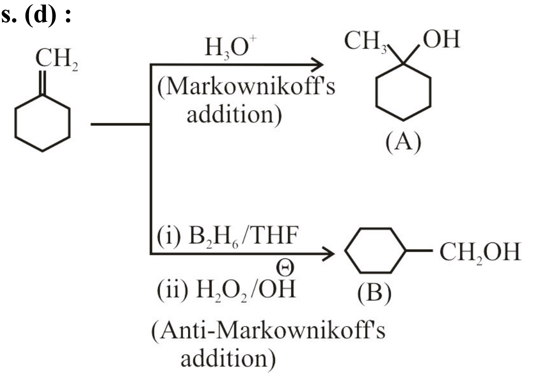
(b) Both 

(c) 
CH_2OH,
CH_3
OH

(d) 
CH_3
OH,
CH_2OH

VITEEE-2014

Ans. (d) :

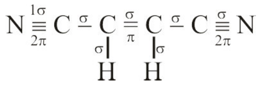

CH_2
H_3O^+
(Markownikoff's addition)
CH_3
OH
(A)
(i) B_2H_6/THF
(ii) $H_2O_2/\overset{\Theta}{O}H$
CH_2OH
(B)
(Anti-Markownikoff's addition)

341. How many sigma and pi-bonds are there in the molecule of dicyanoethene (CN–CH=CH–CN)?

(a) 3 sigma and 3 pi
(b) 5 sigma and 2 pi
(c) 7 sigma and 5 pi
(d) 2 sigma and 3 pi

VITEEE-2014

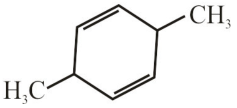
Ans. (c) :

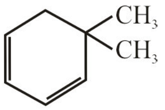


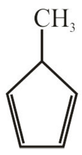
$$N\underset{2\pi}{\overset{1\sigma}{\equiv}}C\overset{\sigma}{-}\underset{\sigma|\,H}{C}\underset{\pi}{\overset{\sigma}{=}}\underset{|\sigma\,H}{C}\overset{\sigma}{-}C\underset{2\pi}{\overset{\sigma}{\equiv}}N$$

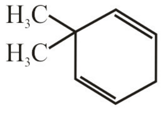
7σ and 5 pi.

342. An alkene having molecular formula C_8H_{12} on ozonolysis yields glyoxal and 2, 2-dimehtyl butane-1, 4-dial. The structure of alkene is

(a) 

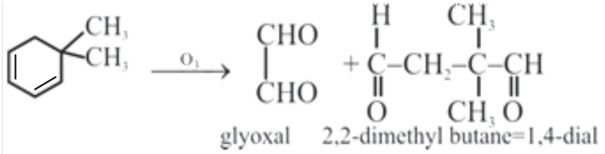
(b) 

(c) 

(d) 

VITEEE- 2011

Ans. (b) : Alkene reacted with ozone to give the following products :

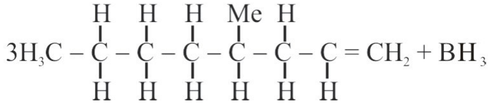

CH_3
CH_3
O_3
CHO
CHO
H
CH_3
C–CH_2–C–CH
O
CH_3 O
glyoxal
2,2-dimethyl butane=1,4-dial

343. Hydroboration oxidation of 4-methyl-octene would give

(a) 4-methyl octanol
(b) 2-methyl decane
(c) 4-methyl heptanol
(d) 4-methy-2-octaone

VITEEE- 2008

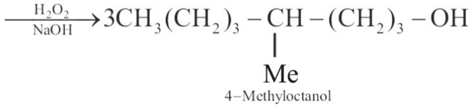
Ans. (a) : Hydroboration-oxidation of alkenes give alcohols containing same number of carbon atoms. The addition follow anti-Markovnikov's rule. Boron atom act as an electrophile. Main two steps are involved. Reagent used BH_3 & NaOH/H_2O_2.



$$3H_3C-\overset{H}{\underset{H}{C}}-\overset{H}{\underset{H}{C}}-\overset{H}{\underset{H}{C}}-\overset{Me}{\underset{H}{C}}-\overset{H}{\underset{H}{C}}-\underset{H}{C}=CH_2+BH_3$$

4- methyl octane

$$\longrightarrow \underset{\text{where R=4-methyl octyl}}{R_3B}$$



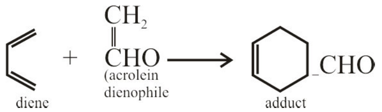
$$\xrightarrow[NaOH]{H_2O_2}3CH_3(CH_2)_3-\underset{\underset{\text{4-Methyloctanol}}{Me}}{CH}-(CH_2)_3-OH$$

344. In which of the below reaction do we find α, β–unsaturated carbonyl compounds undergoing a ring closure reaction with conjugated dienes?

(a) Perkin reaction
(b) Diels-Alder reaction
(c) Claisen rearrangement
(d) Hoffiman reaction

VITEEE- 2007

Ans. (b) : The addition of α, β unsaturated carbonyl compound, with conjugated diene is called Diel's Alder reaction.


CH_2
CHO
(acrolein dienophile
diene
CHO
adduct

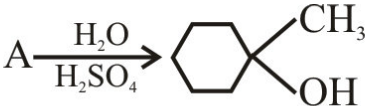
345. Ziegler catalyst to manufacture polyethylene is made by the reaction

(a) $TiCl_4$ with $Al(CH_3)_3$
(b) $TiCl_3$ with CH_3Cl
(c) $TiCl_4$ with $(C_6H_5)_3CCl$
(d) $TiCl_4$ with $ZnCl_2$

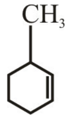
AMU-2017

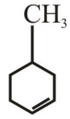
Ans. (a) : Ziegler natta catalyst which is a combination of diethyl aluminum with titanium tetrachloride at a temperature of 333 k to 342 k and a pressure of 6-7 atm. Polythene is made by the reaction of multiple ethylene molecule in the presence of catalyst (Ziegler natta) to break the double bond and connect the carbon atoms into a chain.

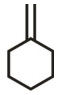
346. In the given reaction, A may be

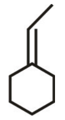

A
H_2O
H_2SO_4
CH_3
OH

@apna_pdf

(a)


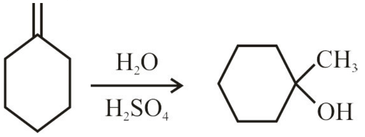
(b)


(c)


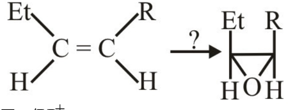
(d)


AMU-2013

Ans. (c) :

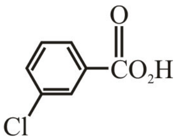


347. What reagent(s) is (are) needed to accomplish the following conversion?



(a) O_3, Zn/H^+

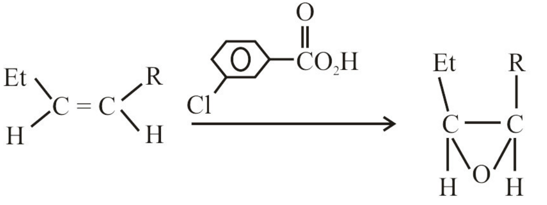
(b) $KMnO_4$, $\bar{O}H$, cold

(c)


(d) H_3O^+

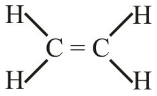
AMU-2013

Ans. (c) : Alkene on react with m – chloroperbenzoic acid to give oxirane or epoxide

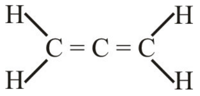


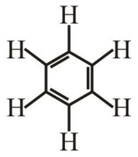
Oxirane (epoxide)

348. Which of the following compounds is strongest acid?

(I)


(II) H – C ≡ C – H

(III)


(IV)


(a) I (b) II
(c) III (d) IV

AMU-2013

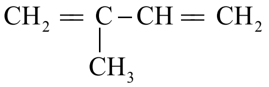
Ans.(b): Acetylene $(CH \equiv CH)$ is strong acid than other because it is more penetrated to the nucleus. So the electrons in s-orbitals are more attracted to the nucleus and the electro negativity of the element having more S-character is more
Hence C in ethyne is more electronegative than in other.

349. The following is a conjugated diene

(a) $CH_3 - CH = C = CH - CH_3$

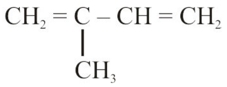
(b) $CH_2 = CH - CH_2 - CH = CH_2$

(c) $CH_2 = CH - CH_2 - CH_2 - CH = CH_2$

(d)

$CH_2 = \underset{\underset{CH_3}{|}}{C} - CH = CH_2$

AMU-2012

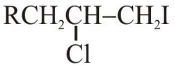
Ans. (d) : A conjugated diene is a molecule that has two double bonds. It the molecule is also a hydrocarbon. It is called alkadiene. When the double bond are separated from each other by two or more single bond, they are called isolated double bonds. Isolated double bonds undergo normal alkene reactions revealing that no interaction occurs between then, the double bond are separated by single bond atypical reaction occur. Such arrangement is called conjugated double bond or conjugated diene.

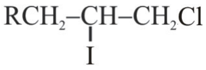
e.g -

$CH_2 = \underset{\underset{CH_3}{|}}{C} - CH = CH_2$

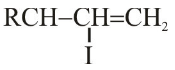
350. In the following reaction,

$RCH_2CH = CH_2 + ICl \rightarrow [A]$

Markownikoff's product [A] is

(a)

$RCH_2\underset{\underset{Cl}{|}}{C}H{-}CH_2I$

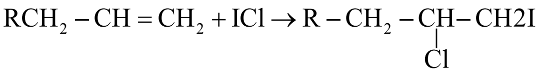
(b)

$RCH_2{-}\underset{\underset{I}{|}}{C}H{-}CH_2Cl$

(c)

$RCH{-}\underset{\underset{I}{|}}{C}H{=}CH_2$

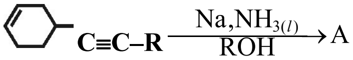
(d) $RCH{=}CH{-}CH_2I$

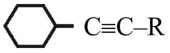
AMU – 2009

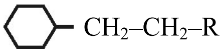
Ans. (a) : In Markownikoffs rule the unsymmetrical reagent adds to a less hydrogenated carbon atom of the double bond.

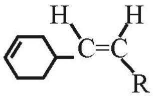

$RCH_2 - CH = CH_2 + ICl \rightarrow R - CH_2 - \underset{\underset{Cl}{|}}{C}H - CH2I$

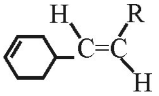
351. The main product (A) of the reaction is



(a)


(b)


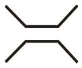
(c)


(d)


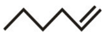
AMU – 2008

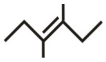
@apna_pdf

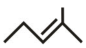
Ans. (d) :

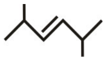
In Birch reduction isolated  are not affected but —≡— in reduced and gives trasn-product.

352. Which of the following alkenes will give propanone and propanal on ozonolysis followed by reaction of ozonide with Zn/H$_2$O ?

(a) 

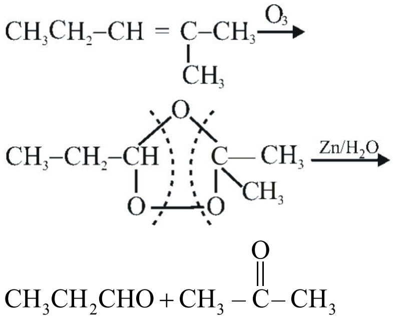
(b) 

(c) 

(d) 

AMU – 2007, 2004

Ans. (c) : 2–Methyl–2–pentene will give propanone and propanal on ozonolysis followed by reaction of ozonide with Zn/H$_2$O.

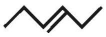


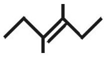
$CH_3CH_2-CH=\underset{CH_3}{\underset{|}{C}}-CH_3 \xrightarrow{O_3}$

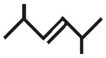
$\xrightarrow{Zn/H_2O}$

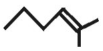
$CH_3CH_2CHO+CH_3-\overset{O}{\overset{||}{C}}-CH_3$

353. Which of the following alkenes will give 2-methyl propanal on ozonolysis followed by the reaction of ozonide with Zn/H$_2$O?

(a) 

(b) 

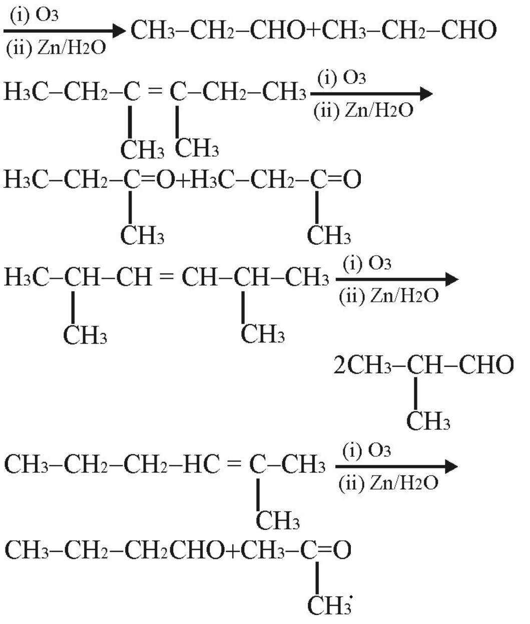
(c) 

(d) 

AMU–2006

AP-EAMCET (Engg.)-21.09.2020, Shift-II

Ans. (c) : $H_3C-CH_2-CH=CH-CH_2-CH_3$



$\xrightarrow[\text{(ii) Zn/H}_2\text{O}]{\text{(i) O}_3} CH_3-CH_2-CHO+CH_3-CH_2-CHO$

$H_3C-CH_2-\underset{CH_3}{\underset{|}{C}}=\underset{CH_3}{\underset{|}{C}}-CH_2-CH_3 \xrightarrow[\text{(ii) Zn/H}_2\text{O}]{\text{(i) O}_3}$

$H_3C-CH_2-\underset{CH_3}{\underset{|}{C}}=O+H_3C-CH_2-\underset{CH_3}{\underset{|}{C}}=O$

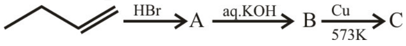
$H_3C-\underset{CH_3}{\underset{|}{CH}}-CH=CH-\underset{CH_3}{\underset{|}{CH}}-CH_3 \xrightarrow[\text{(ii) Zn/H}_2\text{O}]{\text{(i) O}_3}$

$2CH_3-\underset{CH_3}{\underset{|}{CH}}-CHO$

$CH_3-CH_2-CH_2-HC=\underset{CH_3}{\underset{|}{C}}-CH_3 \xrightarrow[\text{(ii) Zn/H}_2\text{O}]{\text{(i) O}_3}$

$CH_3-CH_2-CH_2CHO+CH_3-\underset{CH_3}{\underset{|}{C}}=O$

354. In the sequence of reaction below



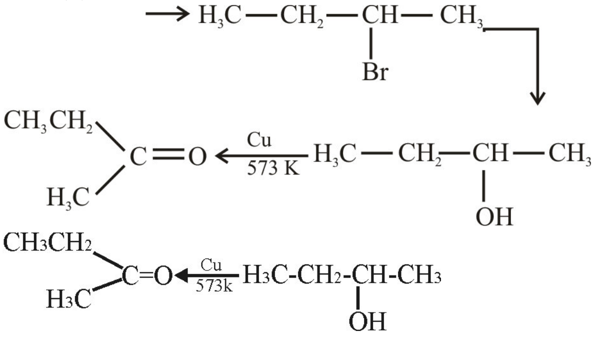
the compound 'C' is

(a) butanal (b) butan-2-one

(c) butan–1–ol (d) butan–2–ol

AMU–2006

Ans. (b) : $H_3C-CH_2-CH=CH_2$



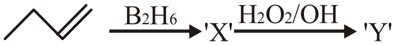
$\to H_3C-CH_2-\underset{Br}{\underset{|}{CH}}-CH_3$

$\begin{matrix}CH_3CH_2\\H_3C\end{matrix}\!\!>C=O \xleftarrow[573\,K]{Cu} H_3C-CH_2-\underset{OH}{\underset{|}{CH}}-CH_3$

$\begin{matrix}CH_3CH_2\\H_3C\end{matrix}\!\!>C=O \xleftarrow[573k]{Cu} H_3C-CH_2-\underset{OH}{\underset{|}{CH}}-CH_3$

Butan-2-one

355. In the sequence of reaction ,



the product 'Y' is

(a) butan –1– o1 (b) butan –2–o1

(c) butanal (d) butan–2–one

AMU–2006

Ans. (a) : $H_3C-CH_2-CH=CH_2$

$\xrightarrow{B_2H_6}(H_3C-CH_2-CH_2-CH_2)_3B$

(X)

$\Big\downarrow H_2O_2 \mid OH^-$

356. Which of the following reactions is the example of electrophilic substitution ?

(a) $CH_2=CH_2+HCl\to CH_3CH_2Cl$

(b) $2CH_3=CH_2+HCl\to CH_3CH_2Cl$

(c) $CH_2=CH_2+H_2\xrightarrow{Ni}CH_3-CH_3$

(d) $C_6H_6+CH_3Cl\xrightarrow{AlCl_3}C_6H_5\,CH_3+HCl$

AMU-2004

Ans. (d) : $C_6H_6+CH_3Cl\xrightarrow{AlCl_3}C_6H_5\,CH_3+HCl$

it is electrophilic substitution reaction.

Here, AlCl$_3$ converts the alkyl chloride into an alkyl carbonium ion.

$CH_3-Cl+AlCl_3\to CH_3^{\oplus}+AlCl_4^{\ominus}$

357. Propene when heated with chlorine at about 500°C form.

(a) $CH_2Cl—CH=CH_2$

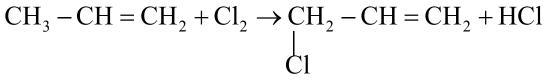
(b) $CH_3—CHCl—CH_2Cl$

(c) $CH_2Cl—CHCl—CH_2Cl$

(d) all of above

AMU 2002

Ans. (a) :



$CH_3-CH=CH_2+Cl_2\to \underset{Cl}{\underset{|}{CH_2}}-CH=CH_2+HCl$

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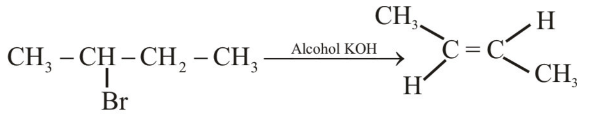
358. **When 2- bromobutane reacts with alcoholic KOH then the product is**

(a) equimolar mixture of 1- butane and 2-butene
(b) Predominantly 2-butene
(c) Predominantly 1-butene
(d) Predominantly 2-butyne

Assam CEE-2019

Ans. (b) : When 2-bromobutane reacts with alcoholic KOH to form trans-2-butene. Trans-2-butene is highly substituted alkene.



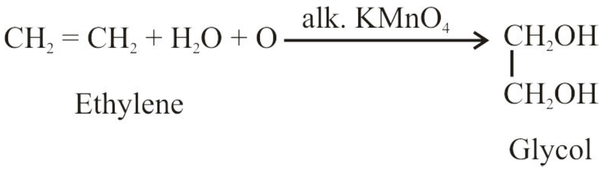
(trans-2-butene)

359. **Which of the following reacts with $KMnO_4$ but does not react with $AgNO_3$?**

(a) C_2H_6
(b) CH_4
(c) C_2H_4
(d) C_2H_2

BCECE-2005

Ans. (c) : Ethylene reacts with KM_nO_4 but does not react with $AgNO_3$. Ethylene is not an acidic nature.



$$CH_2=CH_2+H_2O+O\xrightarrow{\text{alk. }KMnO_4}\begin{array}{l}CH_2OH\\ |\\ CH_2OH\end{array}$$

Ethylene

Glycol

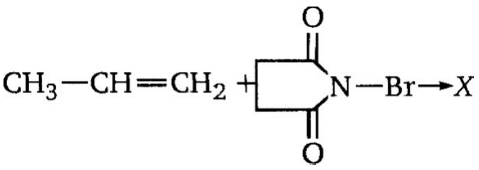
360. **The most stable alkene is :**

(a) $R_2C=CR_2$
(b) $RCH=CHR$
(c) $CH_2=CH_2$
(d) $RCH=CR_2$

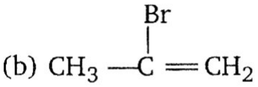
BCECE-2004
AIIMS-1998

Ans. (a) : The more substituted alkene is more stable than less substituted alkene. Alkene is more reactive due to the presence of double bond. So, more the number of electron releasing group of alkyl on the double bond lesser is the stability.

361. **The product 'X', in the following reaction is :**



(a) $CH_2Br—CH=CH_2$

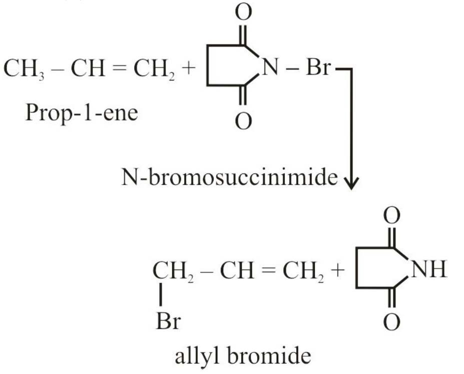


(b) $CH_3—\overset{\overset{\large Br}{|}}{C}=CH_2$

(c) $CH_3CH=CHBr$
(d) none of the above

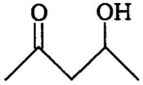
BCECE-2003

Ans. (a) :

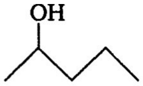


362. **Which one of the following will most readily be dehydrated in acidic conditions?**

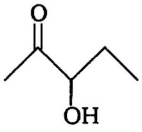
(a)



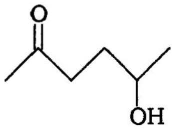
(b)



(c)

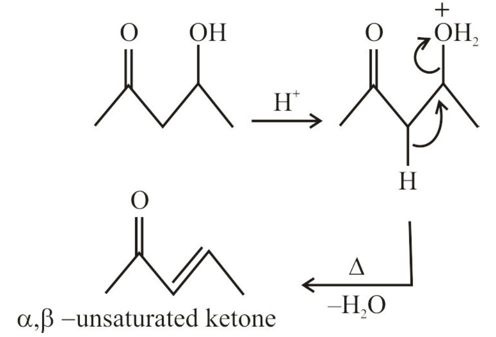


(d)



BCECE-2008

Ans. (a) : The stability increase then greater the conjugation. Β-hydroxyaldehydes or β-hydroxyketones readily undergoes dehydrodion of from more stable α,β - unsaturated aldehydes or ketones.



363. **Ethyl chloride on treatment with alcoholic alkali gives**

(a) C_2H_6
(b) CH_3CHO
(c) C_2H_5OH
(d) $CH_2=CH_2$

BCECE-2009

Ans. (c) : Ethyl chloride can undergo both nucleophilic substitution as well as elimination reaction with strong alkali like KOH. When it undergoes nucleophilic substitution, ethyl alcohol is formed as major product

$$C_2H_5Cl+KOH(aq)\longrightarrow C_2H_5OH+KCl$$

364. **In which of the following can peroxide effect operate?**

(a) $CH_3CH_2CH=CH_2+HCl$
(b) $CH_3CH_2CH=CH_2+HBr$
(c) $CH_3CH=CH{\cdot}CH_3+HBr$
(d) $CH_3CH_2CH=CH_2+HI$

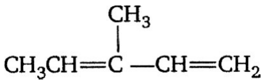
BCECE-2009

@apna_pdf

Ans. (b) : Peroxide effect is also known as kharasch effect. When unsymmetrical alkene react with alkyl halide (only presence of HBr) in the presence of peroxide and reaction proceed via a free radical mechanism.

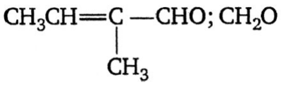
$CH_3–CH_2–CH=CH_2+HBr \xrightarrow{H_2O_2} CH_3–CH_2–CH_2\ CH_2Br$

365. Which set of products is expected on reductive ozonolysis of the following diolefin?



$CH_3CH=\overset{CH_3}{\overset{|}{C}}—CH=CH_2$

(a) $CH_3CHO; CH_3COCH=CH_2$

(b) 

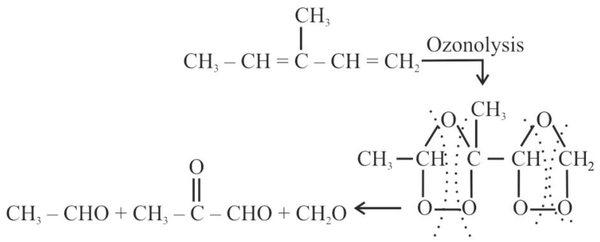
$CH_3CH=\underset{CH_3}{\underset{|}{C}}—CHO; CH_2O$

(c) $CH_3CHO; CH_3COCHO; CH_2O$

(d) $CH_3CHO; CH_3COCH_3; CH_2O$

BCECE-2010

Ans. (c) :



366. In the preparation of alkene from alcohol using Al_2O_3 which is effective factor?

(a) Porosity of Al_2O_3

(b) Temperature

(c) Concentration

(d) Surface area of Al_2O_3

BCECE-2012
NEET-2003
BITSAT-2006

Ans. (b) : In the preparation of alkene from alcohol using Al_2O_3 temperature is the effective factor for dehydration of alcohol by Al_2O_3.

e.g–

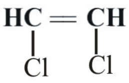
$R-CH_2-CH_2OH \xrightarrow[350\,^{\circ}C-380\,^{\circ}C]{Al_2O_3} R-CH=CH_2+H_2O$

367. The decreasing order of reactivity towards electrophilic addition of the following is–

I. $CH\equiv CH$

II. $CH_2=CH_2$

III. $H_2C=CH—Cl$

IV. 

$\underset{Cl}{\underset{|}{HC}}=\underset{Cl}{\underset{|}{CH}}$

(a) I > II > III > IV
(b) II > I > III > IV
(c) IV > III > I > II
(d) IV > III > II > I

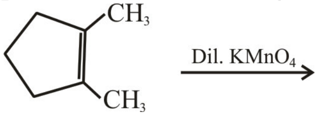
BCECE-2015

Ans. (b) : Ethene is more reactive than Acetylene due to acetylene has more electronegative so the electrophilic addition. Alkene attached with the electron withdrawing group electron.

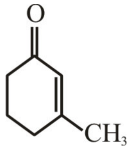
Density decrease so the reactive of electrophilic addition increases.

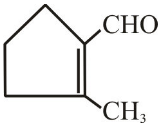
Hence, the order is II > I > III > IV

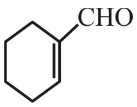
368. What will be the correct structural formula of product for the following reaction?

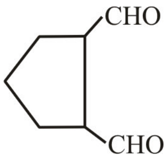


$A \xrightarrow{HIO_4} B \xrightarrow{OH^-} C$

(a) 

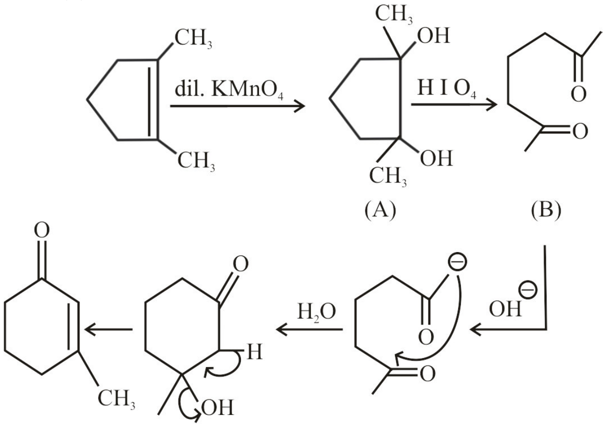
(b) 

(c) 

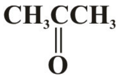
(d) 

[BITSAT-2013]

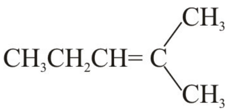
Ans. (a) :



369. Which alkene on ozonolysis gives CH_3CH_2CHO and CH_3CCH_3



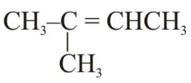
$CH_3\underset{O}{\underset{||}{C}}CH_3$

(a) 

$CH_3CH_2CH=C(CH_3)_2$

(b) $CH_3CH_2CH=CHCH_2CH_3$

(c) $CH_3CH_2CH=CHCH_3$

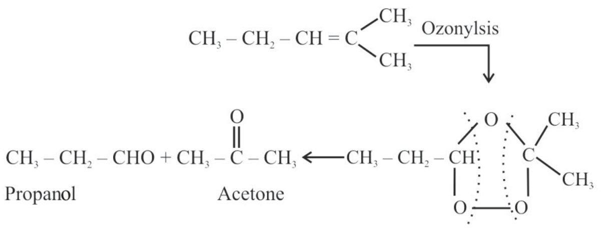
(d) 

$CH_3–\underset{CH_3}{\underset{|}{C}}=CHCH_3$

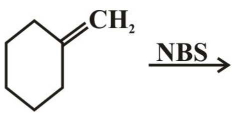
[BITSAT – 2012]

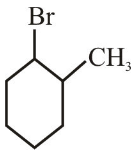
@apna_pdf

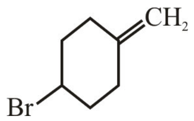
Ans. (a)

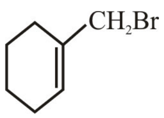


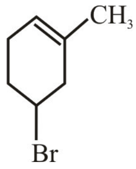
370. What will be the product in the following reaction?



(a)


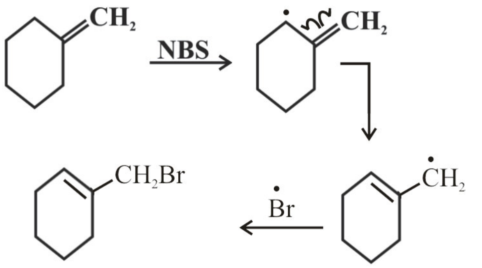
(b)


(c)


(d)


BITSAT – 2011
BHU-2005

Ans. (c) :

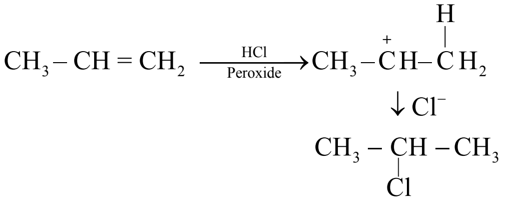


371. The intermediate formed during the addition of HCl to propene in the presence of peroxide is

(a) $CH_3\dot{C}HCH_2Cl$
(b) $CH_2\overset{+}{C}HCH_3$
(c) $CH_3CH_2\dot{C}H_2$
(d) $CH_3CH_2\overset{+}{C}H_2$

[BITSAT- 2009]

Ans. (b) :
The intermediate formed during the addition of HCl to propene in the presence of peroxide is $CH_3–CH^+–CH_3$.



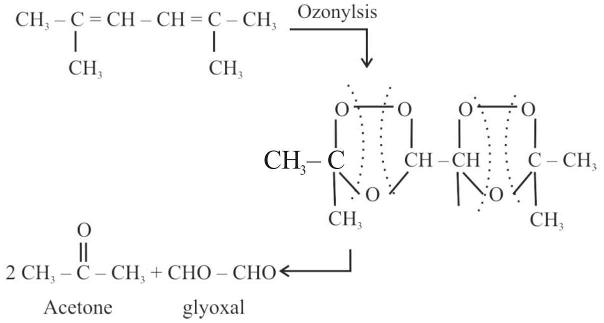
$$CH_3-CH=CH_2 \xrightarrow[Peroxide]{HCl} CH_3-\overset{+}{C}H-\overset{H}{C}H_2 \xrightarrow{Cl^-} CH_3-\underset{Cl}{CH}-CH_3$$

372. Compounds (A) gives two mol acetone and glyoxal on ozonolysis?

(a) 2,5-dimethyl hexyne
(b) 2,5- dimethyl hex-3- ene
(c) 2,5 dimethyl hex-2-yne
(d) 2,5- dimethyl hexa-2,4-diene

CG PET- 2016

Ans. (d) : Ozonolysis refer to the organic chemical reaction where ozone is employed to cleave the unsaturated bands of alkenes and azo compounds.

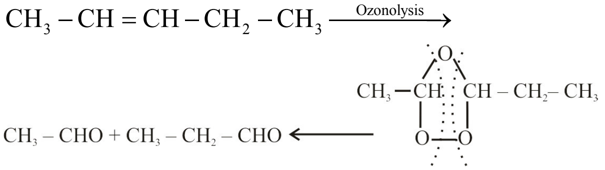


373. The olefin which on ozonolysis gives CH_3CH_2CHO and CH_3CHO is

(a) 2- butene
(b) 1-pentene
(c) 1-butene
(d) 2- pentene

CG PET- 2016

Ans. (d) : 2-Pentene on ozonolysis to give a $CH_3 – CH_2CHO$ and CH_3CHO.



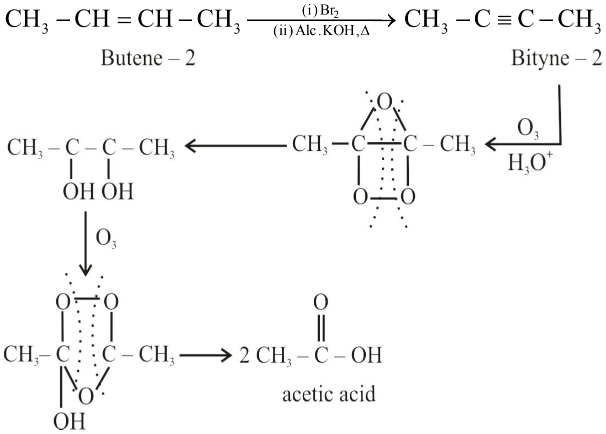
374. Butene-2 $\xrightarrow[2.alc.KOH,\Delta]{1.Br_2}[A]\xrightarrow[H_3^+O]{O_3}[B]$

Compounds A and B are

(a) But-1, 3-diene, formaldehyde
(b) allene, formaldehyde
(c) Butyne-2acetic acid
(d) Butyne-1,formicacid

CG PET -2019, 2021

Ans. (c) :



@apna_pdf

375. Propyne and propene can b distinguished by

(a) cone, H_2SO_4 (b) Br_2 in CCl_4

(c) dil, H_2SO_4 (d) $AgNO_3$ in ammonia

CG PET- 2012

Ans. (d) : Propene and propyne are distinguished by common chemicals tests namely ammonical silver nitrate or ammonical cuprous chloride. Ammonical silver nitrate is also called as Tollen's reagent.

When propyne is mixed with ammonical silver nitrate a white precipitate is formed. Whereas there is no reaction when Tollen's reagent to propene.

Propyne + ammonical silver nitrate → silver acetylide (white ppt.) + NH_3 + H_2O Propene + ammonical silver nitrate → No reaction.

376. $C_2H_2 \xrightarrow[H_2SO_4, H_2O]{Hg^{2+}} A \xrightarrow{[O]} B$

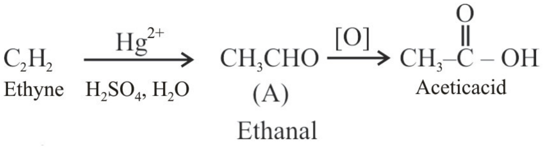
The compound B is

(a) an acid (b) an aldehyde

(c) ketone (d) ethanol

CG PET- 2012

Ans. (a) :



$$\underset{\text{Ethyne}}{C_2H_2} \xrightarrow[H_2SO_4,\ H_2O]{Hg^{2+}} \underset{\substack{(A)\\ \text{Ethanal}}}{CH_3CHO} \xrightarrow{[O]} \underset{\text{Aceticacid}}{CH_3-\overset{\overset{O}{\|}}{C}-OH}$$

377. The addition of HBr is easiest with

(a) $CH_2{=}CHCI$

(b) $CHCI{=}CHCI$

(c) $CH_3 - CH_2{=}CH_2$

(d) $(CH_3)_2C{=}CH_2$

MPPMT-2000

Ans. (d) : Addition of HBr to alkene involves the formation of carbocation intermediate. The carbocation is stabilized by the presence of alkyl group due to +I effect and presence of electron donating group. The number of α - hydrogen is maximum then stability of carbocation increase.

Hence, the $(CH_3)_2$ C = CH_2 is addition of HBr is easiest.

378. Alkene which on ozonolysis yields acetone, is

(a) $CH_2{=}CH{-}CH_2{-}CH_3$

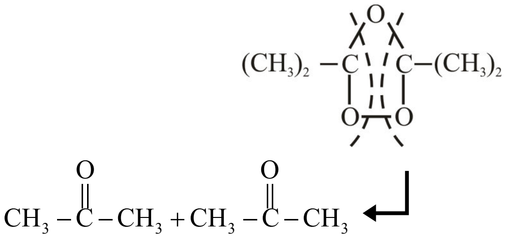
(b) $CH_3{-}CH{=}CH_2$

(c) $CH_3 - CH{=}CH{-}CH_3$

(d) $(CH_3)_2{-}C{=}C{-}(CH_3)_2$

CGPET-2012

Ans. (d) : $(CH_3)_3 – C = C – (CH_3)_2 \xrightarrow{\text{Ozonolysis}}$



379. Baeyer's reagent decolourises which of the following?

(a) Alkane

(b) Alkene

(c) Alkene and alkyne both

(d) None of the above

CG PET -2006

Ans. (c) : Baeyer's reagent is an alkaline solution of cold potassium permanganate ($KMnO_4$) of violet colour solution. It decolourizes by alkene and alkyne both compound which decolourizes Baeyer's reagent. Baeyer's reagent will dissolve in water to give an intense violet or purple colour. It is used for detection of unsaturation in an molecule.

380. The conversion of cis-1 2-dichloroethene to trans-1,2- dichloroethene is an example of

(a) pseudo-unimolecular reaction

(b) the reaction having order between 1 and 2

(c) unimolecular reaction

(d) The conversion is spontaneous so zero-order reaction

CG PET -2017

Ans. (c) : The conversion of cis-1,2-dichloroethene to trans-1,2-dichloroethene is an example of unimolecular reaction. This reaction follow 1st order rate kinetics. It is a reversible reaction. At equilibrium, both isomers are present, with their equilibrium concentrations determined by the rate at which the forward and reverse reaction takes place

$$A \underset{k-1}{\overset{k_1}{\rightleftharpoons}} B$$

381. The compound X(C_5H_8) reacts with ammoniacal $AgNO_3$ to give a white precipitate and reacts with excess of $KMnO_4$ to give the acid, $(CH_3)_2 CH-COOH$. Therefore, X is

(a) $CH_2{=}CH{-}CH{=}CH{-}CH_3$

(b) $CH_3(CH_2)_2C{\equiv}CH$

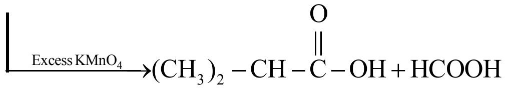
(c) $(CH_3)_2CH{\cdot}{\equiv}CH$

(d) $(CH_3)_2C{=}C{=}CH_2$

CG PET- 2010

Ans. (c) :

$(CH_3)_2-CH-C\equiv CH \xrightarrow{AgNO_3} \underset{\text{White precipitate}}{(CH_3)_2-CH-C\equiv Ag^+}$



$$\xrightarrow{\text{Excess KMnO}_4} (CH_3)_2-CH-\overset{\overset{O}{\|}}{C}-OH+HCOOH$$

Hence, the compound 'X' is 3-methyl but-1-yen.

382. In the reaction,

$$\mathbf{CH_3COOH \xrightarrow{LiAlH_4} A \xrightarrow{PCl_5} B \xrightarrow{alc.KOH} C}$$

the product C is

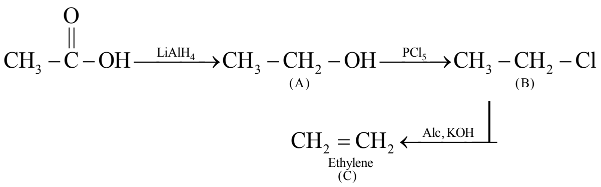
(a) acetaldehyde (b) acetylene

(c) ethylene (d) acetylchloride

JEE Main -2014

@apna_pdf

Ans. (c) :


LiAlH4
(A)
PCl5
(B)
Alc, KOH
Ethylene
(C)

$CH_3-\overset{O}{\overset{\|}{C}}-OH \xrightarrow{LiAlH_4} \underset{(A)}{CH_3-CH_2-OH} \xrightarrow{PCl_5} \underset{(B)}{CH_3-CH_2-Cl} \xrightarrow{Alc, KOH} \underset{(C)}{\underset{Ethylene}{CH_2=CH_2}}$

In the reaction, the produce 'C' is ethylene.

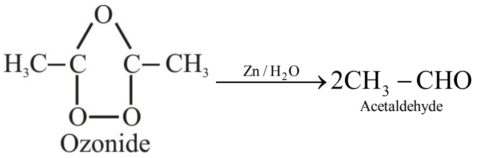
383. One mole of a symmetrical alkene on ozonolysis gives two moles of an aldehyde having a molecular mass of 44 u. The alkene is

(a) propene (b) 1-butene
(c) 2-butene (d) ethene

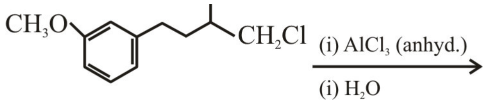
AIEEE 2010, 2008

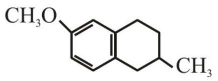
Ans. (c) :
2-butene which is a symmetrical alkene. Therefore, it will undergo ozonolysis and will give two moles of an aldehyde whose molecular mass equals to 44g/mole.

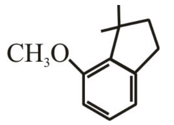
$$CH_3-CH=CH-CH_3+O_3 \xrightarrow[196K]{CHCL_3/CCl_4}$$

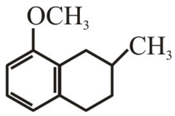

Zn / H2O
2CH3 – CHO
Acetaldehyde
Ozonide

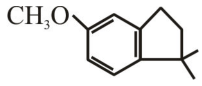
384. The major product of the following reaction is:


CH3O
CH2Cl
(i) AlCl3 (anhyd.)
(i) H2O

(a)


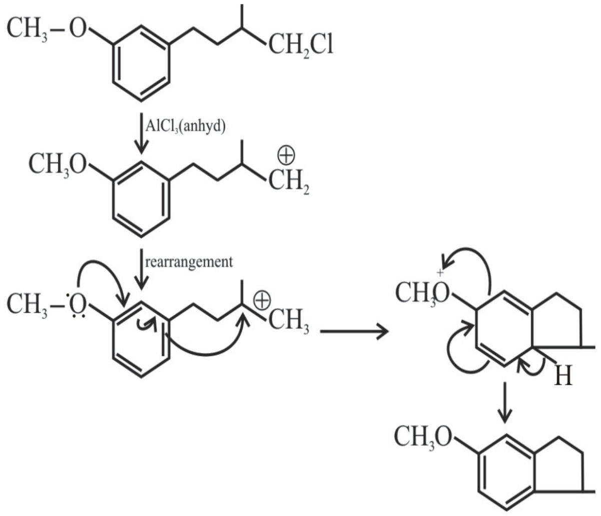
(b)


(c)


(d)


[JEE Main-2019, 10 Jan Shift-I]

Ans. (d) :

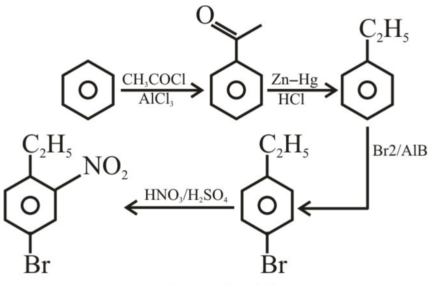

CH3–O
CH2Cl
AlCl3(anhyd)
CH3O
⊕
CH2
rearrangement
CH3–Ö
⊕
CH3
CH3O
H
CH3O

385. The correct sequence of reagents used in the preparation of 4-bromo-2-nitroethyl benzene from benzene is:

(a) $CH_3COCl/AlCl_3$, $Br_2/AlBr_3$, HNO_3/H_2SO_4, Zn/HCl
(b) $CH_3COCl/AlCl_3$, Zn-Hg/HCl, $Br_2/AlBr_3$, HNO_3/H_2SO_4
(c) $Br_2/AlBr_3$, $CH_3CoCl/AlCl_3$, HNO_3/H_2SO_4, Zn/HCl
(d) HNO_3/H_2SO_4, $Br_2/AlCl_3$, $CH_3COCl/AlCl_3$, Zn-Hg/HCl

[JEE Main-2021, 25 Feb Shift-II]

Ans. (b):


O
CH3COCl
AlCl3
Zn–Hg
HCl
C2H5
Br2/AlBr3
C2H5
NO2
HNO3/H2SO4
C2H5
Br
Br

4-Bromo-2-nitroethyl benzene

386. Acetylene does not react with:

(a) Na
(b) Ammoniacal $AgNO_3$
(c) HCl
(d) NaOH

AIEEE 2002
JIPMER-2016

Ans. (d) : We know that acetylene is a weak acid and it has terminal hydrogen

$$\underset{\substack{Weak\\acid}}{CH\equiv CH}+\underset{\substack{Weaker\\base}}{NaOH}\longrightarrow\underset{\substack{Strong\\base}}{CH\equiv C^-Na^+}+\underset{\substack{Strong\\acid}}{H_2O}$$

Acetylene does not react with NaOH because weak acid and strong base not give a strong acid.

387. Acetylene reacts with hypochlorous acid to form

(a) Cl_2CHCHO (b) $ClCH_2COOH$
(c) CH_3COCl (d) $ClCH_2CHO$

AIEEE 2002
UP CPMT-2012

Ans. (a) : Acetylene reacts with hypochlorous acid to form a dichloroacetaldehyde.

$$HC\equiv CH+2HOCl\longrightarrow[CHCl_2-CH(OH)_2]$$
$$\underset{Dichloro\,acetaldehyde}{CHCl_2CHO}\xleftarrow{H_2O}$$

388. 2-hexyne gives trans-2-hexene on treatment with :

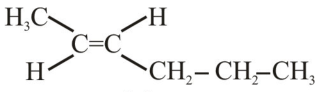
(a) Pt/H_2 (b) Li/NH_3
(c) $Pd/BaSO_4$ (d) $LiAlH_4$

AIEEE 2012, 2004
JEE Main-2018

@apna_pdf

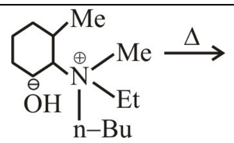
Ans. (b) : 2-hexyne react with Li/NH₃ to give a trans - 2-hexene.

$$\underset{\text{2–hexyne}}{CH_3-C\equiv C-CH_2-CH_2-CH_3}\xrightarrow{Li/NH_3}$$

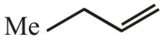


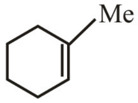
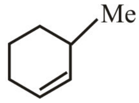
trans-2-hexene

389.



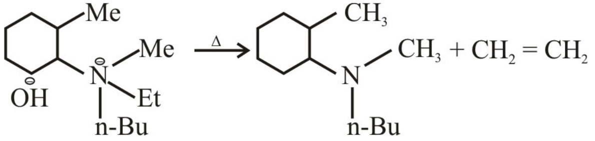
The alkene formed as a major product in the above elimination reaction is :

(a)  (b) $CH_2{=}CH_2$

(a)  (b) 

[AIEEE 2008]

Ans.(b) :



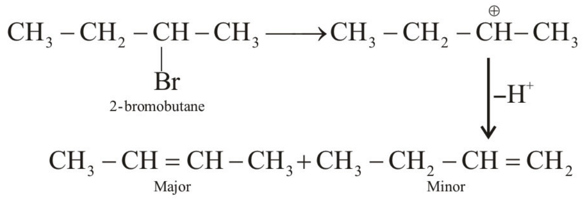
In Hoffmann reaction less substituted alkene is major product.

390. Elimination of bromine from 2-bromobutane results in the formation of:

(a) Predominantly 2-butyne
(b) Predominantly 1-butene
(c) Predominantly 2-butene
(d) Equimolar mixture of 1 and 2-butene

[AIEEE 2005]

Ans. (c) :



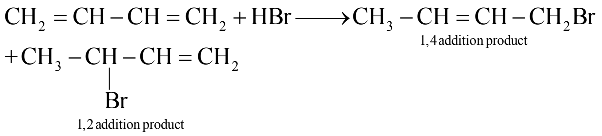
$$\underset{\text{2-bromobutane}}{CH_3-CH_2-\underset{|}{\overset{}{CH}}(Br)-CH_3}\longrightarrow CH_3-CH_2-\overset{\oplus}{C}H-CH_3\xrightarrow{-H^+}\underset{\text{Major}}{CH_3-CH=CH-CH_3}+\underset{\text{Minor}}{CH_3-CH_2-CH=CH_2}$$

391. Reaction of one molecule of HBr with one molecule of 1, 3-butadiene at 40°C gives predominantly :

(a) 1-bromo-2-butene under kinetically controlled conditions
(b) 3-bromobutene under thermodynamically controlled conditions
(c) 1-bromo-2-butene under thermodynamically controlled conditions
(d) 3-bromobutene under kinetically controlled conditions

[AIEEE 2005]

Ans. (c) : 1, 2-addition product is kinetically controlled product while 1, 4-addition product is thermodynamically controlled product and formed at comparatively higher temperature.



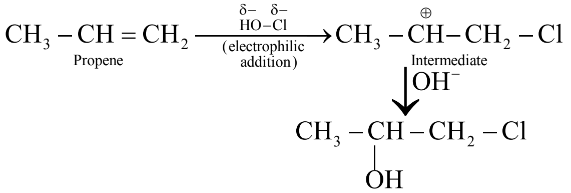
$$CH_2=CH-CH=CH_2+HBr\longrightarrow\underset{\text{1,4 addition product}}{CH_3-CH=CH-CH_2Br}+\underset{\text{1,2 addition product}}{CH_3-\underset{\underset{Br}{|}}{CH}-CH=CH_2}$$

392. The reaction of propene with HOCl (Cl_2 + H_2O) proceeds through the intermediate:

(a) $CH_3\overset{+}{C}HCH_2Cl$ (b) $CH_3CH(OH)\overset{+}{C}H_2$
(c) $CH_3CHCl\overset{+}{C}H_2$ (d) $CH_3\overset{+}{C}HCH_2OH$

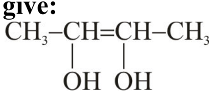
[JEE Main 2016]

Ans. (a) : The reaction of propene with HOCl proceeds through the intermediate $CH_3-\overset{\oplus}{C}H-CH_2Cl$.



$$\underset{\text{Propene}}{CH_3-CH=CH_2}\xrightarrow[\text{(electrophilic addition)}]{\overset{\delta-\ \ \delta-}{HO-Cl}}\underset{\text{Intermediate}}{CH_3-\overset{\oplus}{C}H-CH_2-Cl}\xrightarrow{OH^-}CH_3-\underset{\underset{OH}{|}}{CH}-CH_2-Cl$$

393. But-2-ene on reaction with alkaline $KMnO_4$ at elevated temperature followed by acidification will give:

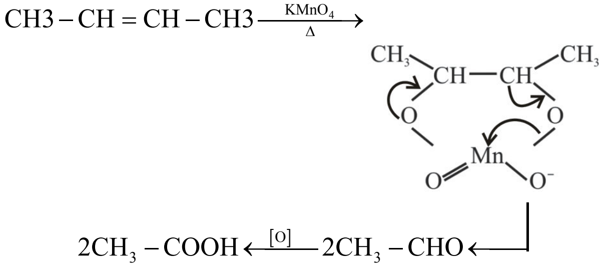
(a) 

$CH_3-\underset{OH}{CH}=\underset{OH}{CH}-CH_3$

(b) One molecule of CH_3CHO and one molecule of CH_3COOH
(c) 2 molecules of CH_3COOH
(d) 2 molecule of CH_3CHO

[JEE Main-2019, 12 April Shift-I]

Ans. (c) : But-2-ene on reaction with alkaline $KMnO_4$ at elevated temperature is give a acetic acid.



$$CH3-CH=CH-CH3\xrightarrow[\Delta]{KMnO_4}\ \cdots\ \longrightarrow 2CH_3-CHO\xrightarrow{[O]}2CH_3-COOH$$

394. Butene-1 may be converted to butane by reaction with :

(a) Zn-HCl (b) Sn-HCl
(c) Zn-Hg (d) Pd/H_2

[AIEEE 2003]

Ans. (d) : Alkene can be converted to alkanes by addition of hydrogen (H_2). In a hydrogenation reaction, two hydrogen atom are added across the double boond of an alkene, resulting in a saturated alkane. The reaction occurs in the presence of a catalyst like nickel, platinum or palladium.

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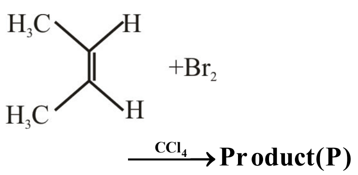
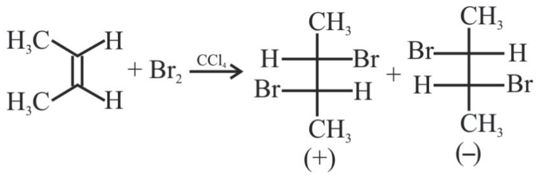
395.



Consider the above chemical reaction. The total number of stereoisomers possible for product P is ....

[JEE Main-2021, 25 July Shift-II]

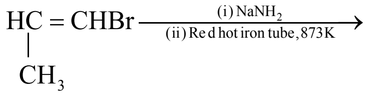
Ans. (2) :



2, 3 dibromobutane

Hence, the total number of stereoisomer is two.

396. For the given reaction :

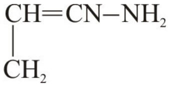


$$\underset{\displaystyle CH_3}{\underset{|}{HC}} = CHBr \xrightarrow[\text{(ii) Red hot iron tube, 873K}]{\text{(i) NaNH}_2}$$

(A)
Major product

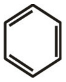
(a) $CH_3CH_2CH_2NH_2$

(b)

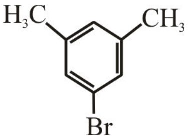


$$\underset{\displaystyle CH_2}{\underset{|}{CH}}=CN-NH_2$$

(c)

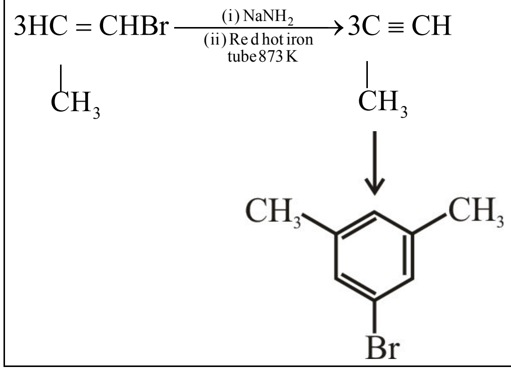


(d)

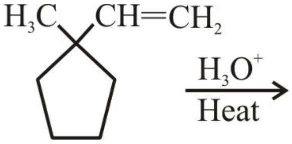


[JEE Main-2021, 26 Feb Shift-I]

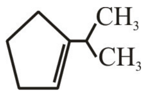
Ans. (d) :



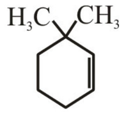
397. The major product in the following reaction is:



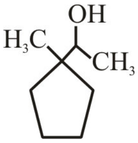
(a)



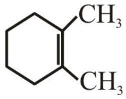
(b)



(c)

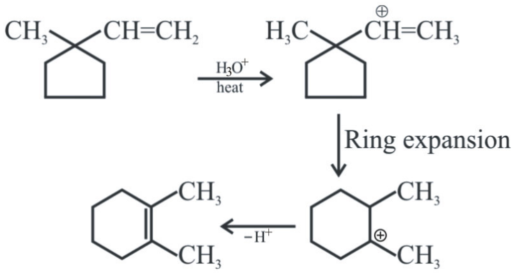


(d)



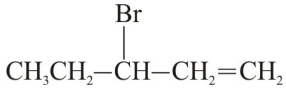
[JEE Main-2020, 5 Sep Shift-II]

Ans. (d) :



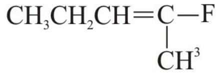
398. The major product obtained from E_2 – elimination of 3-bromo-2-fluoropentane is :

(a)



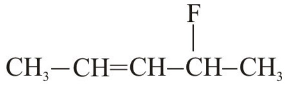
$$CH_3CH_2-\overset{\displaystyle Br}{\overset{|}{CH}}-CH_2=CH_2$$

(b)



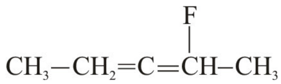
$$CH_3CH_2CH=\underset{\displaystyle CH^3}{\underset{|}{C}}-F$$

(c)



$$CH_3-CH=CH-\overset{\displaystyle F}{\overset{|}{CH}}-CH_3$$

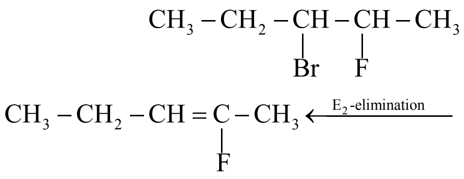
(d)



$$CH_3-CH_2=C=\overset{\displaystyle F}{\overset{|}{CH}}-CH_3$$

[JEE Main-2020, 2 Sep Shift-II]

Ans. (b) :

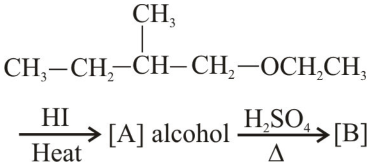


$$CH_3-CH_2-\underset{\displaystyle Br}{\underset{|}{CH}}-\underset{\displaystyle F}{\underset{|}{CH}}-CH_3$$

$$CH_3-CH_2-CH=\underset{\displaystyle F}{\underset{|}{C}}-CH_3 \xleftarrow{E_2\text{-elimination}}$$

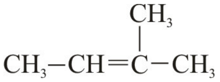
Stable alkene having 5 α–H

399. The major product [B] in the following reactions is :



$$CH_3-CH_2-\overset{\displaystyle CH_3}{\overset{|}{CH}}-CH_2-OCH_2CH_3 \xrightarrow[\text{Heat}]{\text{HI}} [A]\text{ alcohol} \xrightarrow[\Delta]{H_2SO_4} [B]$$

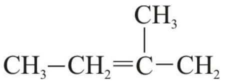
(a)



$$CH_3-CH=\overset{\displaystyle CH_3}{\overset{|}{C}}-CH_3$$

(b) $CH_2=CH_2$

(c)



$$CH_3-CH_2=\overset{\displaystyle CH_3}{\overset{|}{C}}-CH_2$$

(d) $CH_3–CH_2–CH=CH–CH_3$

[JEE Main-2020, 4 Sep Shift-II]

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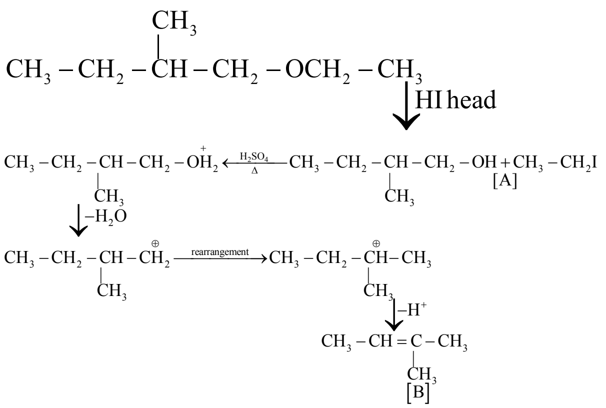
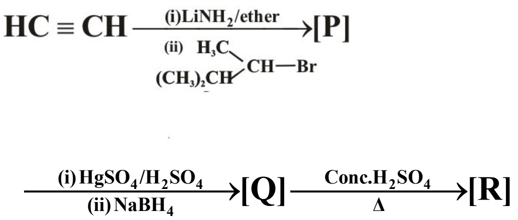
Ans. (a)

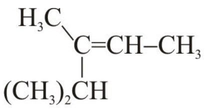

HI head
H_2SO_4 Δ
[A]
$-H_2O$
rearrangement
$-H^+$
[B]

400. The major product [R] in the following sequence of reactions is:

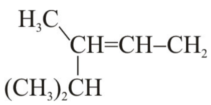


$$HC\equiv CH \xrightarrow[\text{(ii) } \underset{(CH_3)_2CH}{\overset{H_3C}{\ }}\!\!>CH-Br]{\text{(i) } LiNH_2/\text{ether}} [P] \xrightarrow[\text{(ii) } NaBH_4]{\text{(i) } HgSO_4/H_2SO_4} [Q] \xrightarrow[\Delta]{Conc.H_2SO_4} [R]$$

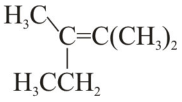
(a)



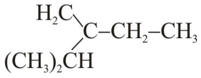
(b)



(c)

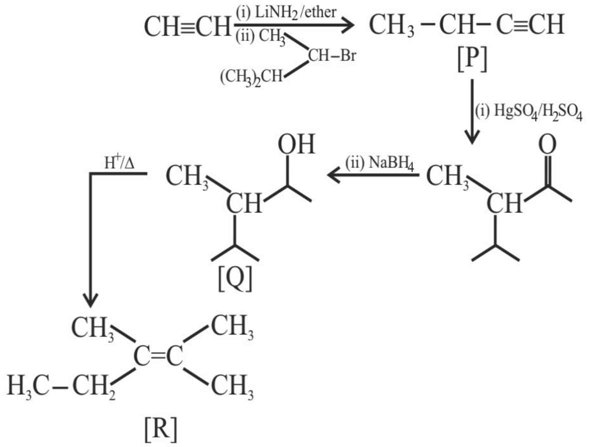


(d)

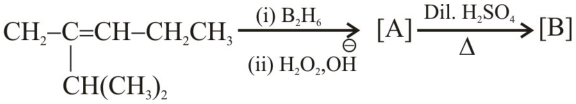


[JEE Main-2020, 4 Sep Shift-II]

Ans. (c) :

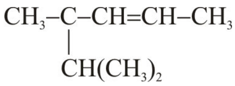

(i) $LiNH_2$/ether
(ii)
[P]
(i) $HgSO_4/H_2SO_4$
(ii) $NaBH_4$
[Q]
H^+/Δ
[R]

401. The major product [B] in the following sequence of reactions is :



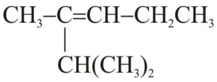
$$CH_2-\underset{CH(CH_3)_2}{C}=CH-CH_2CH_3 \xrightarrow[\text{(ii) } H_2O_2,\overset{\ominus}{O}H]{\text{(i) } B_2H_6} [A] \xrightarrow[\Delta]{\text{Dil. } H_2SO_4} [B]$$

(a)



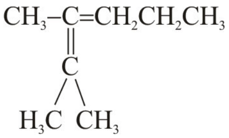
$$CH_3-\underset{CH(CH_3)_2}{C}-CH=CH-CH_3$$

(b)

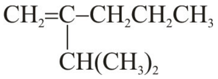


$$CH_3-\underset{CH(CH_3)_2}{C}=CH-CH_2CH_3$$

(c)



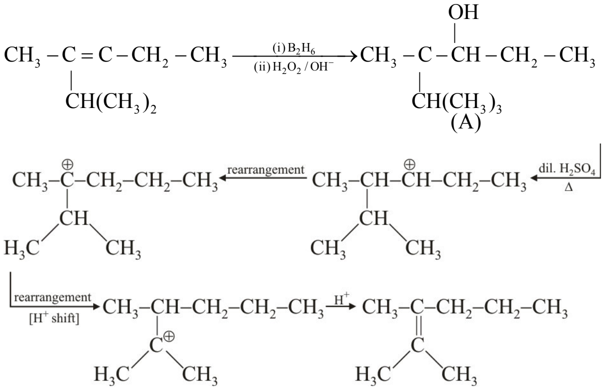
(d)



$$CH_2=\underset{CH(CH_3)_2}{C}-CH_2CH_2CH_3$$

[JEE Main-2020, 8 Jan Shift-II]

Ans. (c) :

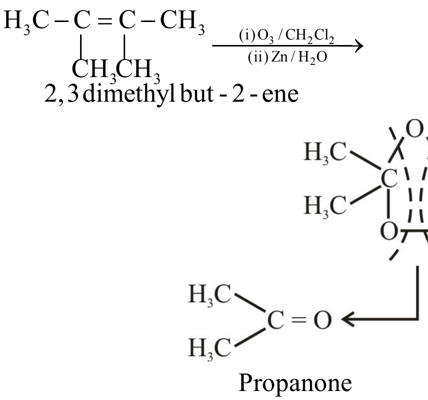

(i) B_2H_6
(ii) H_2O_2/OH^-
(A)
rearrangement
dil. H_2SO_4 Δ
rearrangement [H^+ shift]
H^+

402. Which among the following alkenes on reductive ozonolysis produces only propanone?

(a) 2-Methylpropene
(b) 2-Methylbut-2-ene
(c) 2,3-Dimethylbut-1-ene
(d) 2.3-Dimethylbut-2-ene

J & K CET-(2016)

Ans. (d) :



$$H_3C-\underset{CH_3}{C}=\underset{CH_3}{C}-CH_3 \xrightarrow[\text{(ii) } Zn/H_2O]{\text{(i) } O_3/CH_2Cl_2}$$

2,3 dimethyl but-2-ene

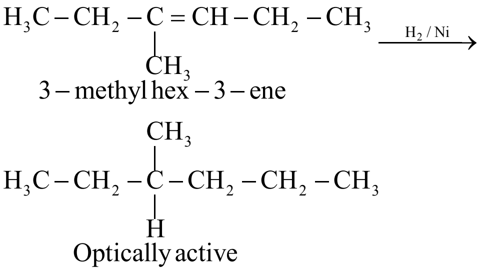
Propanone

403. Which of one of the following alkenes on hydrogenation produces an optically active product?

(a) 2- Methylbut-2-ene (b) 3-Methylhex-3-ene
(c) 2-Methylpent-2-ene (d) 3-Methylpent-2-ene

J & K CET-(2016)

Ans. (b) :



$$H_3C-CH_2-\underset{CH_3}{C}=CH-CH_2-CH_3 \xrightarrow{H_2/Ni}$$

3 – methyl hex – 3 – ene

$$H_3C-CH_2-\overset{CH_3}{\underset{H}{C}}-CH_2-CH_2-CH_3$$

Optically active

@apna_pdf

404. Ethylene can be converted into alcohol by treatment of

(a) aq.KOH
(b) H_2SO_4 as catalyst
(c) moist silver oxide
(d) Zn/HCl.

J & K CET-(2014)

Ans. (b) : Ethene is converted into ethanol by passing its vapour through water in the presence of sulphuric acid. This reaction is called as hydration of ethane.

$$\underset{\text{Ethylene}}{CH_2=CH_2} + H_2O \xrightarrow{H_2SO_4} \underset{\text{Ethanol}}{CH_3-CH_2-OH}$$

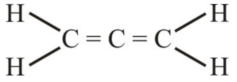
By passing ethane vapours through water in the presence of catalyst sulfuric acid, ethane is transformed to ethanol.

405. Allene (C_3H_4) contains

(a) one triple and two double bonds
(b) two double and four single bonds
(c) two triple and one double bonds
(d) one double and one triple bond.

J & K CET-(2017)
UPTU/UPSEE-2005

Ans. (b) : Allene are organic compound in which one carbon atom has double bond with each of its two adjacent carbon centres. Allenes are classified as cumulated dienes. The parent compound of this clause is propadiene, which is itself also called allene.



In allene (C_3H_4) contains two double bond and four single bond.

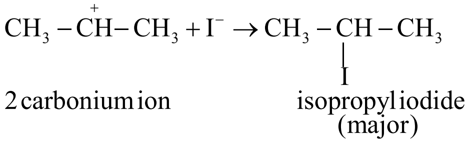
406. Addition of HI on the double bond of propene isopropyl iodide and not n-propyl iodide as the major product. This is because the addition proceeds through

(a) a more stable carbonium ion
(b) a more stable carbanion
(c) a more stable free radical
(d) none of these

J & K CET-(1998)

Ans. (a) :

$$CH_3-CH=CH_2+HI \rightarrow \underset{\text{(Major)}}{CH_3-\overset{\oplus}{C}H_2-CH_3} + \underset{\text{(Minor)}}{CH_3-CH_2-\overset{\oplus}{C}H_2}$$



$$CH_3-\overset{+}{C}H-CH_3+I^- \rightarrow CH_3-\underset{\underset{I}{|}}{CH}-CH_3$$

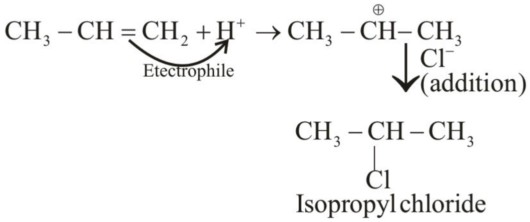
2 carbonium ion isopropyl iodide (major)

407. Reaction between propene and HCl to form isopropyl chloride takes place through

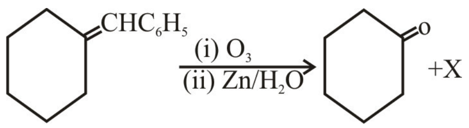
(a) nucleophilic addition reaction
(b) electrophilic substitution reaction
(c) nucleophilic substitution reaction
(d) electrophilic addition reaction

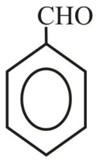
J & K CET-(2010)

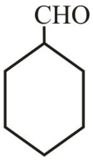
Ans. (d) : Reaction between propene and HCl to form isopropyl chloride take places through electrophilic addition reaction.

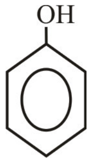


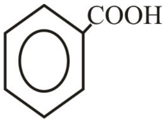
408. Identify the compound X in the following reaction:



(a)


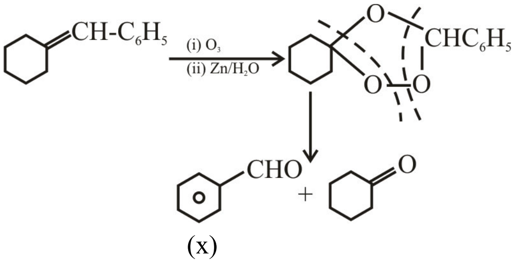
(b)


(c)


(d)


J & K CET-(2010)

Ans. (a) :



409. But-2-ene could exist as

(a) E and Z is isomers
(b) R and S isomers
(c) geometrical isomers
(d) only one compound

J & K CET-(2002)

Ans. (c) : Geometrical isomer is shown by the compound having the same molecular formula but differ in the arrangement of atoms in space. It is also known as Cis and trans isomerism or configurational isomerism. In but-2-ene, the group attached to double bonded carbon are different, that is H and CH_3 on one carbon and other side also has H and CH_3 can be rotated on same side of double bond to form Cis - 2 - butane and on rotating opposite sides of double bonded carbon atom it form trans-2-butene. So but-2-ene shows geometrical isomerism.

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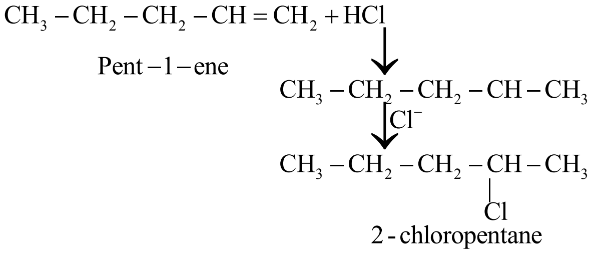
410. Which of the following is formed when pent-1-ene reacts with HCl?
(a) 3-chloropentane
(b) 2-chloropentane
(c) 1,2-dichloropentane
(d) 1-chloropentane

J & K CET-2002

Ans. (b) :



$$CH_3-CH_2-CH_2-CH=CH_2+HCl$$

Pent – 1 – ene

$$\downarrow$$

$$CH_3-CH_2-CH_2-CH-CH_3$$

$$\downarrow Cl^-$$

$$CH_3-CH_2-CH_2-\underset{\substack{|\\ Cl}}{CH}-CH_3$$

2 - chloropentane

This reaction procced through Markownikoff's rule.

411. Which of the following does not react with ammoniacal $AgNO_3$, but decolourises bromine water?
(a) C_2H_6 (b) C_3H_8
(c) C_2H_2 (d) C_2H_4

J & K CET-(2002)

Ans. (d) : C_2H_4 (ethane) decolourise Br water it does not give any white precipitate on reacting with ammonical $AgNO_3$

412. The general molecular formula for a cycloalkyl group is
(a) C_nH_{2n+1} (b) C_nH_{2n-1}
(c) C_nH_{2n} (d) none of these

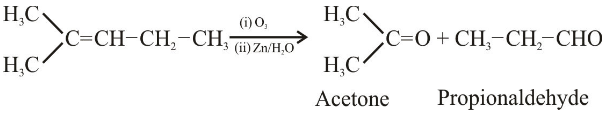
J & K CET-(2002)
UPCPMT-2013

Ans. (b) : The general formula of cycloalkyl group is C_nH_{2n-1}.

413. If ozonolysis of an organic compound A yields acetone and propionaldehyde, then A is
(a) iso-butylene
(b) 3-methyl-2-pentene
(c) 2-methyl-2 pentene
(d) 2- methyl-1-pentene

J & K CET-(2001)

Ans. (c) : 2-methyl-2-pentene on ozonolysis to give a acetone and propionaldehyde



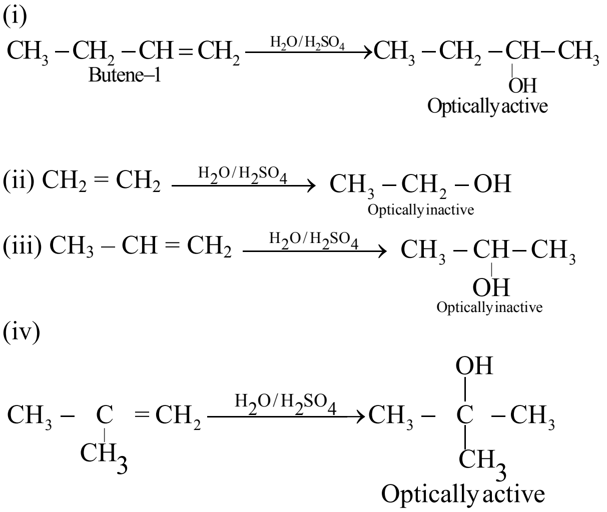
$$\begin{matrix}H_3C\\ H_3C\end{matrix}\!\!>\!C=CH-CH_2-CH_3\xrightarrow[\text{(ii) Zn/}H_2O]{\text{(i) }O_3}\begin{matrix}H_3C\\ H_3C\end{matrix}\!\!>\!C=O+CH_3-CH_2-CHO$$

Acetone Propionaldehyde

414. Which of the following alkenes will not give an optically active alcohol when treated with H_2O/H_2SO_4?
(a) Butene-l (b) Ethene
(c) Propene (d) 2-Methylpropene

J & K CET-(1997)

Ans. (b) :



(i)

$$\underset{\text{Butene–1}}{CH_3-CH_2-CH=CH_2}\xrightarrow{H_2O/H_2SO_4}CH_3-CH_2-\underset{\substack{|\\ OH}}{CH}-CH_3$$

Optically active

(ii) $$CH_2=CH_2\xrightarrow{H_2O/H_2SO_4}\underset{\text{Optically inactive}}{CH_3-CH_2-OH}$$

(iii) $$CH_3-CH=CH_2\xrightarrow{H_2O/H_2SO_4}CH_3-\underset{\substack{|\\ OH}}{CH}-CH_3$$

Optically inactive

(iv)

$$CH_3-\underset{\substack{|\\ CH_3}}{C}=CH_2\xrightarrow{H_2O/H_2SO_4}CH_3-\overset{\substack{OH\\ |}}{\underset{\substack{|\\ CH_3}}{C}}-CH_3$$

Optically active

415. The preparation of ethene from ethanol can be described as
(a) addition (b) dehydration
(c) hydrogenation (d) oxidation

J & K CET-(1999)

Ans. (b) : Ethene is prepared by the dehydration of ethyl alcohol in the presence of conc H_2SO_4 at 160ºC.

$$\underset{\text{Ethanol}}{C_2H_5OH}\xrightarrow[160^\circ C]{\text{Conc.}H_2SO_4}\underset{\text{Ethene}}{CH_2=CH_2}+H_2O$$

416. For the industrial manufacture of high density polyethylene, identify the process that is generally adopted out of the following.
(a) free-radical liquid phase polymerisation
(b) free-radical gas phase polymerisation
(c) Zeigler-Natta or oxide catalysed polymerisation
(d) anionic polymerization

J & K CET-(2001)

Ans. (c) : High density polyethylene is manufacture of low pressure (1.0 – 80 atm) in the presence of a Ziegler - Natta or oxide catalysed polymerization Typical temperature range between 350 – 420K. Hydrogen is mixed with the ethane to control the chain length of polymer.

417. Acid catalysed hydration of alkenes except ethene leads to the formation of
(a) mixture of secondary and tertiary alcohols
(b) mixture of primary and secondary alcohols
(c) secondary or tertiary alcohol
(d) primary alcohol

JCECE - 2008
UPTU/UPSEE-2007

Ans. (c) : Acid catalysed hydration of alkenes except ethane leads to the formation secondery and tertiary alcohols. The alkene involves replacing the π-bond on an alkene with a water molecule. This is done by adding of an alcohol to the more substituted carbon atom and hydrogen to the less substituted carbon atom. This reaction follow Markovinkov's rule and may undergo a carbocation rearrangement.

@apna_pdf

418. Which of the following reagents when heated with ethyl chloride, forms ethylene?

(a) Aueous KOH

(b) Zn/HCl

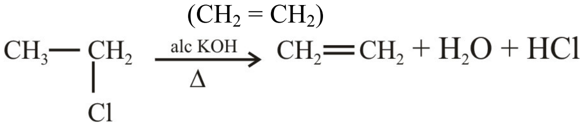
(c) Alcoholic KOH

(d) HI

JCECE - 2009

AP EAMCET-2006

Ans. (c): When ethylchloride ($CH_3 - CH_2Cl$) react with alcoholic KOH in presence of heat the product is ethylene



$$CH_3-\underset{\underset{Cl}{|}}{CH_2} \xrightarrow[\Delta]{alc\ KOH} \overset{(CH_2=CH_2)}{CH_2=CH_2} + H_2O + HCl$$

419. Ziegler-Natta catalyst is

(a) $(Ph_3P)_3$ RhCl

(b) $K[PtCl_3(C_2H_4)]$

(c) $[Al_2(C_2H_6)_6 + TiCl_4]$

(d) $[Fe(C_2H_5)_2]$

JCECE - 2010

WBJEE-2009

UPTU/UPSEE-2014

Ans. (c) : $Al_2(C_2H_6)_6 + TiCl_4$ is Ziegler-Natta catalyst.

420. Anti-Markownikoff's addition of HBr is not observed in

(a) propene (b) 1-butene

(c) but-2-ene (d) pent-2-ene

JCECE - 2011

J & K CET -2012, 1998

Manipal-2016

NEET-1994

BCECE-2005

Ans. (c) : Anti-Markownikoff's rule is not applicable in case of symmetrical alkenes.

The structures of the given compounds are

$$\underset{\text{propene}}{CH_3CH{=}CH_2}\quad \underset{\text{1-butene}}{CH_3CH_2CH{=}CH_3}$$

$$\underset{\substack{\text{but-2-ene}\\\text{(symmetrical)}}}{CH_3CH{=}CHCH_3}\quad \underset{\text{pent-2-ene}}{CH_3CH_2CH{=}CHCH_2}$$

Thus, anti-Markownikoff's rule is not applicable to but-2-ene.

421. An alkene 'A' contains three C—C, eight C—H σ-bonds and one C—C-π bond. 'A' on ozonolysis gives two moles of an aldehyde of molar mass 44u. IUPAC name of A is

(a) but-1-ene

(b) but-2-ene

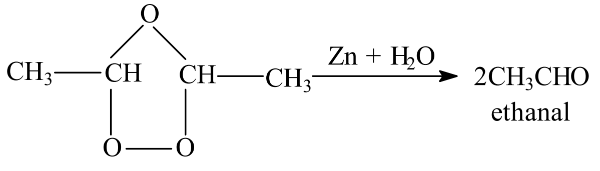
(c) 2-methylpropane

(d) None of these

JCECE - 2013

Ans. (b) : Compound 'A' is but-2-ene.

$CH_3-CH{=}CH-CH_3 \xrightarrow{O_3}$



ozonoid

C — H bonds = 8 σ

C — C bonds = 3 σ

C ═ C bonds = 1 π

422. One mole of a symmetrical alkene on ozonolysis gives two moles of an aldehyde having a molecular mass of 44u. The alkene is

(a) ethene (b) propene

(c) but-1-ene (d) but-2-ene

JCECE - 2013

Ans. (d) : The aldehyde with molecular mass 44 u is CH_3CHO (acetaldehyde). Therefore, the symmetrical alkene is but-2-ene.

$$\underset{\text{but-2-ene}}{CH_3CH{=}CHCH_3} \xrightarrow[\text{(ii) Zn/H}_2\text{O}]{\text{(i)}O_3} \underset{\text{acetaldehyde}}{2CH_3CHO}$$

423. Which of the following statements is not true about low density polythene?

(a) Tough

(b) Highly branched structure

(c) Poor conductor of electricity

(d) Hard

JCECE - 2013

Ans. (b) : Low density polythene has biotin. It is neither soluble in water nor in fat.

424. The main product of the reaction would be

2-butene + chloroform $\xrightarrow{NaOH}$?

(a) butanoic acid

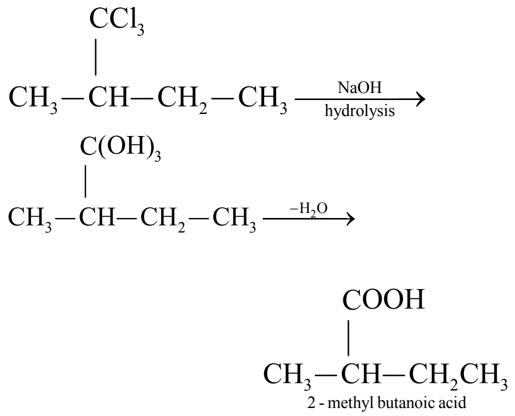
(b) 2-methyl butanoic acid

(c) 1, 1,1-trichloro-2methyl butane

(d) 1, 4-butane diol

JCECE - 2014

Ans. (b) : $CH_3CH{=}CH_3 + CHCl_3 \longrightarrow$



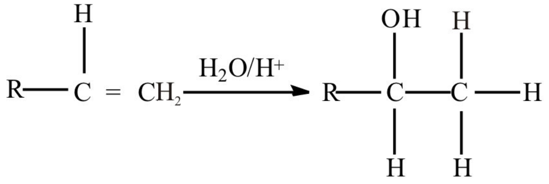
$$CH_3-\overset{\overset{CCl_3}{|}}{CH}-CH_2-CH_3 \xrightarrow[\text{hydrolysis}]{NaOH} CH_3-\overset{\overset{C(OH)_3}{|}}{CH}-CH_2-CH_3 \xrightarrow{-H_2O} \underset{\text{2 - methyl butanoic acid}}{CH_3-\overset{\overset{COOH}{|}}{CH}-CH_2CH_3}$$

@apna_pdf

425. Acid catalysed hydration of alkenes except ethene leads to the formation of
(a) secondary or tertiary alcohol
(b) primary and secondary alcohol
(c) secondary alcohol
(d) tertiary alcohol

JCECE - 2017

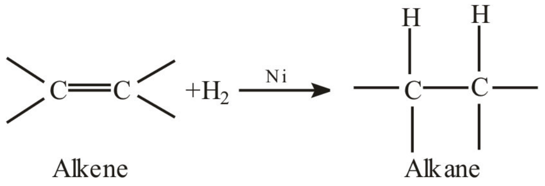
Ans. (a) : Ethene being a 2-carbon compound always forms primary alcohol.



426. Catalyst used in hydrogenation
(a) V_2O_5
(b) Fe
(c) Ni
(d) Pd

JCECE - 2018

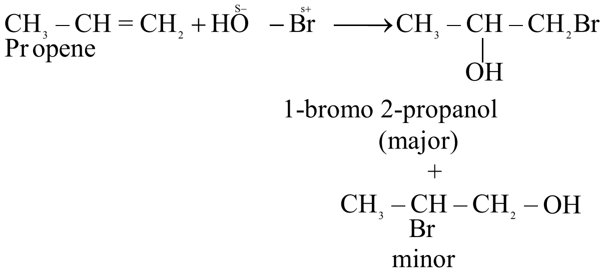
Ans.(c) Catalyst used in hydrogenation is Ni. Hydrogenation reaction is used to reduce the unsaturated compound. This reaction reduces double and triple bonds in hydrocarbons.



427. Which of the following is the major product in the reaction of HOBr with propene?
(a) 2-bromo, 1-propanol
(b) 3-bromo, 1-propanol
(c) 2-bromo, 2-propanol
(d) 1-bromo, 2-propanol

JIPMER-2017
JCEC-2010

Ans. (d) :



$$CH_3-CH=CH_2+\overset{\delta-}{HO}-\overset{\delta+}{Br}\longrightarrow CH_3-\underset{OH}{\underset{|}{CH}}-CH_2Br$$

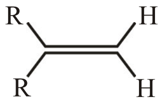
Propene

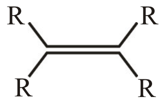
1-bromo 2-propanol
(major)
+

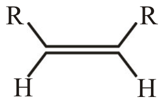
$$CH_3-\underset{Br}{CH}-CH_2-OH$$

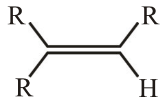
minor

428. Which one of the following alkenes will react faster with H_2 under catalytic hydrogenation conditions?
(R = Alkyl substriuent)

(a)


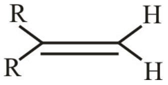
(b)


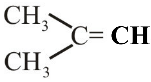
(c)


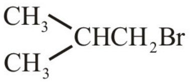
(d)


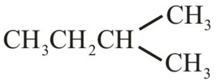
JIPMER-2007
NEET-2005

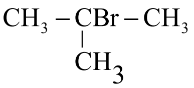
Ans. (a) : The stability of alkene, greater the number of alkyl group attached to the doubly bonded carbon atom, more stable is the alkene.
Less substituted alkene is more react faster with H_2 under catalytic hydrogenation condition.

Hence, the

give more faster

429. The reaction of HBr with

$C= CH_2$ in the presence of peroxide will give:

(a)


(b)


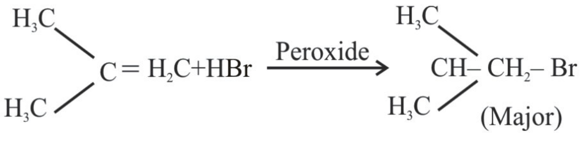
(c)


$CH_3-\underset{CH_3}{\underset{|}{C}}Br-CH_3$

(d) $CH_3CH_2CH_2CH_2Br$

JIPMER-2006

Ans. (a) :

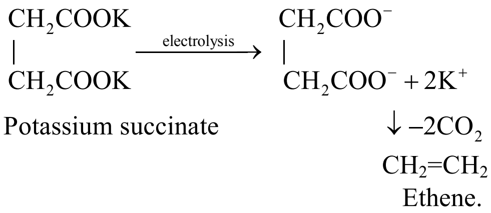


This reaction is known as anti markvaniff rule.

430. What is obtained, when potassium succinate solution is electrolysed?
(a) Ethane
(b) Ethene
(c) Ethyne
(d) All of these

JIPMER-2004

Ans. (b) : Ethene (ethylene) is obtained on electrolysis of potassium succinate this reaction is an example of kolbe's electrolysis.



$$\begin{matrix}CH_2COOK\\|\\CH_2COOK\end{matrix}\xrightarrow{\text{electrolysis}}\begin{matrix}CH_2COO^-\\|\\CH_2COO^-\end{matrix}+2K^+$$

Potassium succinate

$\downarrow -2CO_2$
$CH_2{=}CH_2$
Ethene.

431. $CH_3 - CH_2 - CH_2 - Br \xrightarrow{Alc.KOH}$ Final product is
(a) propene
(b) propanol
(c) cyclopropane
(d) propane-1, 2-diol

JIPMER-2019

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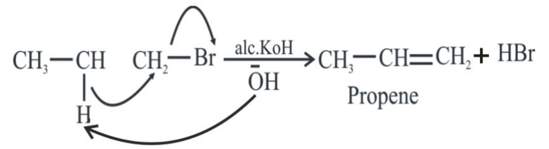
Ans. (a) :

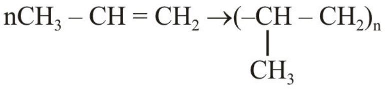


432. Polypropylene can be obtained by polymerization of

(a) $CH_2 = CH–CH_2–Cl$ (b) $CH_2 = CH–Cl$
(c) $CH_3–CH = CH_2$ (d) $CH_3–CHCl_2$

JIPMER-2016

Ans. (c) :



$$nCH_3 - CH = CH_2 \rightarrow (\underset{\underset{CH_3}{|}}{-CH} - CH_2)_n$$

Polypropylene is produced by the chaingrowth polymerization of propene.

433. Ziegler-Natta catalyst is used to prepare

(a) low-density polythene
(b) teflon
(c) high density polythene
(d) nylon-6

Karnataka-CET-2018
Kerala CEE-2011

Ans. (c) : Ziegler–natta catalyst is a mixture of two compound named as triethyl aluminium and titanium tetrachloride. This catalyst is used in the preparation of high density polyethylene and polythenes The molecular formula of Ziegler- Natta catalyst is - $(C_2H_5)_3$ Al and $TiCl_4$.

High density polythene is a polymer made from the monomer in ethylene. It is a very high strength. It is widely used in bottle caps, bottles, printing flaments etc.

434. n-propyl bromide on treating with alcoholic KOH produces

(a) propane (b) propene
(c) propyne (d) propanol

Karnataka-CET, 2008

Ans.(b): Alcoholic KOH is a dehydrohalogenating reagent, so when n-propyl bromide is treated with alcoholic KOH, propene is obtained.

$$\underset{n-propyl\,bromide}{CH_3CH_2CH_2Br} \xrightarrow{alc.KOH} \underset{Propene}{CH_3CH = CH_2} + HBr$$

435. Peroxide effect is observed with the addition of HBr but not with the addition of HI to unsymmetrical alkene because

(a) H-I bond is stronger that H-Br and is not cleaved by the free radical
(b) H-I bond is weaker than H-Br bond so that Iodine free radicals combine to form iodine molecules
(c) Bond strength of HI and HBr are same but free radicals are formed in HBr
(d) All of these

Kerala-CEE-29.08.2021
Karnataka CET-2021

Ans.(b): Due to free radial mechanical (secondary free radial), peroxide effect is observed with the addition of HBr but not with the addition of HI to unsymmetrical alkene because the H-I bond (297 $kJmol^{-1}$) is weaker than it HBr bond and undergoes homolysis readily form iodine free radical. But iodine free radical have greater tendency to combine amongst themselves to form iodine molecules.

$$H - I \xrightarrow[peroxide]{Organic} \dot{H} + \underset{Iodine\,free\,radical}{\dot{I}}$$

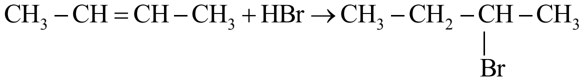
$$\dot{I} + \dot{I} \rightarrow \underset{Iodine\,molecule}{I_2}$$

436. The alkene that will give the same product with HBr in the absence as well as in the presence of peroxide is

(a) 2-butene (b) 1-butene
(c) propene (d) 1-hexene
(e) 2-methylpropene

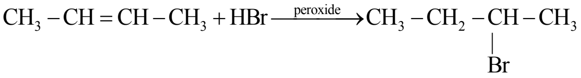
Kerala-CEE-2010

Ans. (a) :



$$CH_3 - CH = CH - CH_3 + HBr \rightarrow CH_3 - CH_2 - \underset{\underset{Br}{|}}{CH} - CH_3$$

This reaction is an example of markwnikoff rule.



$$CH_3 - CH = CH - CH_3 + HBr \xrightarrow{peroxide} CH_3 - CH_2 - \underset{\underset{Br}{|}}{CH} - CH_3$$

This reaction is an example of satyzeff rule.

437. Pick out the correct statements from the following and choose the correct answer from the codes given below

1. Hexa-1, 5-diene is a conjugated diene
2. Prop-1, 2-diene is conjugated diene
3. Hexa-1, 3-diene is a conjugated diene
4. Buta-1, 3 diene is an isolated diene
5. Prop-1, 2 diene is a cumulative diene

(a) 1, 2 (b) 2, 3
(c) 4, 5 (d) 2, 5
(e) 3, 5

Kerala-CEE-2009
UPTU/UPSEE-2013

Ans. (e) :

(i) $\underset{hexa\quad 1,5-diene}{CH_2 = CH - CH_2 - CH_2 - CH = CH_2}$

It is an isolated diene.

(ii) CH_2= C= CH_2 It is cumulative diene
prop-1,2 - diene

(iii) $\underset{hexa-1,3-diene}{\overset{2}{CH_2} = \overset{2}{CH} - \overset{3}{CH} = \overset{4}{CH} - \overset{5}{CH_2} - \overset{6}{CH_3}}$ It is a conjugated diene

(iv) $\underset{But-1,3,diene}{CH_2 = CH - CH = CH_2}$ It is conjugated diene.

(v) $\underset{Prop-1,2diene}{CH_2 = C = CH_2}$ It is a cumulative diene

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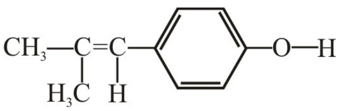
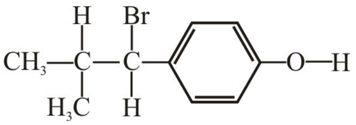
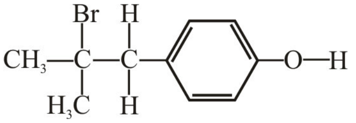
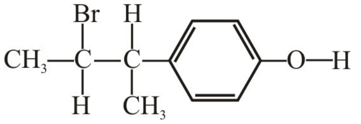
438. The reaction of

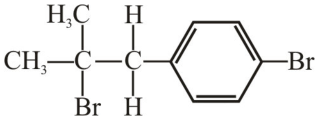


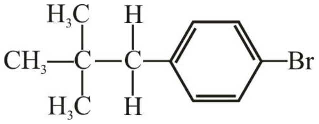
with HBr give predominantly

(a)


(b)


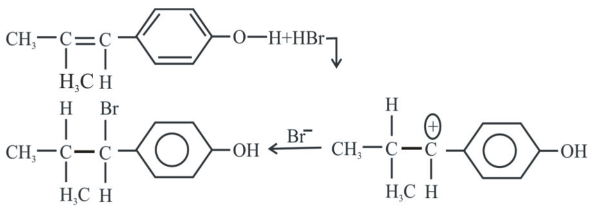
(c)


(d)


(e)


Kerala-CEE-2008

Ans. (a):

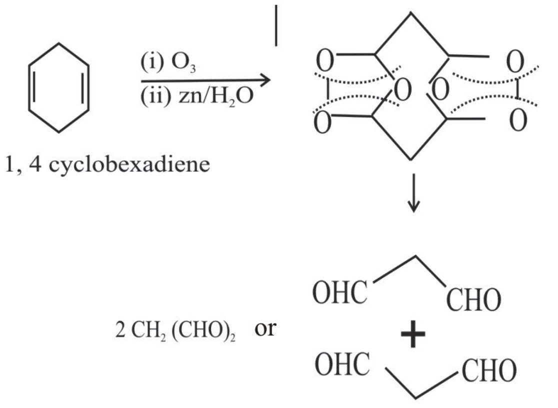


439. An alkene on reductive ozonolysis gives 2-molecules of $CH_2(CHO)_2$. The alkene is:

(a) 2, 4-hexadiene
(b) 1, 3 -cyclohexadiene
(c) 1 , 4-cyclohexadiene
(d) 1- methyl-1, 3-cyclopentadiene
(e) 1, 2-dimethyl cyclopropene

Kerala-CEE-2006

Ans. (c) :



440. The Markownikoff's rule is the best applicable to the reaction between :

(a) $C_2H_4 + HCl$
(b) $C_3H_6 + Br_2$
(c) $C_3H_6 + HBr$
(d) $C_3H_8 + Cl_2$
(e) $C_2H_4 + I_2$

Kerala-CEE-2006
J & K CET-2014
UPTU/UPSEE-2018

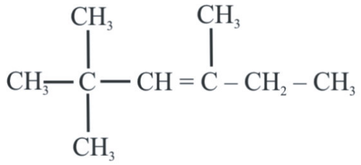
Ans. (c) : Morkownikofl's rule is best applicable to the reaction C_3H_6 +HBr. This rule is used as a guidance for electrophlic addition in those cases where an as a symmetrical reagent is added to an asyunmetrical alkene. i.e. unsymmetrical alkene with HBr. Markovnikov's rule is applicable to predict the regioselectivity of elctrophilic addition reaction of alkenes and alkynes.

441. An alkene having the molecular formula C_9H_{18} on ozonolysis gives 2, 2-dimethyl propanal and 2-butanone. The alkene is :

(A) 2, 2, 2-trimethyl-3-hexene
(B) 2, 2, 6-trimethyl-3-hexene
(C) 2, 3, 4- trimethyl-2-hexene
(D) 2, 2, 4- trimethyl-3-hexene
(E) 2, 2-dimethyl-1-3 heptene

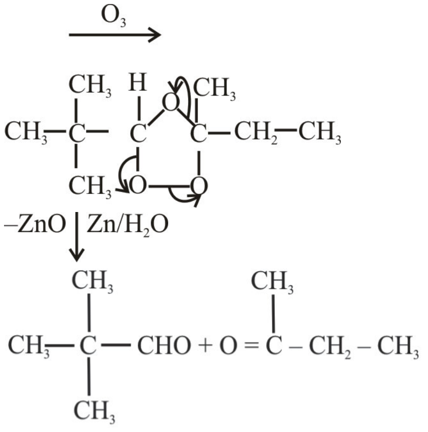
Kerala-CEE-2005
VITEEE-2019

Ans. (d) : The alkene is 2,2,4-trimethyl 3-hexene. On ozonolysis of this alkene gives 2,2,-dimethyl propanol and 2-butanone.



$$CH_3-C(CH_3)_2-CH=C(CH_3)-CH_2-CH_3$$

2, 2, 4 - trimethyl– 3 – hexene.



2,2,dimethyl propanal 2-butanone

442. The presence of Ag^+ ion increases the solubility of alkenes due to the formation of:

(a) dπ-dσ bonding
(b) pσ-pπ bonding
(c) pπ-dπ bonding
(d) pπ-dσ bonding
(e) non of the above

Kerala-CEE-2004

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Ans. (c) Ag^+ forms complex with the alkene by pπ-dπ bonding giving anion and the solubility is increase.

443. Identify the correct statement from below, concerning the structure of $CH_2= C= CH_2$:

(a) The molecule is planer
(b) One of the three carbon atoms is in an-sp^3 hybridized state
(c) The molecule is non-planar with the two –CH_2 groups being in planes perpendicular to each other
(d) All the carbon atoms are sp-hybridized
(e) The molecule is bent with the –C–C–C– angle being 120 degrees.

Kerala-CEE-2004

Ans. (c) : The structure is given as –

$$\underset{sp^2}{CH_2} = \underset{sp}{C} = \underset{sp^2}{CH_2}$$

The molecule is a non-planar with the two –CH_2 groups being in planes perpendicular to each other

444. When 3-phenylpropene reacts with HBr in the presence of peroxide, the major product formed is

(a) 2-bromo 1-phenylpropane
(b) 1, 2-dibromo 3-phenylpropane
(c) 3-(o-bromophenyl) propene
(d) 1-bromo 3-phenylpropane
(e) 3 (p-bromophenyl) propene

Kerala-CEE-2011

Ans. (d) :

$$\underset{\text{3- phenylpropene}}{C_6H_5-CH_2-CH=CH_2} + HBr \xrightarrow{\text{Peroxide}} \underset{\text{1 - bromo - 3- phenyl propane}}{C_6H_5-CH_2-CH_2-CH_2Br}$$

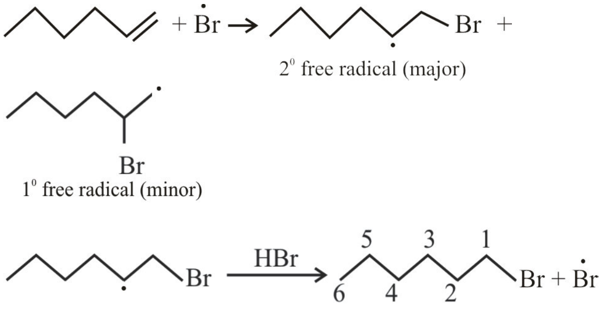
When 3-phenypropene reacts with HBr in the presence of peroxide then reaction is known as Antimarkonikoff or peroxide effect.

445. When HBr adds on hex-1-ene in the presence of benzoyl peroxide, the product is

(a) 2-bromohexane (b) 2, 3-dibromohexane
(c) 1, 2-dibromohexane (d) 2, 4-dibromohexane
(e) 1-bromohexane

Kerala-CEE-2012

Ans. (e) : HBr + benzoyl peroxide → $\dot{Br}$



+ Br•
Br +
2° free radical (major)
Br
1° free radical (minor)
Br
HBr
5
3
1
6
4
2
Br + Br•

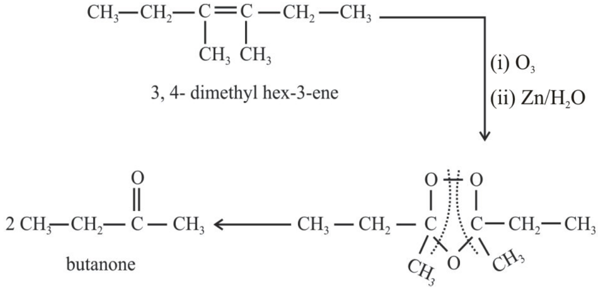
1-brom hexane

446. One mole of alkene on ozonolysis gives 2 moles of butanone. The alkene is

(a) 3,4-dimethylhex-2-ene
(b) 2,3-dimethylhex-3-ene
(c) 3,4-dimethylhex-3-ene
(d) 2,3-dimethylhex-2-ene
(e) 2,5-dimethylhex-3-ene

Kerala-CEE-2013

Ans. (c) :



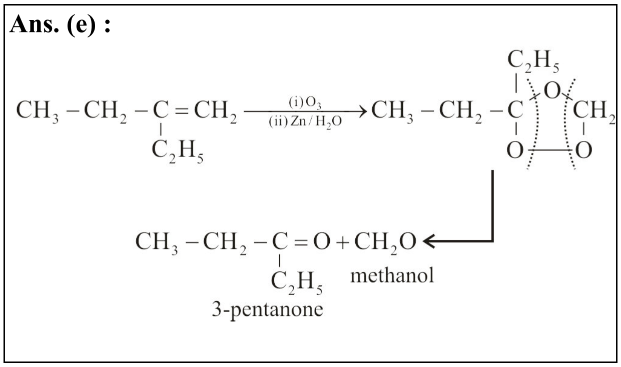
CH₃—CH₂—C=C—CH₂—CH₃
CH₃ CH₃
3, 4- dimethyl hex-3-ene
(i) O₃
(ii) Zn/H₂O
2 CH₃—CH₂—C—CH₃
O
butanone
CH₃—CH₂—C—C—CH₂—CH₃
O O O
CH₃ CH₃

447. The products obtained by the ozonolysis of 2-ethylbut-1-ene are

(a) propanone and ethanol
(b) ethanol and 3-pentanone
(c) butanal and ethanal
(d) methanol and 2-pentanone
(e) methanal and 3-pentanone

Kerala-CEE-2014

Ans. (e) :



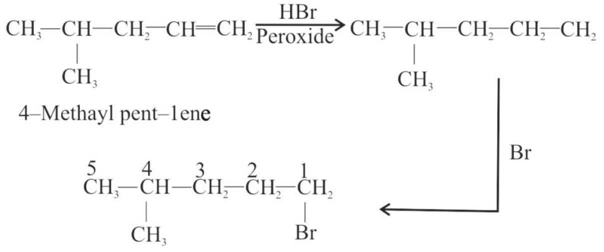
CH₃–CH₂–C=CH₂
C₂H₅
(i) O₃
(ii) Zn/H₂O
CH₃–CH₂–C
C₂H₅
O
CH₂
O O
CH₃–CH₂–C=O + CH₂O
C₂H₅
methanol
3-pentanone

448. The major product obtained by the addition reaction of HBr to 4-methylpent-1-ene in the presence of peroxide is

(a) 1-bromo-4-methylpentane
(b) 4-bromo-2-methylpentane
(c) 2-bromo-4-methylpentane
(d) 3-bromo-2-methylpentane
(e) 2-bromo-2-methylpentane

Kerala-CEE-2016

Ans. (a) :



CH₃—CH—CH₂—CH=CH₂
CH₃
HBr
Peroxide
CH₃—CH—CH₂—CH₂—CH₂
CH₃
4–Methayl pent–1ene
Br
5 4 3 2 1
CH₃—CH—CH₂—CH₂—CH₂
CH₃
Br

1-Bromo-4methylpentane

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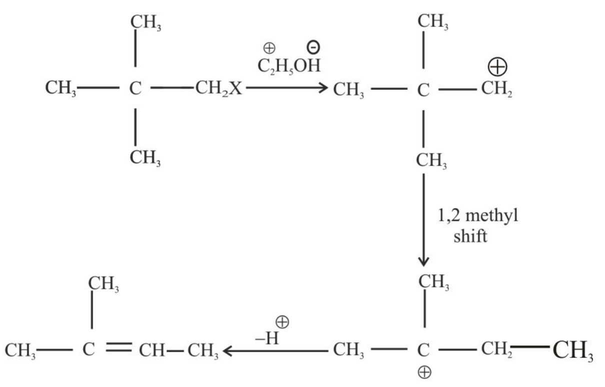
449. The neopentyl halide in ethanol yields alkenes by E1 mechanism due to
(a) low concentration of solvent
(b) absence of base
(c) it is a primary halide
(d) steric factor which prevents E2 mechanism
(e) salvation effect

Kerala-CEE-2019

Ans. (d) :



The neopentyl halide in ethanol yields alkenes by E_1 mechanism due to steric factor which prevent E_2 Mechanism.

450. Propylene on treatment with HBr/H_2O_2 provides
(a) 1-bromopropane
(b) 2-bromopropane
(c) 1,2-dibromopropane
(d) 1-bromopropan-2-ol
(e) 2-bromopropan-1-ol

Kerala-CEE-2019

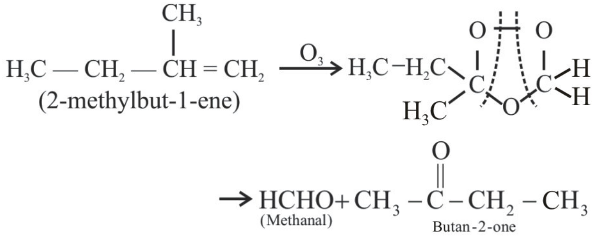
Ans. (a) : Propylene react HBr/H_2O_2 the product is 1-bromoprpane.

$$\underset{\text{Propylene}}{CH_3-CH=CH_2} \xrightarrow[H_2O_2]{HBr} \underset{\text{1-bromopropane}}{CH_3-CH_2-CH_2-Br}$$

451. The products obtained by the ozonolysis of 2-methylbut-1-ene are
(a) propanone and ethanol
(b) propanone and methanol
(c) butanone and methanol
(d) ethanal and propanal
(e) butanone and methanal

Kerala-CEE-2020

Ans.(e): The ozonolysis of 2-methylbut-1-ene given



452. The catalyst used in the Wacker process of oxidation of ethyne to ethanol is
(a) Silver
(b) Nickel
(c) $PdCl_2$
(d) V_2O_5
(e) Ziegler catalyst

Kerala-CEE-2020

Ans.(c): The Wacker process or the Hoechst-Wacker process refers to the oxidation of ethylene to acetaldehyde in the presence of palladium (11) chloride as the catalyst.

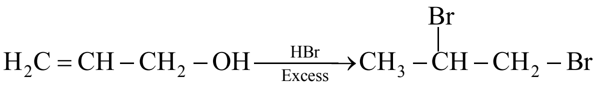
453. The major product of the following reaction is

$$CH_2=CH-CH_2-OH \xrightarrow[\text{excess}]{HBr} \textbf{product}$$

(a) $CH_3-CHBr-CH_2Br$
(b) $CH_2=CH-CH_2Br$
(c) $CH_3-CHBr-CH_2-OH$
(d) $CH_3-CHOH-CH_2OH$

Kerala-CEE-29.08.2021

Ans. (a) :



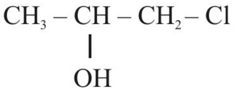
$$H_2C=CH-CH_2-OH \xrightarrow[\text{Excess}]{HBr} CH_3-\overset{\overset{\large Br}{|}}{C}H-CH_2-Br$$

In above reaction the alkene reacts with an excess of hydrogen bromide to give the final product. In this double bond is removed & Br is added to its place. Also, –OH is removed for –Br group. It follows Markownikov's Rule for the formation of the product.

454. For the reaction,

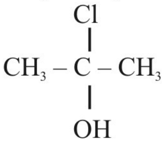
$$\mathbf{CH_3-CH=CH_2+HOCl \rightarrow A}$$

The product A is :
(a) $CH_3-CHCl-CH_2OH$

(b) 

$$CH_3-\underset{\underset{\large OH}{|}}{CH}-CH_2-Cl$$

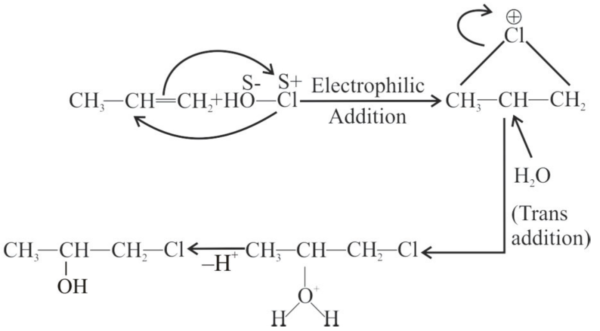
(c) $CH_3-CH_2-CH_2-COCl$

(b) 

$$CH_3-\underset{\underset{\large OH}{|}}{\overset{\overset{\large Cl}{|}}{C}}-CH_3$$

Manipal-2019

Ans. (b) :



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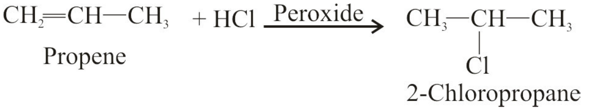
455. When propene reacts with HCl in presence of peroxide, the product is

(a) 1-chloro propane
(b) 1, 1-dichloro propane
(c) 2-chloro propane
(d) 1, 2-dichloro propane

MHT CET-02.05.2019, SHIFT-III

Ans. (c) :


$$\underset{\text{Propene}}{CH_2{=}CH-CH_3} + HCl \xrightarrow{\text{Peroxide}} \underset{\text{2-Chloropropane}}{CH_3-\underset{\substack{|\\Cl}}{CH}-CH_3}$$

When propane reacts with HCl in presence of peroxide, the product is 2-Chloropropane.

456. α - butylene when subjected to hydroboration oxidation reaction, yields

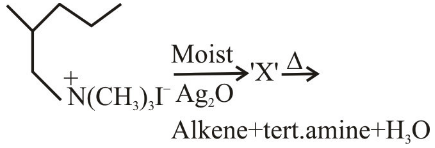
(a) iso-butyl alcohol
(b) sec-butyl alcohol
(c) n-butyl alcohol
(d) tert-butyl alcohol

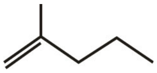
MHT CET-02.05.2019, SHIFT-III

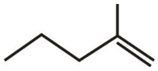
Ans.(c): α- butylenes when subject to hydroboration-oxidation on reaction, yields n-butyl alcohol.

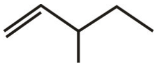
$$\underset{\alpha-\text{butylene}(1-\text{butene})}{CH_3=CH_2-CH_2-CH_3} \xrightarrow[H_2O_2]{BH_3} \underset{n-\text{butyl alcohol}}{CH_3-CH_2-CH_2-CH_2-OH}$$

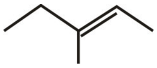
457. Identify the alkene that is produced in the following series of reactions



(a) 

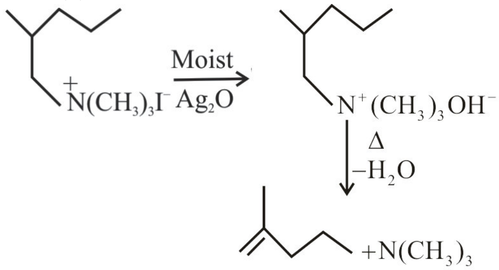
(b) 

(c) 

(d) 

MHT CET-2014

Ans. (a) :

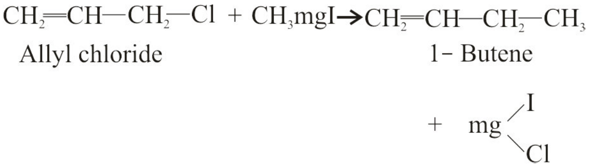


458. For synthesis of 1-butene, CH_3MgI should be treated with

(a) propene
(b) 2-chloropropene
(c) allyl chloride
(d) ethyl chloride

MHT CET-2007

Ans. (c) :


$$\underset{\text{Allyl chloride}}{CH_2{=}CH-CH_2-Cl} + CH_3mgI \rightarrow \underset{\text{1- Butene}}{CH_2{=}CH-CH_2-CH_3} + mg\begin{smallmatrix}I\\Cl\end{smallmatrix}$$

459. Select the true statement about benzene amongst the following

(a) because of unstauration benzene easily undergoes addition
(b) there are two types of C–C bonds in benzene molecule
(c) there is cyclic delocalisation of π-electrons in benzene
(d) monosubstitution of benzene gives three isomeric products.

NEET-1992

Ans. (c) :

Benzene has large resonance energy due to the six conjugated carbon of benzene. The delocalization of P-orbital's carbon on the sp^2 hybridized is give the aromaticity

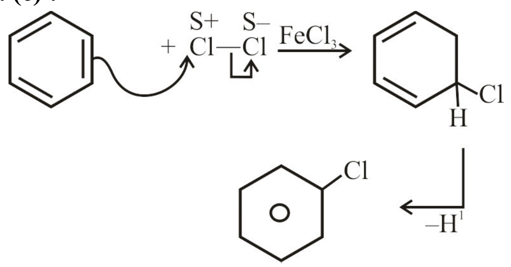
- Benzene is a planer molecule containing a ring of six carbon atoms each with a hydrogen atom attached
- The six carbon atom forms a perfectly regular hexagon. All of the carbon carbon-carbon bond has exactly the same length.
- There are delocalized electron above and below the plane of the ring which make benzene particularly stable
- Benzene resists addition reaction because those reactions would involve breaking the delocalization and losing stability.

460. Electrophile in the case of chlorination of benzene in the presence of $FeCl_3$ is

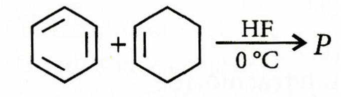
(a) Cl
(b) $FeCl_3$
(c) Cl^+
(d) Cl^-

NEET-1996

Ans. (c) :



461. In the given reaction



the product P is

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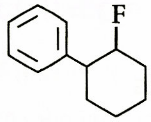
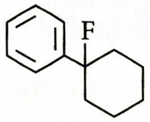
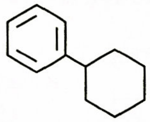
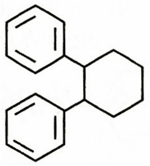
(a) 

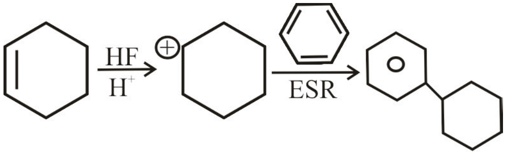
(b) 

(c) 

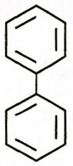
(d) 

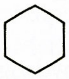
NEET-II 2016

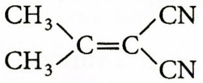
Ans. (c) :



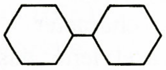
462. In which of the following molecules, all atoms are coplanar?

(a) 

(b) 

(c) 

$$(CH_3)_2C=C(CN)_2$$

(d) 

NEET-II 2016

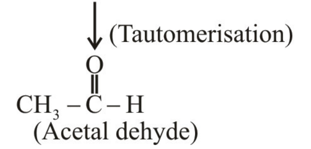
Ans. (a) : Coplanar means atoms a groups of atom that lie on the same plane. Biphenyl has both Benzene rings on the same plane. When all atoms of a compound are in the same plane are called coplanar compound coplanarity in organic compounds is seen in unsaturated molecues.

463. When acetylene is passed through dil, H_2SO_4 in the presence of $HgSO_4$, the compound formed is

(a) acetic acid
(b) ketone
(c) ether
(d) acetaldehyde

NEET-1999

Ans. (d) : Acetylene add a ater molecule when treated with dil H_2SO_4 in the presence of $HgSO_4$ to form acetal dehyde (ethanal).



$$CH\equiv CH+H_2O\rightarrow CH_2=CH-OH \text{ (Unstable Alcohol)} \xrightarrow{\text{(Tautomerisation)}} CH_3-\overset{\overset{O}{\|}}{C}-H$$

(Acetal dehyde)

464. Base strength of

$$\underset{(i)}{H_3C\overline{C}H_2}, \underset{(ii)}{H_2C=\overline{C}H} \text{ and } \underset{(iii)}{H-C\equiv\overline{C}}$$ **is in the order of**

(a) (i) > (iii) > (ii)
(b) (i) > (ii) > (iii)
(c) (ii) > (i) > (iii)
(d) (iii) > (ii) > (i)

NEET-2008

Ans. (b) : Basic strength are directly proportional to the least acidic. So alkane is least acidic and alkane is more basic. Hence the order is–

$$CH_3-\overset{\ominus}{C}H_2 > CH_2=\overset{\ominus}{C}H > H-C\equiv\overset{\ominus}{C}$$

465. The restricted rotation about carbon carbon double bond in 2-butene is due to

(a) overlap of one s and sp^2-hybridized orbitals
(b) overlap of two sp^2-hybridized orbitals
(c) overlap of one p and one sp^2-hybridized orbitals
(d) sideways overlap of two p-orbitals

NEET-1993, 2000

Ans. (d) : Restricted rotation about carbon-Carbon double bond in 2-butene is due to sideways overlap of 2p-orbital's π-bond gives rigidity to molecule, the rotation around the double bond is prevented. The restriction in free rotation makes the position of groups attached to sp^2 hybrid.

466. The reaction,

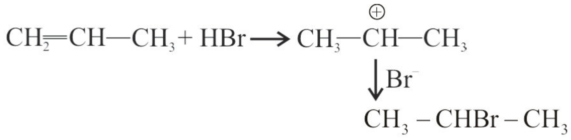
$$CH_2=CH-CH_3+HBr\longrightarrow CH_3CHBr-CH_3$$

is

(a) electrophilic substitution
(b) free radical addition
(c) nucleophilic addition
(d) electrophilic addition

NEET-1996

Ans. (d) : : In this reaction HBr undergoes heterolytic fission. This reaction is known or electrophilic addition reaction



$$CH_2=CH-CH_3+HBr\longrightarrow CH_3-\overset{\oplus}{C}H-CH_3 \xrightarrow{Br^-} CH_3-CHBr-CH_3$$

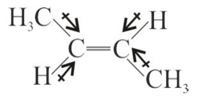
467. Which of the following has zero dipole moment?

(a) 1-Butene
(b) 2- Methyl-1-propane
(c) cis-2-Butene
(d) trans-2-Butene

NEET-1996

Ans. (d) : Trans 2-butene has zero dipole moment became dipole moment of two alkyl group and two hydrogen atom are opposed and cancel

trans-2butene



μ = 0

468. Which reagent converts propene to 1-propanol?

(a) H_2O, H_2SO_4
(b) B_2H_6, H_2O_2, OH^-
(c) $Hg(OAc)_2$, $NaBH_4/H_2O$
(d) Aq.KOH

NEET-2000

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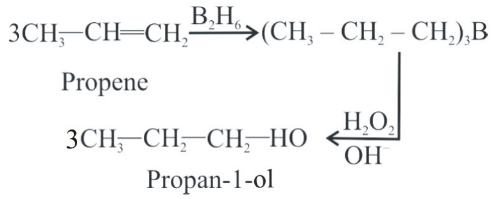
Ans. (b) :



469. Which is maximum stable?

(a) I-Butene

(b) cis-2-Butene

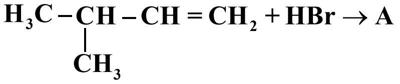
(c) trans-2-Butene

(d) All have same stability

NEET-2000

Ans. (c) : Trans-2-butene is much more stable isomer. The reason is that in the cis from the methyl group satirically interact and destabilize it relative to the trans form This is most stable as the repulsion between two methyl group is least.

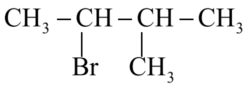
470.



$$H_3C-\underset{\displaystyle CH_3}{\underset{|}{CH}}-CH=CH_2+HBr\rightarrow A$$

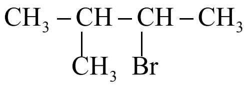
A (predominantly) is

(a)



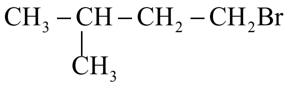
$$CH_3-\underset{Br}{\underset{|}{CH}}-\underset{CH_3}{\underset{|}{CH}}-CH_3$$

(b)



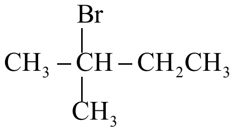
$$CH_3-\underset{CH_3}{\underset{|}{CH}}-\underset{Br}{\underset{|}{CH}}-CH_3$$

(c)



$$CH_3-\underset{CH_3}{\underset{|}{CH}}-CH_2-CH_2Br$$

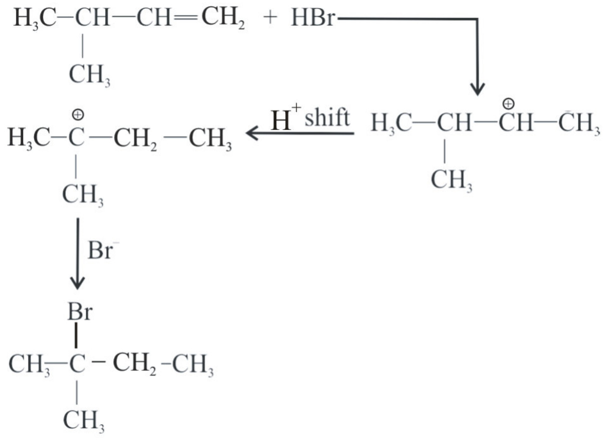
(d)



$$CH_3-\overset{Br}{\overset{|}{\underset{CH_3}{\underset{|}{C}}}}H-CH_2CH_3$$

NEET-2008

Ans. (d) :



471. Which of the compound with molecular formula C_5H_{10} yields acetone on ozonolysis?

(a) 3-Methyl-1-butene

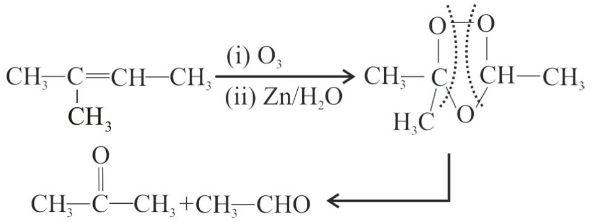
(b) Cyclopentane

(c) 2-Methyl-1-butene

(d) 2-Methyl-2-butene

NEET-2007

Ans. (d) :



472. Reaction of HBr with propene in the presence of peroxide gives

(a) isopropyl bromide

(b) 3-bromopropane

(c) allyl bromide

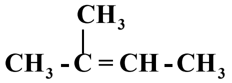
(d) n-propyl bromide

NEET-2004

Ans. (d) : Reaction of HBr with propene in the presence of peroxide gives n-propyl bromide.

$$CH_3-CH=CH_2+HBr\xrightarrow{\text{Peroxide}}\underset{\text{n-propyl bromide}}{CH_3-CH_2-CH_2-Br}$$

473. The compound,



$$CH_3-\overset{CH_3}{\overset{|}{C}}=CH-CH_3$$

on reaction with $NaIO_4$ in the presence of $KMnO_4$ gives

(a) CH_3COCH_3

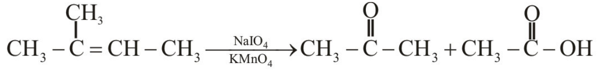
(b) $CH_3COCH_3+CH_3COOH$

(c) $CH_3COCH_3+CH_3CHO$

(d) $CH_3CHO+CO_2$

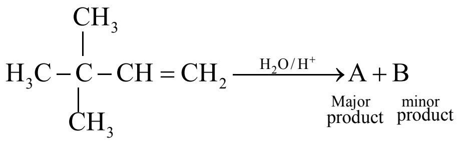
NEET-2003

Ans. (b) :



$$CH_3-\overset{CH_3}{\overset{|}{C}}=CH-CH_3\xrightarrow[KMnO_4]{NaIO_4}CH_3-\overset{O}{\overset{\|}{C}}-CH_3+CH_3-\overset{O}{\overset{\|}{C}}-OH$$

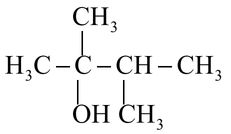
474. In the following reaction



$$H_3C-\overset{CH_3}{\overset{|}{\underset{CH_3}{\underset{|}{C}}}}-CH=CH_2\xrightarrow{H_2O/H^+}\underset{\text{Major product}}{A}+\underset{\text{minor product}}{B}$$

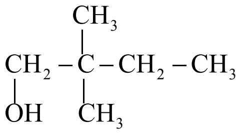
The major product is

(a)



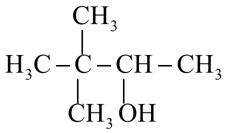
$$H_3C-\overset{CH_3}{\overset{|}{\underset{OH}{\underset{|}{C}}}}-\underset{CH_3}{\underset{|}{CH}}-CH_3$$

(b)



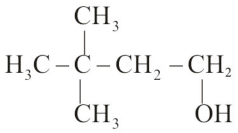
$$\underset{OH}{\underset{|}{CH_2}}-\overset{CH_3}{\overset{|}{\underset{CH_3}{\underset{|}{C}}}}-CH_2-CH_3$$

(c)



$$H_3C-\overset{CH_3}{\overset{|}{\underset{CH_3}{\underset{|}{C}}}}-\underset{OH}{\underset{|}{CH}}-CH_3$$

(d)



$$H_3C-\overset{CH_3}{\overset{|}{\underset{CH_3}{\underset{|}{C}}}}-CH_2-\underset{OH}{\underset{|}{CH_2}}$$

NEET-2012

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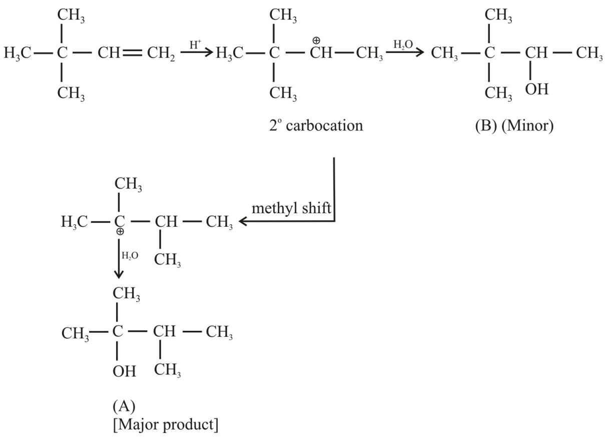
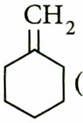
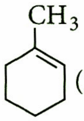
Ans. (a) :

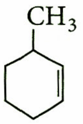


475. **In the reaction with HCl, an alkene reacts in accordance with the Markovnikov's rule to give a prodct 1-chloro-1-methyl-cyclohexane. The possible alkene is**

(a)  (A)

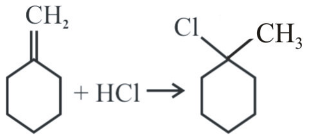
(b)  (B)

(c) (A) and (B)

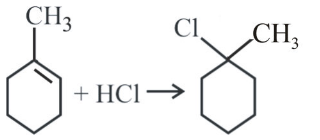
(d) 

NEET-2015

Ans. (c) :

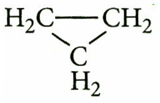


1-Chloro-1-methyl cyclohexane



1-Chloro-1-methyl cyclohexane

476. **Which of the following compounds shall not produce propene by reaction with HBr followed by elimination or direct only elimination reaction?**

(a) 

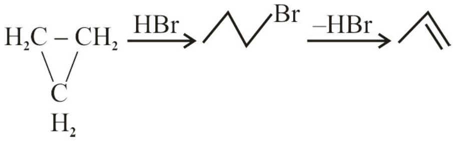
(b) $H_3C-\overset{H_2}{C}-CH_2OH$

(c) $H_2C=C=O$

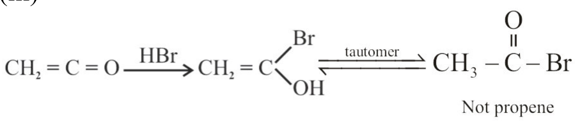
(d) $H_3C-\overset{H_2}{C}-CH_2Br$

NEET-II 2016

Ans. (c) :

(i) 

(ii) $CH_3-CH_2-CH_2-OH \xrightarrow{HBr} \underset{Br}{\underset{|}{CH_3-CH-CH_3}} \xrightarrow{-HBr} CH_3-CH=CH_2$

(iii) 

(v) $CH_3-CH_2-CH_2-Br \xrightarrow{-HBr} CH_3-CH=CH_2$

477. **The major product of the following chemical reaction is**

$$\begin{matrix}CH_3\\CH_3\end{matrix}\!\!>CH-CH=CH_2+HBr\xrightarrow{(C_6H_5CO)_2O_2}$$

(a) $\begin{matrix}CH_3\\CH_3\end{matrix}\!\!>CBr-CH_2-CH_3$

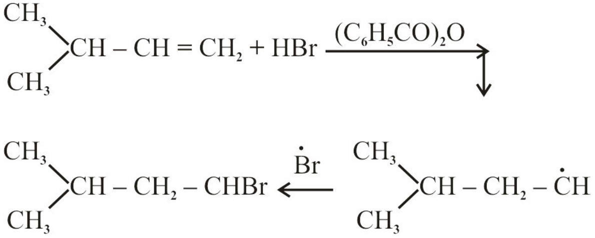
(b) $\begin{matrix}CH_3\\CH_3\end{matrix}\!\!>CH-CH_2-CH_2-Br$

(c) $\begin{matrix}CH_3\\CH_3\end{matrix}\!\!>CH-CH_2-CH_2-O-COC_6H_5$

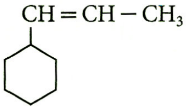
(d) $\begin{matrix}CH_3\\CH_3\end{matrix}\!\!>CH-\underset{Br}{\underset{|}{CH}}-CH_3$

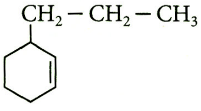
NEET-2021

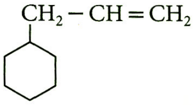
Ans. (b) :

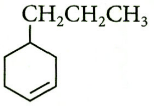


478. **An alkene on ozonolysis gives methanal as one of the product. Its structure is**

(a) 

(b) 

(c) 

(d) 

NEET-2020

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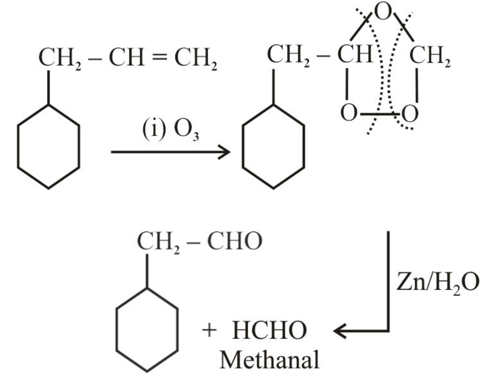
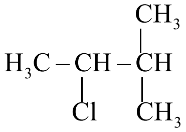
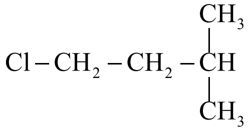
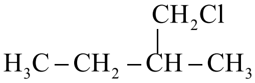
Ans. (c)

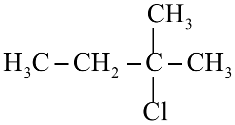


479. An alkene A on reaction with O_3 and Zn–H_2O gives propanone and ethanal in equimolar ratio. Addition of HCl to alkene A gives B as the major product. The structure of product B is

(a) 
$H_3C-\underset{Cl}{\underset{|}{CH}}-\overset{CH_3}{\overset{|}{\underset{CH_3}{\underset{|}{CH}}}}$

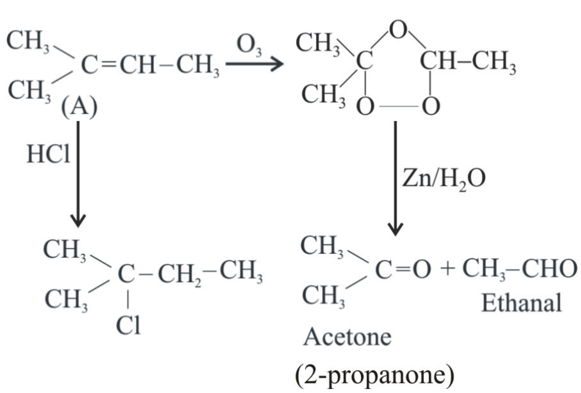
(b) 
$Cl-CH_2-CH_2-\overset{CH_3}{\overset{|}{\underset{CH_3}{\underset{|}{CH}}}}$

(c) 
$H_3C-CH_2-\overset{CH_2Cl}{\overset{|}{CH}}-CH_3$

(d) 
$H_3C-CH_2-\overset{CH_3}{\overset{|}{\underset{Cl}{\underset{|}{C}}}}-CH_3$

NEET-2019

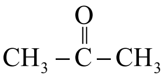
Ans. (d) :



480. Write the final product of the following reaction:

$$CH_3-CH=CH_2+H_2O\xrightarrow[50°C]{PdCl_2/CuCl_2}$$

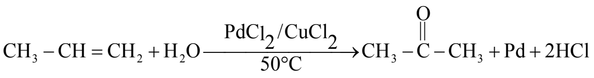
(a) CH_3CH_2CHO (b) $CH_3CH_2CH_2-OH$

(c) 
$CH_3-\overset{O}{\overset{\|}{C}}-CH_3$

(d) $CHO-CH=CH_2$

Tripura JEE-2022

Ans. (c) :


$CH_3-CH=CH_2+H_2O\xrightarrow[50°C]{PdCl_2/CuCl_2}CH_3-\overset{O}{\overset{\|}{C}}-CH_3+Pd+2HCl$

This reaction is known as wacker synthesis.

481. When $CH_2=CH-COOH$ is reduced with $LiAlH_4$, the compound obtained will be

(a) CH_3-CH_2-COOH
(b) $CH_2=CH-CH_2OH$
(c) $CH_3-CH_2-CH_2\ OH$
(d) CH_3-CH_2-CHO

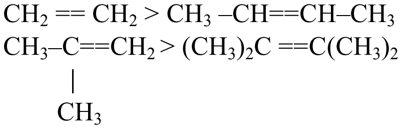
UPTU/UPSEE-2007

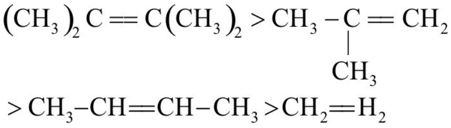
Ans. (b) :

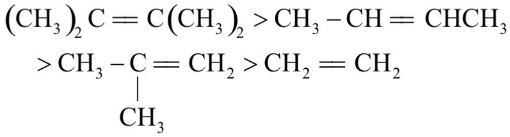
$$CH_2=CH-COOH\xrightarrow{LiAlH_4}CH_2=CH-CH_2OH$$

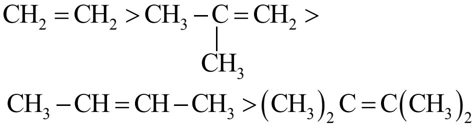
$LiAlH_4$ is a reducing agent to reduce ^-COOH group to CH_2OH group but cannot reduce double bond.

482. Mark out the correct decreasing order of ease of addition of halogen.

(a) 
$CH_2=CH_2 > CH_3-CH=CH-CH_3 > CH_3-\underset{CH_3}{\underset{|}{C}}=CH_2 > (CH_3)_2C=C(CH_3)_2$

(b) 
$(CH_3)_2C=C(CH_3)_2 > CH_3-\underset{CH_3}{\underset{|}{C}}=CH_2 > CH_3-CH=CH-CH_3 > CH_2=H_2$

(c) 
$(CH_3)_2C=C(CH_3)_2 > CH_3-CH=CHCH_3 > CH_3-\underset{CH_3}{\underset{|}{C}}=CH_2 > CH_2=CH_2$

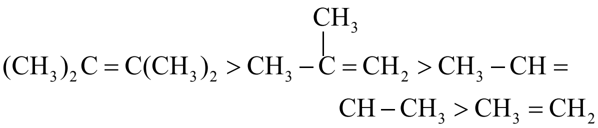
(d) 
$CH_2=CH_2 > CH_3-\underset{CH_3}{\underset{|}{C}}=CH_2 > CH_3-CH=CH-CH_3 > (CH_3)_2C=C(CH_3)_2$

UPTU/UPSEE-2012

Ans. (b) : As stability of alkene increases then the stability of addition of halogen in alkene increases.

Stability of alkene ∝ No. of ∝- hydrogen

Hence, the order of decreasing are –


$(CH_3)_2C=C(CH_3)_2 > CH_3-\overset{CH_3}{\overset{|}{C}}=CH_2 > CH_3-CH=CH-CH_3 > CH_3=CH_2$

483. Wacker process is an industrial process of the oxidation of terminal alkenes. Which of the following represents a true statement about the product?

(a) The product is an aldehyde with same number of carbon atoms as in the alkene
(b) The product is a ketone with same number of carbon atoms as in the alkene

@apna_pdf

(c) The product is an oxirane with same number of carbon atoms as in the alkene

(d) The product is a terminal alcohol as the net reaction is hydration of an alkene

UPTU/UPSEE-2011

Ans. (a,b) : Wacker process is an industrial process of oxidation of terminal alkene –

- The product is an aldehyele with same number of carbon atom as in the alkene.
- The product is a ketone with same number of carbon atoms as in the alkene.

484. An alkene having molecular formula, C_6H_{10}, gives OHC $(CH_2)_4$CHO, on ozonolysis, The alkene is

(a) hexane -1

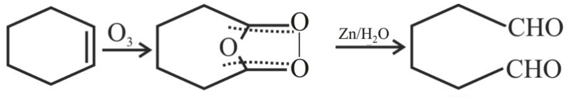
(b) hexane -2

(c) cyclohexene

(d) 1- methylcyclohexene -1

UPTU/UPSEE-2010

Ans. (c) :


O₃
O
O
O
Zn/H₂O
CHO
CHO

or

$OHC-(CH_2)_4-CHO$

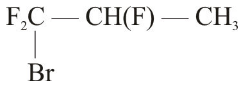
An alkene having molecular formula, C_6H_{10} gives $OHC(CH_2)_4$ CHO on ozonolysis. The alkene is cyclohexene.

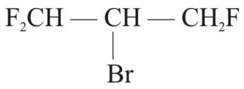
485. The major product of the following reaction is

$$F_3C-CH=CH_2+HBr\longrightarrow$$

(a) $F_3C-CH_2-CH_2Br$

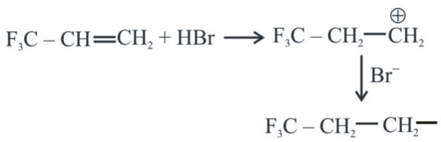
(b) $F_3C-CH(Br)-CH_3$

(c)

$F_2\underset{\substack{|\\Br}}{C}-CH(F)-CH_3$

(d)

$F_2CH-\underset{\substack{|\\Br}}{CH}-CH_2F$

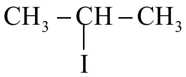
WB-JEE-30.04.2022
JEE Main – 2019

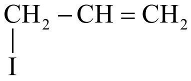
Ans. (a) :

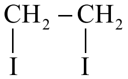

F₃C – CH=CH₂ + HBr ⟶ F₃C – CH₂–C⊕H₂
Br⁻
F₃C – CH₂– CH₂– Br

486. The major product *p* in the following reaction is $CH_3-CH=CH_2\xrightarrow[\text{Peroxide}]{\text{HI}}P$

(a) $CH_3CH_2CH_2I$

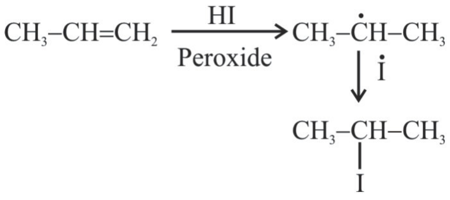
(b)

$CH_3-\underset{\substack{|\\I}}{CH}-CH_3$

(c)

$\underset{\substack{|\\I}}{CH_2}-CH=CH_2$

(d)

$\underset{\substack{|\\I}}{CH_2}-\underset{\substack{|\\I}}{CH_2}$

WB-JEE-2008

Ans. (b) :


CH₃–CH=CH₂
HI
Peroxide
CH₃–ĊH–CH₃
İ
CH₃–CH–CH₃
I

The product formed is markvoniff rule.

487. The addition of HBr to 2- pentene gives

(a) 2- bromopentane only

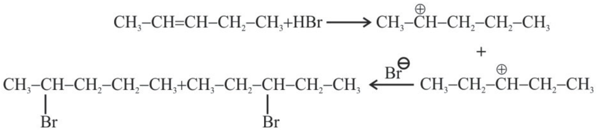
(b) 3- bromopentane only

(c) 2- bromopentane and 3-bromopentane

(d) 1- bromopentane and 3- bromopentane

WB-JEE-2009

Ans. (c) :


CH₃–CH=CH–CH₂–CH₃+HBr ⟶ CH₃–C⊕H–CH₂–CH₂–CH₃
+
CH₃–CH–CH₂–CH₂–CH₃+CH₃–CH₂–CH–CH₂–CH₃ ⟵ Br⊖ CH₃–CH₂–C⊕H–CH₂–CH₃
Br
Br

488. Among the alkenes which one produces tertiary butyl alcohol on acid hydration?

(a) $CH_3-CH_2-CH=CH_2$

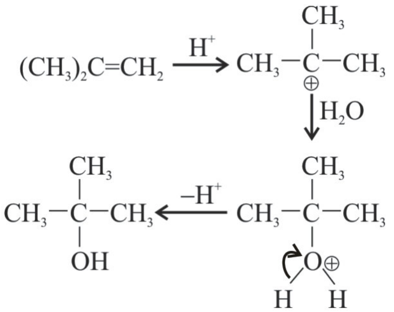
(b) $CH_3-CH=CH-CH_3$

(c) $(CH_3)_2C=CH_2$

(d) $CH_3-CH=CH_2$

WB-JEE-2011

Ans. (c) :


(CH₃)₂C=CH₂
H⁺
CH₃–C⊕–CH₃ (CH₃)
H₂O
CH₃–C(CH₃)–CH₃ O⊕ H H
–H⁺
CH₃–C(CH₃)–CH₃ OH

t–butylalcohol.

489. In 2-butene, which one of the following statements is true?

(a) C_1-C_2 bond is a $sp^3-sp^3-\sigma$-bond

(b) C_2-C_3 bond is a $sp^3-sp^2-\sigma$-bond

(c) C_1-C_2 bond is a $sp^3-sp^2-\sigma$-bond

(d) C_1-C_2 bond is a $sp^2-sp^2-\sigma$-bond

WB-JEE-2012

@apna_pdf

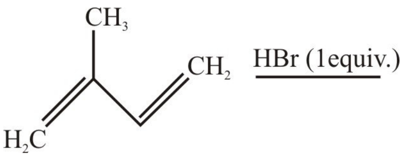
Ans. (c) : The structure of 2–butane is–

$$\overset{1}{CH_3}-\overset{2}{CH}=\overset{3}{CH}-\overset{4}{CH_3}$$

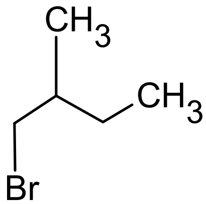
$sp^3 \quad sp^2 \quad sp^2 \quad sp^3$

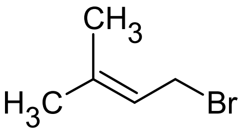
In 2–butane, C_1–C_2 bond is a sp^3–sp^2–σ bond and C_3–C_4 bond is a sp^2–sp^3 –σ bond.

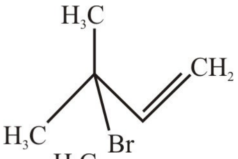
490.

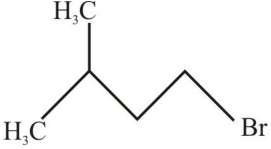

CH3
CH2
H2C
HBr (1equiv.)

The major product of the above reaction is

(a)


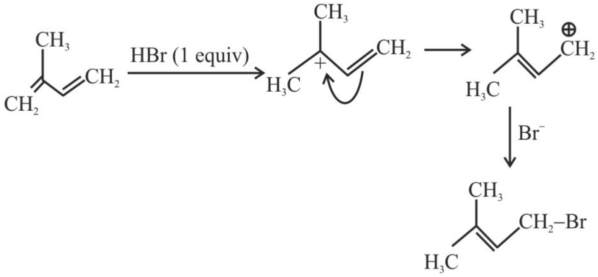
(b)


(c)


(d)


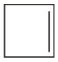
WB-JEE-2015

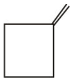
Ans. (b) :


CH3
CH2
CH2
HBr (1 equiv)
CH3
H3C
+
CH2
CH3
⊕
CH2
H3C
Br⁻
CH3
CH2–Br
H3C

491. Ozonolysis of an alkene produces only one dicabonyl compound. The structure of the alkene is

(a) $H_3C-CH=CH-CH_3$

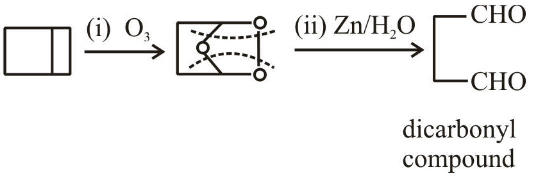
(b)


(c)


(d) $CH_3-CH=CH-CH-CH_2$

WB-JEE-2016

Ans. (b) : Ozonolysis of an cyclobutene produces only one dicarbonyl compound.

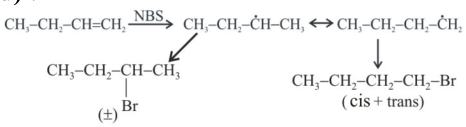

(i) O3
(ii) Zn/H2O
CHO
CHO
dicarbonyl compound

492. The number of possible organobromine compounds which can be obtained in the allylic bromination of 1-butene with N-bromosuccinimide is

(a) 1
(b) 2
(c) 3
(d) 4

WB-JEE-2018

Ans. (d) :


CH3–CH2–CH=CH2
NBS
CH3–CH2–ĊH–CH3
CH3–CH2–CH2–ĊH2
CH3–CH2–CH–CH3
Br
(±)
CH3–CH2–CH2–CH2–Br
(cis + trans)

The allylic bromination of 1–butane with N–bromosuccinimide, the possible number of organobromine is 4.

493. The correct order of the addition reaction rates of halogen acids with ethylene is

(a) hydrogen chloride> hydrogen bromide > hydrogen iodide
(b) hydrogen iodide > hydrogen bromide > hydrogen chloride
(c) hydrogen bromide > hydrogen chloride > hydrogen iodide
(d) hydrogen iodide > hydrogen chloride > hydrogen bromide

WB-JEE-2019

Ans. (b) : The stability of hydrogen halides decreases down the group due to decrease in bond (H–X) dissociation energy. Hence, the addition of hydrogen halide with alkene will be HI>HBr>HCl>HF.

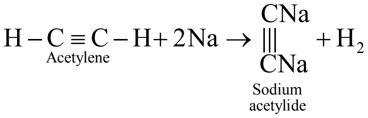
3. Alkynes

494. Which of the following compounds liberates hydrogen gas on reacting with sodium metal?

(a) C_6H_6
(b) C_2H_2
(c) C_2H_4
(d) C_2H_6

AP-EAMCET (Med.)-1999

Ans. (b) : The sodium reacts with acetylene to evolve H_2 gas.

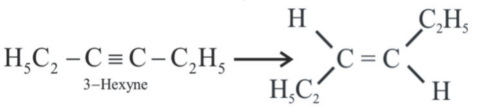


$$\underset{\text{Acetylene}}{H-C\equiv C-H}+2Na \rightarrow \underset{\text{Sodium acetylide}}{\begin{matrix}CNa\\ |||\\ CNa\end{matrix}}+H_2$$

Na has basic characteristics so, it reacts with acidic compounds. In the given compounds C_2H_2 has acidic nature because H attached with triple bonded carbon has acidic character.

@apna_pdf

495. Consider the following transformation :



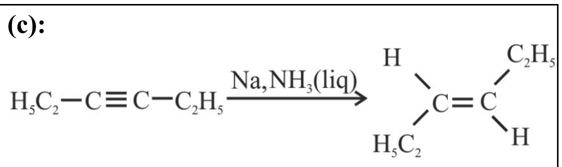
trans-3-hexene
as major product

Which one of the following reagents is suitable for the above transformation?

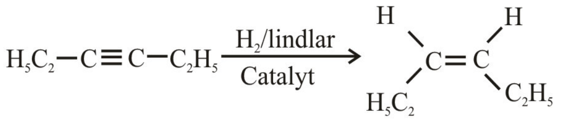
(a) H_2 Lindlar catalyst (b) $LiAlH_4$
(c) Na, NH_3(liq) (d) Zn-Hg/HCl

SCRA-2015

Ans. (c):

(a)


Trans-alkene

(b)


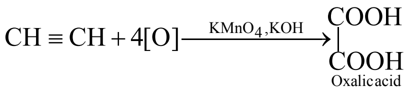
cis-alkene

496. Dilute $KMnO_4$ oxidises acetylene to

(a) acetic acid (b) carbon dioxide
(c) oxalic acid (d) acetaldehyde

A.P.EAMCET-1992

Ans. (c) : Acetylene react with dilute $KMnO_4$ to give oxalic acid.



$$CH\equiv CH+4[O]\xrightarrow{KMnO_4,KOH}\underset{\text{Oxalic acid}}{\begin{matrix}COOH\\|\\COOH\end{matrix}}$$

497. The hybridisation involved in acetylene is

(a) sp (b) sp^2
(c) sp^3 (d) dsp^2

A.P.EAMCET-1993

Ans. (a) : Acetylene (C_2H_2), the hybridisation involve in acetylene is sp because it has triple bonded compound. The structure of acetylene is–

$HC\equiv CH$

498. In the following reaction sequence,

$$CaC_2\xrightarrow{H_2O}P\xrightarrow{\text{Hot iron}}Q\xrightarrow[AlCl_3]{CH_3Cl}R$$

the product R is

(a) benzene
(b) toluene
(c) ethylbenzene
(d) n-propyl benzene

A.P.EAMCET-1995

Ans. (b) :

$$CaC_2\xrightarrow{H_2O}\underset{\underset{(P)}{\text{Acetylene}}}{HC\equiv CH}\xrightarrow[\text{tube}]{\text{Hot iron}}\underset{\underset{(Q)}{\text{Benzene}}}{C_6H_6}\xrightarrow[AlCl_3]{CH_3Cl}\underset{\underset{(R)}{\text{Toluene}}}{C_6H_5CH_3}$$

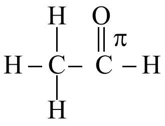
499. The number of π bonds in the product formed by passing acetylene through dil. H_2SO_4 containing mercuric sulphate is

(a) zero (b) one
(c) two (d) three

A.P.EAMCET-1997

Ans. (b) : $\underset{\text{Acetylene}}{CH\equiv CH}+H_2O\xrightarrow{\text{dil.}H_2SO_4/HgSO_4}\underset{\text{Acetaldehyde}}{CH_3CHO}$

The product is -



In acetaldehyde only one π– bond present

500. The homologue of ethyne is

(a) C_2H_4 (b) C_2H_6
(c) C_3H_8 (d) C_3H_4

JIPMER-2009
UP CPMT-2008
AP-EAMCET (Medical)-2006, 1998

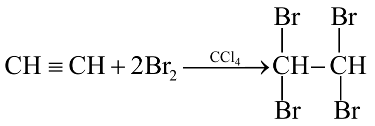
Ans. (d) : A homologue is a compound belonging to series of compounds differing from each other by a repeating unit, such as a methylene bridge-CH_2 group. For ethyne C_2H_2 homologue will be C_3H_4.

501. A gas decolourises Br_2 in CCl_4 and forms a precipitate with ammonical silver nitrate. The gas is

(a) C_2H_2 (b) C_2H_4
(c) C_2H_6 (d) CH_4

A.P.EAMCET-1998

Ans. (a) :



$$CH\equiv CH+2Br_2\xrightarrow{CCl_4}\begin{matrix}Br & Br\\|&|\\CH-&CH\\|&|\\Br&Br\end{matrix}$$

$$CH\equiv CH+2NH_4OH+2AgNO_3\longrightarrow$$
$$H_2O+2NH_4NO_4+\underset{\underset{\text{(White ppt)}}{\text{Silver acetylide}}}{Ag-C\equiv C-Ag}$$

If the compound decolourises Br_2/CCl_4, it must be unsaturated and it gives a white ppt with $AgNO_3/NH_4OH$, the surety of a compound is alkyne (C_2H_2)

502. The number of C – C sigma bonds present in 1–butyne is

(a) 2 (b) 3
(c) 4 (d) 5

A.P.EAMCET-1999

Ans. (b) : $\underset{\text{1-butyne}}{\overset{1}{C}H\equiv\overset{2}{C}-\overset{3}{C}H_2-\overset{4}{C}H_3}$

Hence, the number of three C–C sigma bond present in 1-butyne.

@apna_pdf

503. The number of acetylene molecules required to form one molecule of benzene is

(a) 1 (b) 2
(c) 3 (d) 4

A.P.EAMCET-1999

Ans. (c) : $\underset{\text{Acetylene}}{3C_2H_2} \xrightarrow[\text{Polymerisation}]{\text{Red hot iron tube}} \underset{\text{Benzene}}{C_6H_6}$

When the number of 3 moles of acetylene molecules required to form one molecule of benzene.

504. Which of the following hydrocarbons has least carbon-carbon bond length?

(a) C_2H_6 (b) C_2H_4
(c) C_6H_6 (d) C_2H_2

A.P.EAMCET-2000

Ans. (d) : C_2H_2 has least C – C bond length i.e. 1.20 Å.

- C_2H_4 has least C–C bond length is 1.33 Å.
- C_2H_6 has least C–C bond length is 1.54 Å.

505. Which of the following reacts with ammonical cuprous chloride?

(a) CH_4 (b) C_2H_2
(c) C_2H_6 (d) C_6H_6

A.P.EAMCET-2000

Ans. (b) : Acetylene (C_2H_2) reacts with ammonical cuprous chloride

$$\underset{\text{Acetylene}}{HC \equiv CH} \xrightarrow[NH_4OH]{Cu_2Cl_2} \underset{\text{Cuprous acetalide}}{Cu-C\equiv C-Cu}$$

506. The reagent used for converting acetylene to oxalic acid is

(a) $HgSO_4$/aqueous H_2SO_4
(b) $HgSO_4/CH_3COOH$
(c) $KMnO_4$/KOH, 25^0C
(d) Cr_2O_3/H_2SO_4

A.P.EAMCET-2002

Ans. (c) : The reagent KMnO4/KOH, 25^0C is used for converting acetylene to oxalic acid

$$\underset{\text{Acetylene}}{CH \equiv CH} + 4[O] \xrightarrow[KOH, 25^\circ C]{KMnO_4} \underset{\text{oxalic acid}}{HOOC-COOH}$$

507. When acetylene is passed through red hot iron tube, compound X is formed. Which one of the following reactions will yield X as the major product?

(a) $C_6H_5OH + Zn \xrightarrow{\text{Distillation}}$
(b) $C_6H_5SO_3H + NaHCO_3 \rightarrow$
(c) $C_6H_{12} + 3H_2 \xrightarrow{Ni}$
(d) $C_6H_5Cl + H_2O \xrightarrow{\Delta}$

A.P.EAMCET-2003

Ans. (a) : When acetylene iron tube, benzene is formed

$$\underset{\text{Acetylene}}{3C_2H_2} \xrightarrow{\text{Red hot tube}} \underset{(\times)}{C_6H_6}$$

$$C_6H_5OH + Zn \xrightarrow{\text{distillation}} C_6H_6 + ZnO$$

508. The following reaction is an example of ....reaction.

$C_2H_4Br_2 \xrightarrow{\text{Alc.KOH}} C_2H_2$

(a) addition
(b) dehydrobromination
(c) substitution
(d) debromination

A.P.EAMCET-2004

Ans. (b) :

$$\underset{\substack{\text{Ethylene}\\\text{dibromide}}}{C_2H_4Br_2} + \underset{\text{Alc.}}{2KOH} \xrightarrow{\Delta} \underset{\text{Acetylene}}{CH \equiv CH} + 2KBr + 2H_2O$$

This reaction is dehydrohalogenation reaction.

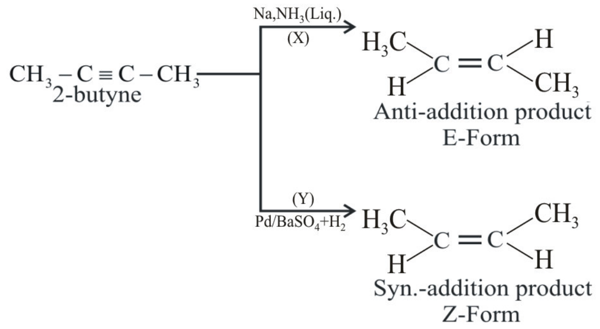
509. What are X and Y respectively in the following reaction?

$Z-\text{product} \xrightarrow{y} 2-\text{butyne} \xrightarrow{x} E-\text{product}$

(a) Na/NH_3(liq.) and $Pd/BaSO_4 + H_2$
(b) Ni/140^0 C and $Pd/BaSO_4 + H_2$
(c) Ni/140^0C and Na/NH_3 (liq.)
(d) $Pd/BaSO_4 + H_2$ and Na/NH_3 (liq.)

A.P.EAMCET-2008

Ans. (a) :



510. Which of the following compounds reacts with an aqueous solution of $Ag(NH_3)_2OH$?

(a) Ethane (b) Ethene
(c) 1 – Butyne (d) 2 – Butyne

MPPET - 2012

Ans. (c) : Terminal alkyne (1-butyne)
$H_3C - H_2C - C \equiv CH$ posses acidic hydrogen. Hence it reacts with $Ag(NH_3)_2OH$ to form a ppt. of silver salt.

511. Action of zinc dust on tetrabromo ethane gives

(a) CH_2OH (b) $CH \equiv CH$
(c) $\begin{matrix} CH = CH_2 \\ | \\ CH_2OH \end{matrix}$ (d) $CH_3 — CH_3$

A.P. EAMCET-1996

Ans. (b) :

$$\underset{\text{Tetrabromo ethane}}{C_2H_2Br_4} + 2Zn \xrightarrow[\text{reaction}]{\text{elimination}} \underset{\text{Acetylene}}{C_2H_2} + 2ZnBr_2$$

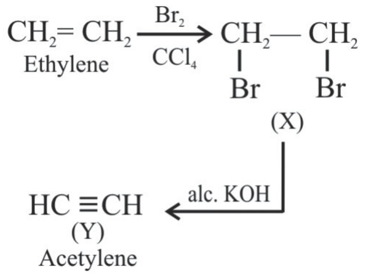
512. Ethylene reacted with bromine in CCl_4 to form X. X is treated with alcoholic KOH to give Y. X and Y are respectively

@apna_pdf

(a) $BrCH_2—CH_2Br$ and C_2H_2
(b) C_2H_5Br and C_2H_4
(c) C_2H_5Br and C_6H_6
(d) $C_2H_5Br_3$ and C_2H_4

A.P. EAMCET-2000

Ans. (a) :


$CH_2=CH_2$
Ethylene
Br_2
CCl_4
$CH_2—CH_2$
Br
Br
(X)
alc. KOH
$HC\equiv CH$
(Y)
Acetylene

513. Ethyne is treate with 30% H_2SO_4 in the presence of 1% mercuric sulphate at 70°C. What is the product formed?
(a) Ethene
(b) Ethanol
(c) Ethanal
(d) Ethylene glycol

A.P.EAMCET/1999

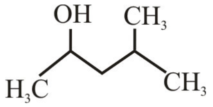
Ans. (c) :

$$\underset{\text{Acetylene}}{CH\equiv CH}+H_2O\xrightarrow[70^0C]{1\%\,HgSO_4}\underset{\substack{\text{Ethanal}\\ \text{or}\\ \text{Acetaldehyde}}}{CH_3CHO}$$

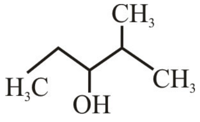
514. The major product form the following reaction sequence is

$$\text{Propyne}\xrightarrow[\substack{\text{iii)}\Delta\\ \text{iv)}Pd,H_2\\ \text{v)}NaBH_4}]{\substack{\text{i)}Hg^{2*}/H^+,333K\\ \text{ii)}NaOH}}$$

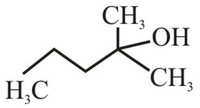
(a)


OH
CH_3
H_3C
CH_3

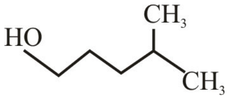
(b)


CH_3
H_3C
OH
CH_3

(c)

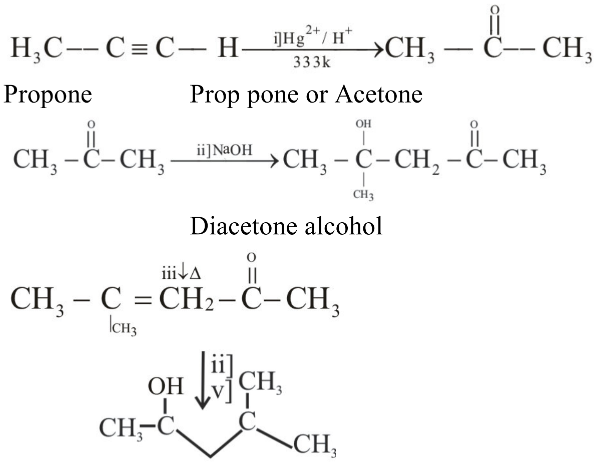

CH_3
OH
H_3C
CH_3

(d)



TS EAMCET 10.08.2021, Shift-I

Ans. (a) :


$H_3C—C\equiv C—H$
i]Hg^{2+}/H^+
333k
$CH_3—\overset{O}{\overset{||}{C}}—CH_3$
Propone
Prop pone or Acetone
ii]NaOH
Diacetone alcohol
iii↓Δ
ii]
v]
OH
CH_3
CH_3

515. Ammonicla cuprous chloride will give red precipitate with which one of the following
(a) $CH_3-C\ \ C\equiv C-CH_3$
(b) $CH_3-CH=CH_2$
(c) $CH_3-C\equiv CH$
(d) $CH_3-CH=CH-CH_3$

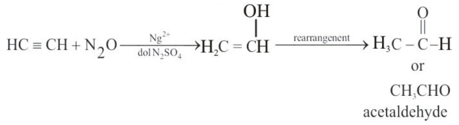
MPPET-2008

Ans. (c) : The compound which reacts with ammonicla cuprous chloride which produces a red precipitate is ethyne (acetylene)- The option (c) is correct.

516. Reaction of acetylene with water in the presence of H_2SO_4 and $HgSO_4$ gives :
(a) Acetone
(b) Acetablehyde
(c) Acetic acid
(d) Formaldehyde

SCRA - 2009

Ans. (b) : Acetylene reacts with water in the presence of dill sulphuric acid and mercuric sulphate to form unstable product which under goes rearrangement to give acetaldehyde.


$HC\equiv CH+N_2O$
Ng^{2+}
dol N_2SO_4
$H_2C=\overset{OH}{CH}$
rearrangenent
$H_3C-\overset{O}{\overset{||}{C}}-H$
or
CH_3CHO
acetaldehyde

517. Identify the alkyne in the following sequence of reactions,

$$\text{Alkyne}\xrightarrow[\text{Lindlar's catalyst}]{H_2}A\xrightarrow{\text{Ozonolysis}}\underset{\text{only}}{B}$$

$$\xrightarrow[\text{process}]{\text{Wacker}}CH_2=CH_2$$

(a) $H_3C—C\equiv C—CH_3$
(b) $H_3C—CH_2—C\equiv CH$
(c) $H_2C=CH—C\equiv CH$
(d) $HC\equiv C=CH_2—CH_3$

AP EAMCET (Engg.)-2009
BITSAT – 2009

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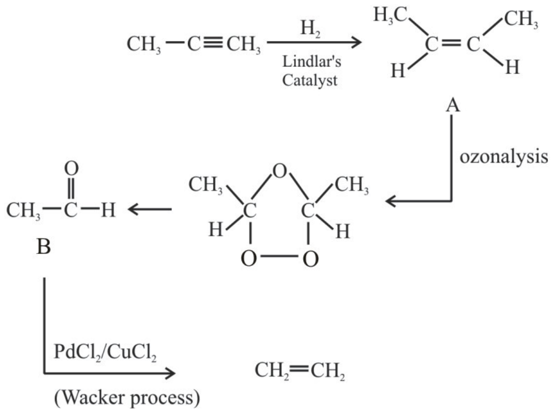
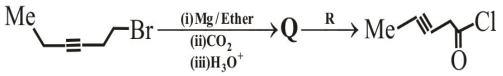
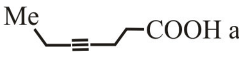
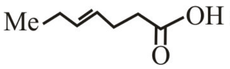
Ans. (a)

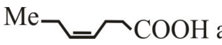

CH₃—C≡CH₃
H₂
Lindlar's Catalyst
H₃C
CH₃
C=C
H
H
A
ozonalysis
O
CH₃—C—H
B
PdCl₂/CuCl₂
(Wacker process)
CH₂=CH₂

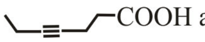
518. In the following reaction sequence Identify product 'Q' and reagent 'R'


Me
Br
(i)Mg/Ether
(ii)CO₂
(iii)H₃O⁺
Q
R
Me
Cl
O

(a)  and $SOCl_2$

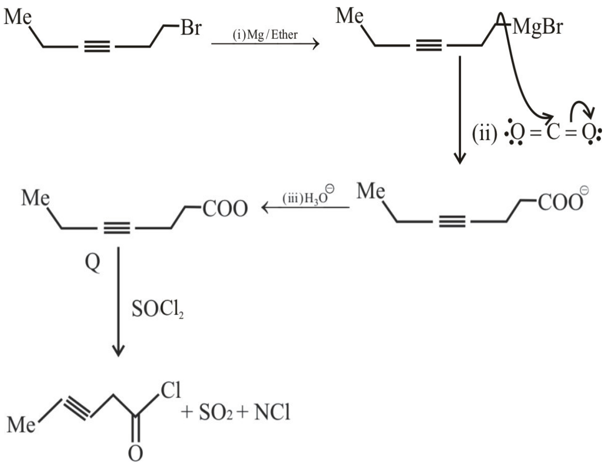
(b)  and SO_2Cl_2

(c)  and $SOCl_2$

(d)  and $CH_3SO_2Cl_2$

AP EAPCET 19-08-2021 Shift-I

Ans. (c) :


Me
Br
(i)Mg/Ether
Me
MgBr
(ii) O=C=O
Me
COO
(iii)H₃O
Me
COO⁻
Q
SOCl₂
Me
Cl
O
+ SO₂ + NCl

519. In the following reaction:

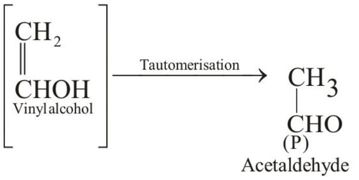
$$HC\equiv CH\xrightarrow[Hg^{2+}]{H_2SO_4}\text{'P'}$$

Product 'P' will not give

(a) Tollen's reagent test
(b) Brady's reagent test
(c) Victor Meyer test
(d) Iodoform test.

KARNATAKA NEET 2013

Ans. (c) : $HC\equiv CH\xrightarrow[Hg^{2+}]{H_2SO_4}$


CH₂
CHOH
Vinylalcohol
Tautomerisation
CH₃
CHO
(P)
Acetaldehyde

Acetaldehyde does not give Victor Meyer test.

520. The number of sigma and pi bonds in pent-2-yne is

(a) 12 and 2
(b) 11 and 2
(c) 13 and 2
(d) 12 and 3

COMEDK 2012

Ans. (a):

$$CH_3-C\equiv C-CH_2-CH_3$$

Pent-2-yne

Total number of π bonds = 2

Total number of σ bonds = 12

521. Ethylene can be separated from acetylene by passing the mixture through

(a) fuming h_2SO_4
(b) pyrogallol
(c) ammoniacal Cu_2CI_2
(d) charcoal powder

WB-JEE-2009

Ans. (c) : Ethylene can be separated from acetylene by passing the mixture through ammonical Cu_2Cl_2.

$$CH\equiv CH+CuCl_2(\text{ammonical})\rightarrow \underset{\substack{\text{Copper acetylide}\\\text{(red ppt.)}}}{CuC\equiv CC_4}$$

$$CH_2=CH_2+CuCl_2(\text{ammonical})\rightarrow \text{No reaction}$$

522. Acetylene and HCHO react in presence of copper acetylide catalyst to form:

(a) 1-butyne-1, 4-diol
(b) 2-butyne-1, 2-diol
(c) 2-butyne-1, 4-diol
(d) none of these

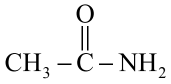
AP-EAMCET (Medical), 2006

Ans. (c) : When acetylene and HCHO react in presence of copper acetylene catalyst to formed the 2-butync-1,4-diol.

$$\underset{\text{Acetylene}}{H-C\equiv C-H}+\underset{\text{Formaldehyde}}{2HCHO}\rightarrow \underset{\text{2-butyne-1,4-diol}}{HOH_2C-C\equiv C-CH_2OH}$$

523. Identify C in the following reaction

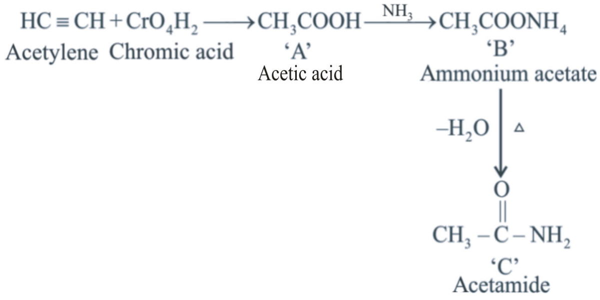
$$C_2H_2\xrightarrow[\text{acid}]{\text{Chromic}}A\xrightarrow{NH_3}B\xrightarrow[-H_2O]{\Delta}C$$

(a) $CH_3-CH_2-NH_2$
(b) CH_3-CN
(c) $CH_3-CH_2-NH-CH_3$
(d)  $CH_3-\overset{\overset{O}{\|}}{C}-NH_2$

AP-EAMCET (Medical), 2008

@apna_pdf

Ans. (d) : When chromic acid (CrO_4H_2) treated with acetylene then acetic acid is formed. Further acetic acid reacted with ammonia to formed the ammonium acetate. When heat supplied on ammonium acetate then acetamide is formed



524. In the following reaction

$$C_2H_2 \xrightarrow[HgSO_4/H_2SO_4]{H_2O\ 60^0 C} X \rightleftharpoons CH_3CHO$$

What is X?

(a) CH_3CH_2OH (b) CH_3OCH_3
(c) CH_3CH_2CHO (d) $H_2C{=}CHOH$

AP-EAMCET (Medical), 2001

Ans. (d) : Acetylene (C_2H_2) treated with water or dil. H_2SO_4 in presence of Hg^{2+} or $HgSO_4$, vinyl alcohol is obtained which undergoes rearrangement to form acetaldehyde (CH_3–CHO).

$$\underset{\text{Acetylene}}{HC\equiv CH} + H_2O \xrightarrow{H_2SO_4/HgSO_4} \underset{\text{Vinylalcohol}}{H_2C=CH-OH} \xrightleftharpoons{\text{Rearrangement}} \underset{\text{Acetaldehyde}}{CH_3-CHO}$$

525. When acetylene gas is passed through .... solution, a white precipitate is formed :

(a) Aqueous silver nitrate
(b) Ammoniacal cuprous chloride
(c) Ammoniacal silver nitrate
(d) Aqueous potassium permanganate

AP-EAMCET (Medical), 2002

Ans. (c) : When acetylene (C_2H_2) gas is passed through ammoniacal silver nitrate ($AgNO_3$) solution, a white precipitate is formed. The reaction is given below –

$$\underset{\text{Acetylene}}{H-C\equiv C-H} + \underset{\text{Silver nitrate}}{2AgNO_3} + \underset{\text{Ammonium hydroxide}}{2NH_4OH} \longrightarrow$$

$$\underset{\text{Silver acetylide}}{Ag^{2+}\cdot\bar{C}\equiv\bar{C}} + \underset{\text{Ammonium nitrate}}{2NH_4NO_3} + 2H_2O$$

526. In the following reaction, X and Y are respectively :

$$C_2H_2 \xrightarrow{X} C_6H_6 \xrightarrow{Y} C_6H_5SO_3$$

(a) iron tube/heating, Na_2SO_4
(b) Zn, conc. H_2SO_4
(c) red hot iron tube, fuming H_2SO_4
(d) H_2/Pd —$BaSO_4$, dil/H_2SO_4

AP-EAMCET (Medical), 2002

Ans. (c) : When 3 moles of ethyne is passed through red hot iron tube at 873K. It undergoes cyclic polymerization to form benzene. When benzene reacts with fuming H_2SO_4 undergo sulphonation and forms benzene sulphonic acid.

$$\underset{\text{Ethyne}}{3H_2C_2} \xrightarrow[\text{iron tube}]{\text{Red hot}} \underset{\text{Benzene}}{C_6H_6}$$

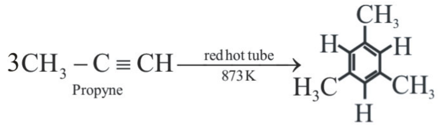
$$\underset{\text{Benzene}}{C_6H_6} + \underset{\text{Sulfuric acid}}{H_2SO_4} \longrightarrow \underset{\text{Benzene sulphonic acid}}{C_6H_5SO_3H} + H_2O$$

527. When propyne is passed through a red hot iron tube at 873K, the reaction gives product having molecular formula of

(a) C_7H_8 (b) C_9H_{12}
(c) C_8H_{10} (d) C_6H_6

TS EAMCET 04.08.2021, Shift-I

Ans. (b) :

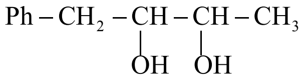


1,3,5 trimethyl benzene (mesitylene)

Hence, the molecular formula of 1,3,5 trimethyl benzene is C_9H_{12}.

528. $Ph-CH_2-CH=CH-CH_3 \xrightarrow[\text{(ii)Alc.KOH}]{\text{(i)}Br_2}$

(a) $Ph - CH = CH - CH = CH_2$

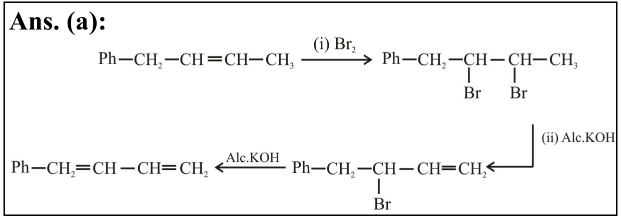
(b)


$Ph-CH_2-\underset{OH}{CH}-\underset{OH}{CH}-CH_3$

(c) $Ph - CH_2 - C = C \equiv CH_3$
(d) $Ph - C \equiv C - CH_2 - CH_3$

AIIMS 25 May 2019 (Evening)

Ans. (a):

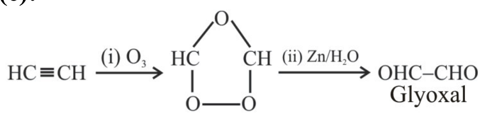


529. Ozonolysis of acetylene gives

(a) HCHO (b) CH_3CHO
(c) CHO-CHO (d) none of these

AIIMS-1996

Ans. (c):



530. The end product (C) in the following sequence of reactions

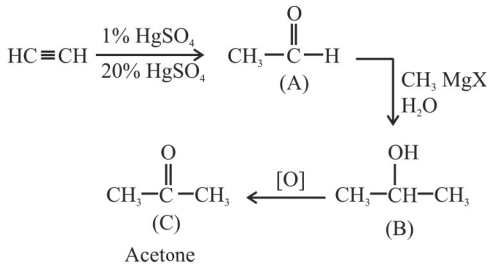
$$HC\equiv CH \xrightarrow[20\%\ H_2SO_4]{1\%HgSO_4} A \xrightarrow[H_2O]{CH_3MgX} B \xrightarrow{[O]} (C)$$

(a) acetic acid (b) isopropyl alcohal
(c) acetone (d) ethanol

AIIMS-2017, 1997
CG PET-2004

@apna_pdf

Ans. (c):



531. Which is the most suitable reagent among the following to distinguish compound (3) from rest of the compounds?

1. $CH_3-C\equiv C-CH_3$
2. $CH_3-CH_2-CH_2-CH_3$
3. $CH_3-CH_2C\equiv CH$
4. $CH_3-CH=CH_2$

(a) Bromine in carbon tetrachloride
(b) Bromine in acetic acid
(c) Alk $KMnO_4$
(d) Ammoniacal silver nitrate

[AIIMS-2015]

Ans. (d): : Only terminal allcyne react with ammonical solution of silver nitrate. ($AgNO_3$)

$$CH_3-CH_2-C\equiv CH+2[Ag(NH_3)_2]NO_3\rightarrow \underset{\text{White ppt.}}{CH_3-CH_2-C\equiv \overset{\ominus}{C}\overset{\oplus}{Ag}}$$

Rest other campaind donot react with ammonical solution of silver nitrate.

(i) $CH_3-C\equiv C-CH_3+2[Ag(NH_3)_2]NO_3\rightarrow$No reaction
(ii)$CH_3-CH_2-CH_2-CH_3+2[Ag(NH_3)_2]NO_3\rightarrow$No reaction
(iii) $CH_3-CH=CH_2+2[Ag(NH_3)_2]NO_3\rightarrow$No reaction

532. Predict the nature of P in the following reaction

$$CH_3C\equiv CCH_3\xrightarrow[\text{heat}]{NaNH_2/\text{inert solvent}}P$$

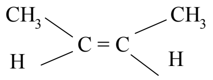
(a) $CH_2\equiv CHCH=CH_2$
(b) $CH_2=C=CH-CH_3$
(c) $CH_3CH_2C\equiv CH$
(d) No reaction

[AIIMS-2014]

Ans. (c):
We know that when alkynes are heated with $NaNH_2$ in an inert solvent, the triple bond moves towards end of the chain.

$$CH_3-C\equiv C-CH_3+NaNH_2\xrightarrow[\text{heat}]{\text{inert solvent}}CH_3-CH_2-C\equiv C^-Na^+\downarrow H_2O$$
$$CH_3-CH_2-C\equiv CH$$

533. Which of the following has the lowest dipole moment ?

(a)


(b) $CH_3C\equiv CCH_3$
(c) $CH_3CH_3C\equiv CH$
(d) $CH_3=CH-C\equiv CH$

[AIIMS-2013]

Ans. (b): In but-2-yne has two methyl group have dipolar direction to each other Hence, the resultant dipole moment is zero.

$$CH_3-C\equiv C\rightarrow CH_3$$
$$\mu=O$$

534. 1-Butyne can be distinguished most easily from 2-butyne by

(a) bromine water
(b) ozonmolysis
(c) Tollen's reagent
(d) $KMnO_4$ solution

AIIMS-2011
NEET Mains-2012
BCECE-2003]
JIPMER-2005

Ans. (c): The hydrogen atom that are attached to triply bonded carbon are weakly acidic in nature. The two alkyne. The reaction with tollen's reagent. Tollen's reagent is a chemical reagent which consist of a solution of silver nitrate, ammonia and some sodium hydroxide. Due to acidic nature of the hydrogen atoms attached to the triply bonded carbon, terminal alkynes react with heavy metallic salts like silver nitrate. Hence, 1–butyne is a terminal alkyne, it will react with Tollen's reagent while 2-butyne will not react as it as internal alkyne.

535. Which of the following gives propyne on hydrolysis?

(a) Al_4C_3
(b) Mg_2C_3
(c) B_4C
(d) La_4C_3

[AIIMS-2005]

Ans. (b): Mg_2C_3 (Magnesium carbide) on hydrolysis to give propyne.

$$Mg_2C_3+4H_2O\rightarrow \underset{\text{Propyne}}{CH_3-C\equiv CH}+2Mg(OH)_2$$

$$Al_4C_3+12H_2O\rightarrow \underset{\text{Methane}}{3CH_4}+4Al(OH)_3$$

536. With ammoniacal cuprous chloride solution, a reddish brown precipitate is obtained on treating with:

(a) CH_4
(b) C_2H_4
(c) C_2H_2
(d) C_3H_6

[AIIMS-2001]

Ans.(c): Acetylene on reaction with ammonical cuprous chloride solution gives a reddish brown precipitate of copper acetylide.

$$H-C\equiv C-H\xrightarrow[NH_4OH]{CuCl_2}\underset{\substack{\text{Copper}\\\text{acetylide}\\\text{Red}\\\text{Ppt}}}{Cu-C\equiv C-Cu}$$

IN the above reaction $2NH_3Cl+2H_2O$ are also formed in the products side.

537. Alkynes usually show which type of reaction?

(a) Substitution
(b) Elimination
(c) Addition
(d) Replacement

AIIMS-1999

@apna_pdf

Ans. (c): Alkyne undergo addition reaction due to the presence of loosely held π–electrons. Due to the presence of a triple bond in alkynes, halogen, water etc. Can be added to them by the process of the addition reaction. The addition reaction of unsaturated compound are added by a group of atoms or molecule to form a saturated compound. An addition occur when two or more compounds combine to form a single product.

538. 1-Butyne and cold alkaline [$KMnO_4$] react to produce:

(a) $CH_3\ CH_2\ COOH$
(b) $CH_3CH_2COOH + CO_2$
(c) $CH_3CH_2COOH + HCOOH$
(d) $CH_3\ CH_2CH_2COOH$

[AIIMS-1997]

Ans. (b):

$$CH_3-CH_2-C\equiv CH \xrightarrow[\text{alkaline}\,KMnO_4]{\text{Cold}} CH_3-CH_2-COOH+CO_2$$

539. Chloroform when heated with silver powder gives.

(a) CH_4
(b) H_3C-CH_3
(c) $CH\equiv CH$
(d) $CH_2=CH_2$

AP- EAMCET(Medical) -2010

Ans. (c): When two mole of chloroform heated with six moles of solid silver powder gives the acetylene.

$$2CHCl_3 + 6Ag(s) \longrightarrow CH\equiv CH + 6AgCl$$

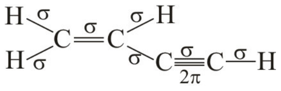
Chloroform Silver powder acetylene

540. The number of σ and π bonds present in 1-butene-3-yne is

(a) 7 and 3
(b) 5 and 5
(c) 7 and 2
(d) 6 and 4

AP - EAMCET(MEDICAL) - 2009

Ans. (a) : The structure of 1-butene-3-yene is given as–



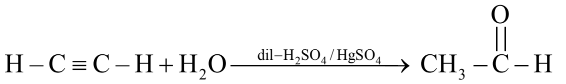
Number of σ-bond = 7
Number of π-bond = 3

541. The number of π -bonds in the product formed by passing acetylene through dil. H_2SO_4 containing mercuric sulphate is:

(a) zero
(b) one
(c) two
(d) three

AP – EAMCET - (Medical)-1997

Ans. (b) : When acetylene passes through the dilute H_2SO_4 in the presence of mercuric sulphate then acetaldehyde is formed.



$$\underset{\text{Alkyne}}{H-C\equiv C-H}+H_2O \xrightarrow{\text{dil}-H_2SO_4/HgSO_4} \underset{\text{Acetaldehyde}}{CH_3-\overset{\overset{\displaystyle O}{||}}{C}-H}$$

As we know, acetaldehyde contains the one π-bonds

542. When acetylene is passed into methanol at 160-200°C on the presence of a small amount of potassium methoxide under pressure, the following is formed –

(a) Polyvinyl alcohol
(b) Divinyl ether
(c) Dimethyl ether
(d) Methyl vinyl ether

VITEEE-2019

Ans. (d) : When acetylene is passed into methanol at 160-200°C in the presence of a small amount (1-2%) of potassium methoxide and under pressure just high enough to prevent boiling, methyl vinyl ether is formed.

$$HC\equiv CH+CH_3O^- \longrightarrow C^-H=CHOCH_3$$
$$\xrightarrow{CH_3OH} \underset{\text{Methyl vinyl ether}}{CH_2=CHOCH_3}+CH_3O^-$$

543. Identify Z in the following reaction sequence

$$CH_3CH_2CH_2OH \xrightarrow[160-180°C]{\text{Conc.}H_2SO_4} X$$
$$\downarrow$$
$$Y \xrightarrow[\text{(ii)}NaNH_2]{Br_2+CCl_4}$$

(a) $CH_3-CH(NH_2)-CN_2NH_2$
(b) $CH_3-CHOH-CH_2OH$
(c) $CH_3-C(OH)=CH_2$
(d) $CH_3-C\equiv CH$

VITEEE-2015

Ans. (d) :

$$CH_3CH_2CH_2OH \xrightarrow[160°-180°C]{\text{Conc.}H_2SO_4} \underset{(X)}{CH_3CH=CH_2}$$

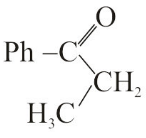
$$\xrightarrow{Br_2}\xrightarrow{\text{alc.KOH}} \underset{(Y)}{CH_3CHBr-CH_2Br}$$

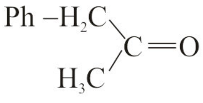
$$[CH_3C(Br)=CH_2+CH_3CH=CHBr]$$

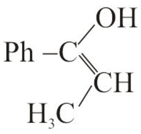
$$\xrightarrow[-HBr]{NaNH_2} \underset{(Z)}{CH_3C\equiv CH}$$

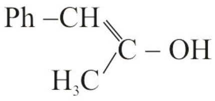
Alcoholic KOH brings about dehydrobromination of Y and give a mixture of vinyl bromide. While $NaNH_2$ is a strong base to give propyne.

544. $Ph-C\equiv C-CH_3 \xrightarrow{Hg^{2+}/H^+}$ A.

(a)


(b)


(c)


(d)


VITEEE-2014

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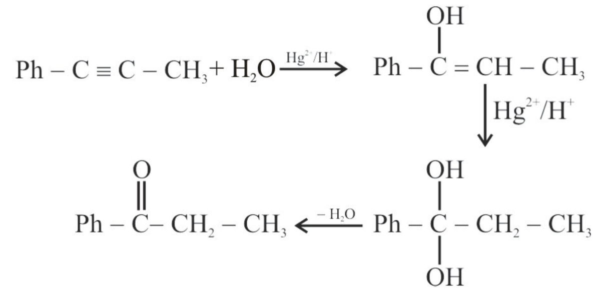
Ans. (a) :



$$Ph-C\equiv C-CH_3+H_2O\xrightarrow{Hg^{2+}/H^+}Ph-\overset{OH}{\overset{|}{C}}=CH-CH_3 \xrightarrow{Hg^{2+}/H^+} Ph-\underset{OH}{\underset{|}{\overset{OH}{\overset{|}{C}}}}-CH_2-CH_3 \xrightarrow{-H_2O} Ph-\overset{O}{\overset{\|}{C}}-CH_2-CH_3$$

545. Consider following reaction ,

$$HC\equiv CH\xrightarrow[H_2SO_4]{Hg^{2+}/HgSO_4}X\xrightarrow{CH_3MgBr}Y\xrightarrow{H_3C^+}Z$$

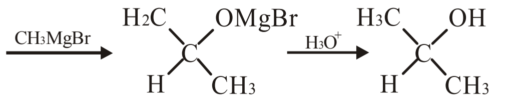
The compound 'Z' is

(a) 1–propanol (b) 2– Propanol

(c) Propanol (d) Propan–2–one

AMU–2006

Ans. (b) : $HC\equiv CH\xrightarrow[H_2SO_4]{Hg^{2+}/HgSO_4}CH_3CHO$



546. In the reaction sequence

$$HC\equiv CH\xrightarrow[ether]{NaNH_3}'A'\xrightarrow[ether]{CH_3CH_2CH_2Br}'B'$$

the product 'B' is

(a) 1- butyne (b) 1-pentyne

(c) 2-butyne (d) 2-pentyne

AMU-2004

Ans. (b) : $HC\equiv CH\xrightarrow[ether]{NaNH_2}HC\equiv CNa$

$HC\equiv CNa+CH_3CH_2CH_2Br\rightarrow$

$\underset{\text{1–Pentyne}}{HC\equiv C-CH_2CH_2CH_3}+NaBr$

547. The correct description of bonds in acetylene molecule is

(a) $3\sigma, 1\pi$

(b) $3\sigma, 2\pi$

(c) $4\sigma, 2\pi$

(d) $4\sigma, 1\pi$

Assam CEE-2020

Ans. (b) : Acetylene moleculas formula = C_2H_2

$$H\overset{\sigma}{—}C\overset{\sigma\,\pi\pi}{\equiv}C\overset{\sigma}{—}H$$

in 1 bond 1σ only and in triple bond 1σ and 2π bond so, total bond = $3\sigma, 2\pi$

548. Which of the following will react with hex-2-yne to produce trans-hex-2-ene?

(a) $LiAlH_4$

(b) Pt/H_2

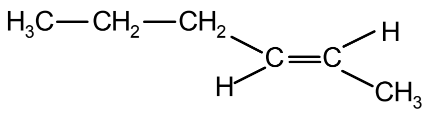
(c) Li/NH_3

(d) $Pd/BaSO_4$

Assam CEE-2021

Ans.(a): $CH_3-C\equiv C-CH_2-CH_2-CH_3$

$\downarrow LiAlH_4$



549. $CH_3C\equiv CH\xrightarrow[+Hg^{2+},60^0C]{H_2SO_4}?$

(a) CH_3CHO (b) CH_3COOH

(c) CH_3COCH_3 (d) CH_3CH_2COOH

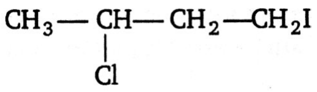
BCECE-2009

Ans. (c) : $\underset{\text{Propyne}}{CH_3-C\equiv CH}\xrightarrow[+Hg_2+,60^\circ C]{H_2SO_4}\underset{\text{Acetone}}{CH_3-\overset{O}{\overset{\|}{C}}-CH_3}$

550. Predict the product 'C' obtained in the following reaction of butyne–1

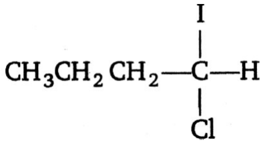
$$CH_3CH_2-C\equiv CH+HCl\longrightarrow B\xrightarrow{HI}C$$

(a)



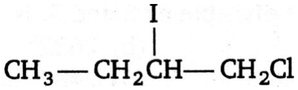
$CH_3-\underset{Cl}{\underset{|}{CH}}-CH_2-CH_2I$

(b)



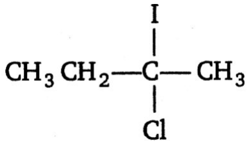
$CH_3CH_2CH_2-\underset{Cl}{\underset{|}{\overset{I}{\overset{|}{C}}}}-H$

(c)



$CH_3-CH_2\overset{I}{\overset{|}{CH}}-CH_2Cl$

(d)

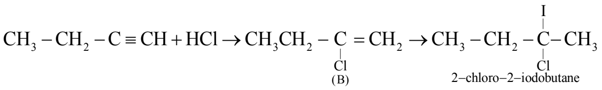


$CH_3CH_2-\underset{Cl}{\underset{|}{\overset{I}{\overset{|}{C}}}}-CH_3$

BCECE-2012

NEET-2007

Ans. (d) :



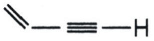
$$CH_3-CH_2-C\equiv CH+HCl\rightarrow \underset{(B)}{CH_3CH_2-\underset{Cl}{\underset{|}{C}}=CH_2}\rightarrow \underset{\text{2–chloro–2–iodobutane}}{CH_3-CH_2-\underset{Cl}{\underset{|}{\overset{I}{\overset{|}{C}}}}-CH_3}$$

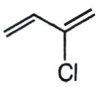
551. $2HC\equiv CH\xrightarrow[+NH_4Cl]{CH_2Cl_2}A\xrightarrow[HCl]{1mol}B$

Indentify the compounds A and B.

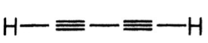
A **B**

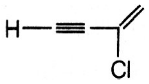
(a)





(b)





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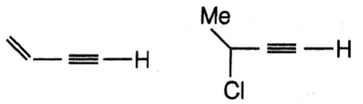
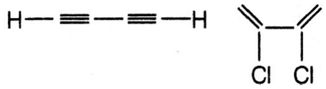
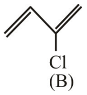
(c) 

(d) 

BCECE-2015

Ans. (a) :

$$2HC\equiv CH\xrightarrow[+NH_4Cl]{CH_2Cl_2}\underset{(A)}{CH_2=CH-C\equiv CH}\xrightarrow[HCl]{1\,mol}$$


(B)

552. Consider the following reaction sequence of alkene

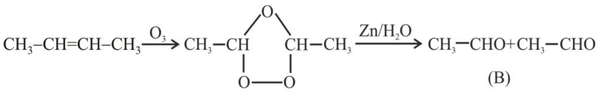
$$CH_3CH=CHCH_3\xrightarrow{O_3}A\xrightarrow[Zn]{H_2O}B$$

The product B is–

(a) $CH_3CH_2COCH_3$ (b) CH_3COCH_3
(c) CH_3CHO (d) CH_3CH_2CHO

BCECE-2015

Ans. (c) :



A

553. When propyne is treated with H_2SO_4 (aq) in presence

(a) propanal
(b) n-propyl hydrogen sulphate
(c) acetone (d) propanol

BCECE-2017
IIT JEE-1983

Ans. (c) :

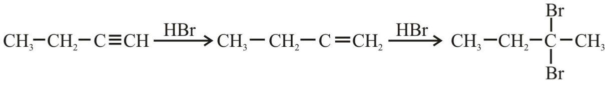
When propyne is treated with H_2SO_4(aq) in presence to give acetone.

554. Which of the following product is obtained when 1-butyne reacts with excess of HBr?

(a) 2, 2-dibromobutane (b) 2-bromobutane
(c) 1,1,2,2-tetra bromobutane
(d) 1,2-dibromo butane

BCECE-2018

Ans. (a) :



$$CH_3-CH_2-C\equiv CH\xrightarrow{HBr}CH_3-CH_2-C=CH_2\xrightarrow{HBr}CH_3-CH_2-\underset{Br}{\overset{Br}{C}}-CH_3$$

2, 2–dibromobutane

2,2–dibromobutane is obtained when 1-butyne reacts with excess of HBr.

555. The most suitable catalyst for the hydrogenation of

2 – Hexyne ⟶ 2 – cis-Hexene is

(a) Pd-$BaSO_4$ (b) $(Ph_3P)_3RhCl$
(c) 10% Pd – C (d) Raney Ni

[BITSAT – 2007]

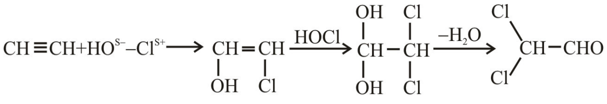
Ans. (a) : A palladium catalyst ($Pd/BaSO_4$) is deliberately poisoned with lead/sulphur compound. This reagent is known as Lindlar's catalyst. They give a cis product. Reduction of 2–hexyne in $Pd/BaSO_4$ to give a ci & –2–hexane.

556. What will be the main product when acetylene reacts with hypochlorous acid?

(a) Trichloroacetaldehyde
(b) Acetaldehyde
(c) Dichloroacetaldehyde
(d) Chloro acetaldehyde

[BITSAT – 2013]

Ans. (c) :



$$CH\equiv CH+HO^{S-}-Cl^{S+}\longrightarrow \underset{OH}{CH}=\underset{Cl}{CH}\xrightarrow{HOCl}\underset{OH}{\overset{OH}{CH}}-\underset{Cl}{\overset{Cl}{CH}}\xrightarrow{-H_2O}(Cl)_2CH-CHO$$

dichlaroacetaldehyele

557. The degree of unsaturation of C_6H_5 and butyne-2 respectively are

(a) 6 and 3
(b) 6 and 2
(c) 2 and 6
(d) 4 and 2

CG PET- 2016

Ans. (d) :

Every ring or π–bond in a compound is said to represent the degree of unsaturaltion.

$$\text{Degree of aunsaturation}=\frac{2C+2+N-X-H}{2}$$

Where, C=Number of carbons
N=No. of nitrogen
X=No. of halogen (F, Cl, Br, I)
H=No, of hydrogen.

$$\text{For } C_6H_5\text{, DoU}=\frac{2\times 6+2-5}{2}=\frac{9}{2}=4.5$$

$$\text{For 2–butyne, DoU }=\frac{2\times 4+2-6}{2}=\frac{4}{2}=2$$

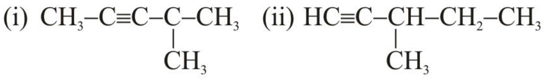
558. One of the isomer of the 5th member of alkyne series is optically active, it is

(a) 4– methyl pent–2–yne
(b) 3– methyl pent–1–yne
(c) 4– methyl pent–1– yne
(d) 3,3–dimethyl but–1– yne

CG PET- 2013

Ans. (b) :

The 5th member of alkyne is C_5H_8.



(i) $CH_3-C\equiv C-\underset{CH_3}{C}-CH_3$ (ii) $HC\equiv C-\underset{CH_3}{CH}-CH_2-CH_3$

4–methyl pent–2–yne 3–methyl pent–1–yne

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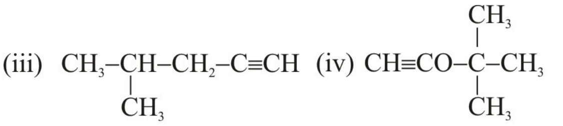
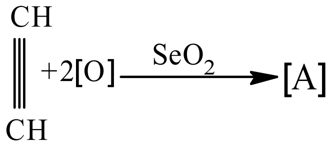


(iii) $CH_3-\underset{CH_3}{CH}-CH_2-C\equiv CH$ (iv) $CH\equiv CO-\overset{CH_3}{\underset{CH_3}{C}}-CH_3$

4–methyl–pent–1–yne 3,3–dimethyl but–1–yne

559. Consider the following reaction

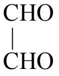


$$CH\equiv CH + 2[O] \xrightarrow{SeO_2} [A]$$

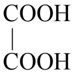
The product [A] is

(a) HCOOH (formic acid)

(b) CH_3COOH (acetic Acid)



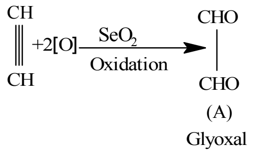
(c) $\begin{matrix}CHO\\|\\CHO\end{matrix}$ (glyoxal)



(d) $\begin{matrix}COOH\\|\\COOH\end{matrix}$ (oxalic acid)

CG PET -2017

Ans. (c) : On treatment of acetylene with SeO_2, we get glyoxal (on oxidation) is obtained.


CH
CH
+2[O]
SeO₂
Oxidation
CHO
CHO
(A)
Glyoxal

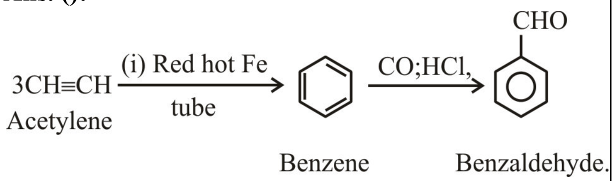
560. Consider the following chemical reaction.

$$CH\equiv CH \xrightarrow[\text{(2) CO, HCl, AlCl}_3]{\text{(1) Red hot Fe tube, 873K}}$$

Product the number of sp^2 hybridised carbon atom(s) present in the product is ....

[JEE Main-2021, 25 Feb Shift-I]

Ans. ():


3CH≡CH
Acetylene
(i) Red hot Fe
tube
CO;HCl,
CHO
Benzene
Benzaldehyde.

In benzaldehyde, total number of sp^2 c–atom is 7.

561. The hydrocarbon which can react with sodium in liquid ammonia is:

(a) $CH_3CH_2CH_2C\equiv CCH_2CH_2CH_3$

(b) $CH_3CH_2C\equiv CH$

(c) $CH_3CH=CHCH_3$

(d) $CH_3CH_2C\equiv CCH_2CH_3$

[AIEEE 2008]

Ans. (b) :

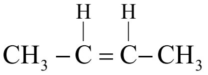
$$CH_3-CH_2-C\equiv CH \xrightarrow{Na/Liq.NH_3} CH_3-CH_2-C\equiv CNa+H_2$$

Alkynes having terminal $C\equiv C$–H react with Na in liquid NH_3 to yield H_2. Terminal alkynes hydrogen are acidic.

562. The treatment of CH_3MgX with $CH_3C\equiv C–H$ produces

(a) $CH_3–CH=CH_2$

(b) $CH_3C\equiv C-CH_3$

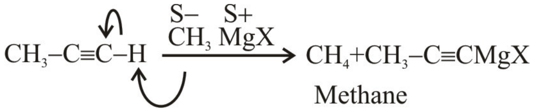


(c) $CH_3-\overset{H}{C}=\overset{H}{C}-CH_3$

(d) CH_4

[AIEEE 2008]

Ans. (d) : Grignard reagent (RMgx) abstracts the acidic proton as it acts as base when an acidic hydrogen is present. The terminal alkyne hydrogen is acidic.


CH₃–C≡C–H
S–
S+
CH₃ MgX
CH₄+CH₃–C≡CMgX
Methane

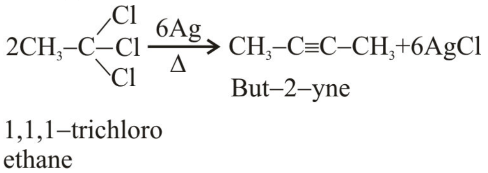
563. The major organic compound formed by the reaction of 1,1,1-trichloroethane with silver powder is :

(a) Acetylene (b) Ethene

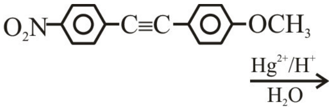
(c) 2–butyne (d) 2–butene

[JEE Main 2014]

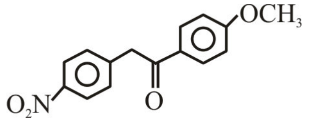
Ans. (c) :


2CH₃–C–Cl
Cl
Cl
6Ag
Δ
CH₃–C≡C–CH₃+6AgCl
But–2–yne
1,1,1–trichloro
ethane

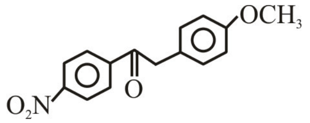
564. The major product obtained from the following reaction is :


O₂N
C≡C
OCH₃
Hg²⁺/H⁺
H₂O

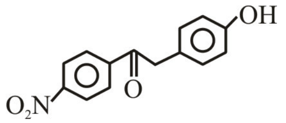
(a)



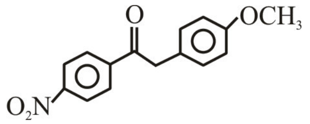
(b)



(c)

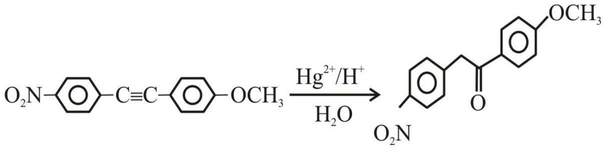


(d)



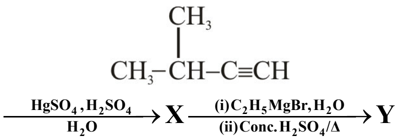
[JEE Main-2020, 6 Sep Shift-I]

Ans. (a) :

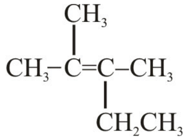

O₂N
C≡C
OCH₃
Hg²⁺/H⁺
H₂O
OCH₃
O
O₂N

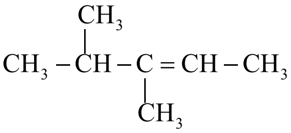
@apna_pdf

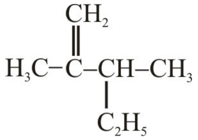
565. **The major product (Y) in the following reaction is:**

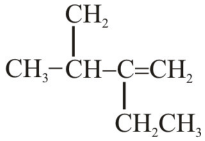

HgSO₄, H₂SO₄
H₂O
X
(i) C₂H₅MgBr, H₂O
(ii) Conc. H₂SO₄/Δ
Y

$$CH_3-CH(CH_3)-C\equiv CH \xrightarrow[H_2O]{HgSO_4,\,H_2SO_4} X \xrightarrow[\text{(ii) Conc. } H_2SO_4/\Delta]{\text{(i) } C_2H_5MgBr,\,H_2O} Y$$

(a)

$CH_3-C(CH_3)=C(CH_2CH_3)-CH_3$

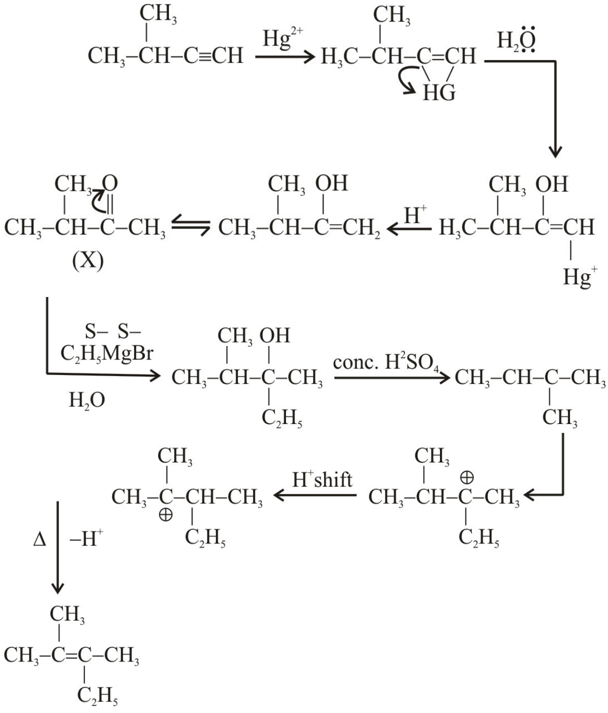
(b)

$CH_3-CH(CH_3)-C(CH_3)=CH-CH_3$

(c)

$H_3C-C(=CH_2)-CH(C_2H_5)-CH_3$

(d)

$CH_3-CH(CH_2)-C(CH_2CH_3)=CH_2$

[JEE Main-2020, 9 Jan Shift-I]

Ans. (a) :


Hg²⁺
HG
H₂Ö
H⁺
Hg⁺
(X)
S– S–
C₂H₅MgBr
H₂O
conc. H²SO₄
H⁺shift
Δ
–H⁺

566. **The major product of the following reaction is:**

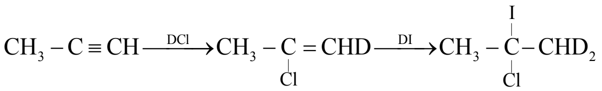
$CH_3C\equiv CH \xrightarrow[\text{(ii) DI}]{\text{(i) DCl(1equiv.)}}$

(a) $CH_3CD(Cl)CHD(I)$ (b) $CH_3CD_2CH(Cl)(I)$

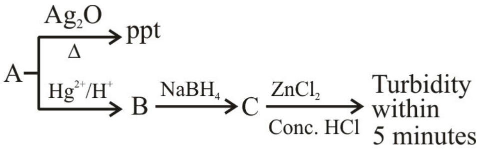
(c) $CH_3CD(I)CHD(Cl)$ (d) $CH_3C(I)(Cl)CHD_2$

[JEE Main-2019, 9 April Shift-I]

Ans. (d) :


$$CH_3-C\equiv CH \xrightarrow{DCl} CH_3-C(Cl)=CHD \xrightarrow{DI} CH_3-C(I)(Cl)-CHD_2$$

567. **Consider the following reactions,**


Ag₂O
Δ
ppt
A
Hg²⁺/H⁺
B
NaBH₄
C
ZnCl₂
Conc. HCl
Turbidity within 5 minutes

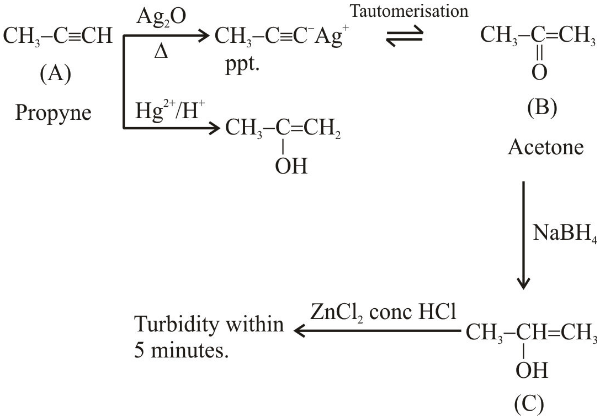
A is

(a) $CH\equiv CH$ (b) $CH_3C\equiv C\,CH_3$

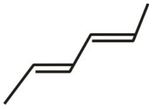
(c) $CH_3-C\equiv CH$ (d) $CH_2=CH_2$

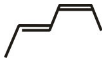
[JEE Main-2019, 12 April Shift-II]

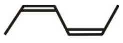
Ans. (c) :


CH₃–C≡CH
(A)
Propyne
Ag₂O
Δ
CH₃–C≡C⁻Ag⁺
ppt.
Tautomerisation
CH₃–C=CH₃
O
(B)
Acetone
Hg²⁺/H⁺
CH₃–C=CH₂
OH
NaBH₄
ZnCl₂ conc HCl
Turbidity within 5 minutes.
CH₃–CH=CH₃
OH
(C)

568. **The correct order of heat of combustion for following alkadienes is :**

(A)


(B)


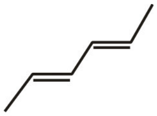
(C)


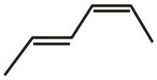
(a) (B) < (C) < (A) (b) (A) < (B) < (C)

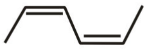
(c) (A) < (C) < (B) (d) (C) < (B) < (A)

[JEE Main-2020, 9 Jan Shift-I]

Ans. (b):

(i)

(Trans, trans)

(ii)

(Trans, Cis)

(iii)

(Cis, Cis)

Heat of combustion $\propto \dfrac{1}{\text{Stability}}$

We know that, trans is more stable than cis form, so the order is A>B>C Hence, the order of heat of combustion is C>B>A.

@apna_pdf

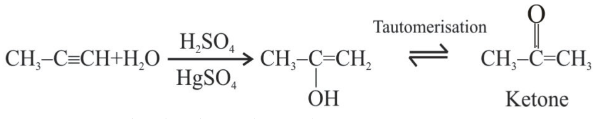
569. Hydration of which one of the following yields a ketone?

(a) Propyne (b) Ethene

(c) Propene (d) Ethyne

J & K CET-2009, 2002

Ans. (a) :



$CH_3-C\equiv CH+H_2O \xrightarrow[HgSO_4]{H_2SO_4} CH_3-\underset{OH}{C}=CH_2 \overset{\text{Tautomerisation}}{\rightleftharpoons} CH_3-\overset{O}{\overset{\|}{C}}-CH_3$ Ketone

Propyne on hydration give a ketones.

570. 1- Butyne on hydration gives:

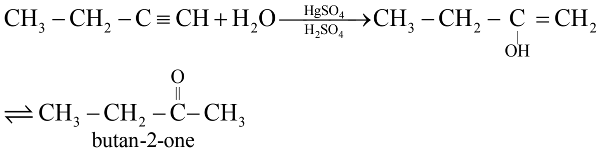
(a) butane-1, 2-diol (b) butan-1-ol

(c) butan-2-ol (d) butan-2-one

J & K CET-(2008)

Ans. (d) :

1–butybne on hydration give a butan–2–ane



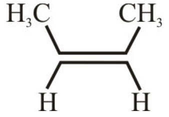
$CH_3-CH_2-C\equiv CH+H_2O \xrightarrow[H_2SO_4]{HgSO_4} CH_3-CH_2-\underset{OH}{C}=CH_2$

$\rightleftharpoons CH_3-CH_2-\overset{O}{\overset{\|}{C}}-CH_3$

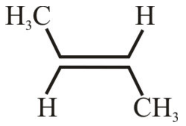
butan-2-one

571. The major product in the reaction of 2-butyne with Li/Liq. NH_3 is

(a)



(b)

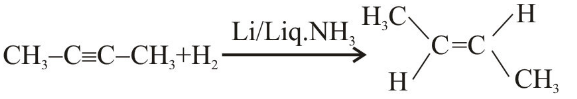


(c) $CH_3CH_2CH_2CH_3$

(d) $H_2C = CH – CH_2 – CH_3$

J & K CET-(2006)

Ans. (b) :



$CH_3–C\equiv C–CH_3+H_2 \xrightarrow{Li/Liq.NH_3}$ $H_3C(H)C=C(H)CH_3$

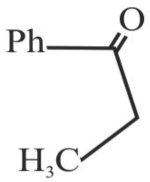
trans–but–2–ene

Reaction of 2–butyne of non–terminal alkyne with a solution of an alkali metal (Na/Li or K) in liquid ammonia give a trans alkene.

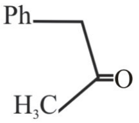
572. $Ph - C \equiv C - CH_3 \xrightarrow{Hg^{2+}/H^+} A$

the product A is

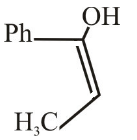
(a)



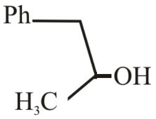
(b)



(c)

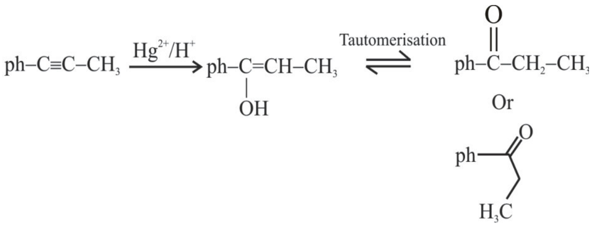


(d)



J & K CET-(2004)

Ans.(a):



$ph–C\equiv C–CH_3 \xrightarrow{Hg^{2+}/H^+} ph–\underset{OH}{C}=CH–CH_3 \overset{\text{Tautomerisation}}{\rightleftharpoons} ph–\overset{O}{\overset{\|}{C}}–CH_2–CH_3$

Or

573. The number of sigma and Pi-bonds in but-l-en-3-yne are

(a) 5 sigma and 5 pi

(b) 7 sigma and 3 pi

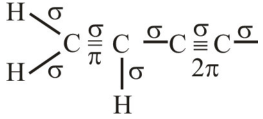
(c) 8 sigma and 2 pi

(d) 7 sigma and 2 pi

JEE Main -2014

Ans. (b) :

The structure of but –1–en–3–yne



In but–1–en–3–yne, the number of sigma bond is 7 and π–bonds is 3.

574. Products of the following reaction are :

$$CH_3C\equiv CCH_2CH_3 \xrightarrow[\text{(ii) hydrolysis}]{\text{(i) } O_3}$$

(a) $CH_3COOH + CO_2$

(b) $CH_3COOH + HOOC\ CH_2CH_3$

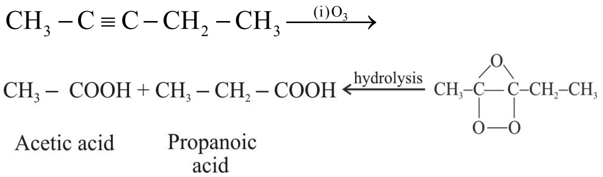
(c) $CH_3CHO+CH_3CH_2CHO$

(d) $CH_3COOH + CH_3COCH_3$

J & K CET-1999

NEET-2005

Ans. (b) :



$CH_3-C\equiv C-CH_2-CH_3 \xrightarrow{(i) O_3}$

$CH_3-COOH+CH_3-CH_2-COOH \xleftarrow{\text{hydrolysis}}$ ozonide

Acetic acid Propanoic acid

@apna_pdf

575. Calcium carbide reacts with H_2O to produce

(a) ethane (b) methane

(c) ethylene (d) acetylene

JCECE - 2007

JIPMER-2010

Ans. (d) :
Calcium carbide is a solid element and chemical formula CaC_2. When calcium carbide react with water to give a acetylene.

$$CaC_2(S)+2H_2O(l)\rightarrow \underset{\text{Acetylene}}{C_2H_2(g)}+Ca(OH)_2(g)$$

This reaction is also termed as ethine formally known as acetylene. Acetylene is commonly used as welding or cutting. Acetylene is basically a colorless gas.

576. Alkynes occur in nature in

(a) free state

(b) partially free state

(c) not in free state

(d) None of these

JCECE - 2013

Ans. (c) : Alkynes are unsaturated compound, therefore, not found in free state in nature.

577. $$CH_3—C\equiv CH \xrightarrow[1\%\ HgSO_4]{40\%\ H_2SO_4} A \xrightarrow{\text{Isomerisation}} CH_3COCH_3$$

Structure of A and the type of isomerism in the above reaction are respectively.

(a) prop-1-en-2-ol, metamerism

(b) prop-1-en-1-ol, tautomerism

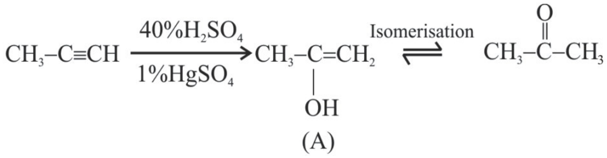
(c) prop-2-en-2-ol, c/s and trans isomerism

(d) prop-2-en-1-ol, tautomerism

JCECE - 2013

NEET-2017

Ans. (b) :



$$CH_3–C\equiv CH \xrightarrow[1\%HgSO_4]{40\%H_2SO_4} \underset{(A)}{CH_3–\underset{\substack{|\\OH}}{C}=CH_2} \overset{\text{Isomerisation}}{\rightleftharpoons} CH_3–\overset{\substack{O\\||}}{C}–CH_3$$

Hence, the structure of A is prop–1–en–1ol and the type of isomerism is tautomerism.

578. What is the best way to carry out the following transformation?

1- pentyne → pentanal

(a) $HgSO_4/H_2SO_4$

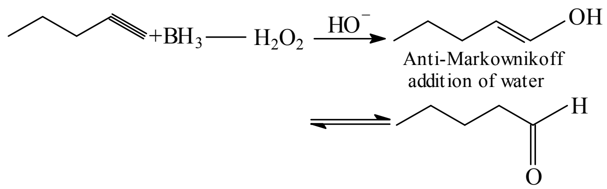
(b) H_2/Lindlar's catalyst; O_3; $Zn-H_2O$

(c) HIO_4/H_2O

(d) $BH_3;H_2O_2/NaOH$

JCECE - 2014

Ans. (d) :



579. Choose the correct alkyne which gives alkanal on hydroboration and hydrolysis.

(a) $CH_3 — C \equiv C — CH_3$

(b) $CH_3 — CH_2 — CH = CH — C \equiv CH$

(c) $CH_3 — C \equiv CH$

(d) $CH_3 — CH_2 — C \equiv CH — CH_3$

JCECE - 2016

Ans. (c) : 1-alkyne gives aldehyde on hydroboration and hydrolysis.

580. The hydrocarbon which can react with sodium in liquid ammonia is

(a) styrene

(b) acetylene

(c) propylene

(d) pentane

JCECE - 2017

Ans. (b) : Reaction of acetylene with sodium in liquid ammonia proceeds as

$$H—C\equiv C—H+2Na \xrightarrow{\text{Liq.}NH_3} CH_2=CH_2+2NaNH_2$$

581. When 2-butyne is treated with pd-$BaSO_4$; the product formed will be

(a) 1-butene

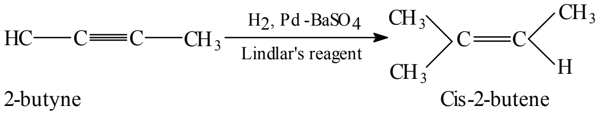
(b) trans-2-butene

(c) cis-2-butene

(d) 2-hydroxy butane

JCECE - 2017

Ans. (c) : The reaction proceeds as



582. On warming with silver powder, chloroform is converted into

(a) acetylene

(b) hexachloroethane

(c) 1,1,2,2-tetrachlolroethane

(d) ethylene

JIPMER-2012

Ans. (a) : For making acetylene from chloroform ($CHCl_3$). We have to heat is with silver powder. We have to heat it with silver powder and the reaction is–

$$2CHCl_3+6Ag\rightarrow C_2H_2+6AgCl$$

Ag (Silver powder) behave as a reducing agent in this reaction. Ag itself oxidized from. O to +1 oxidation state and reduce to carbon from +2 to –1 oxidation state. Hence, chloroform is heated with silver powder, acetylene is produced.

583. Propyne on passing through red hot copper tube forms

(a) benzene (b) toluene

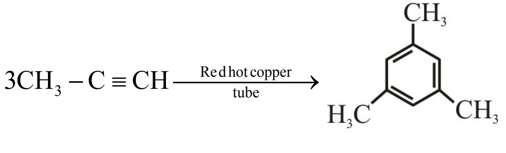
(c) mesitylene (d) None of these

JIPMER-2012

Kerala CEE-2004

@apna_pdf

Ans. (c) : Propyne on passing through red hot copper tube forms a mesitylene.



Meistylene

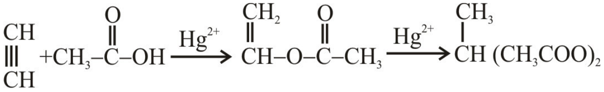
584. $\begin{array}{c}\text{CH}\\|||\\\text{CH}\end{array}$ **reacts with acetic acid in presence of** Hg^{2+} **to give:**

(a) $\begin{array}{l}CH_3\\|\\CH(CH_3COO)_2\end{array}$ (b) $\begin{array}{l}CH(CH_3COO)_2\\|\\CH(CH_3COO)_2\end{array}$

(c) $\begin{array}{l}CH_3\\|\\CH_2(CH_3COO)\end{array}$ (d) None of these

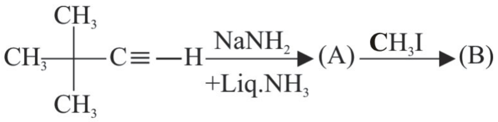
JIPMER-2006

Ans. (a) :
When acetylene react with acetic acid in presence of Hg^{2+} to give a $CH_3–CH(CH_3COO)_2$



$$\begin{array}{c}\text{CH}\\|||\\\text{CH}\end{array} + CH_3-\overset{\overset{O}{\|}}{C}-OH \xrightarrow{Hg^{2+}} \overset{\overset{CH_2}{\|}}{CH}-O-\overset{\overset{O}{\|}}{C}-CH_3 \xrightarrow{Hg^{2+}} \overset{\overset{CH_3}{|}}{CH}\,(CH_3COO)_2$$

585. In the reaction.



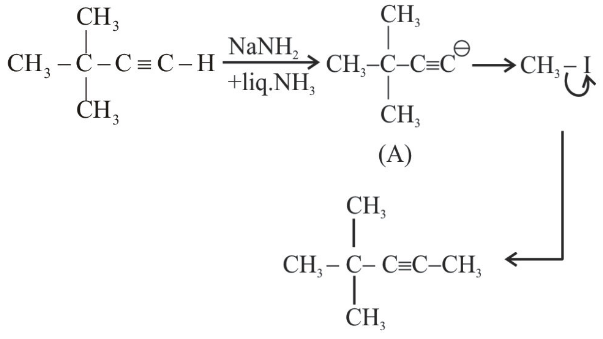
$$CH_3-\underset{\underset{CH_3}{|}}{\overset{\overset{CH_3}{|}}{C}}-C\equiv-H \xrightarrow[+Liq.NH_3]{NaNH_2} (A) \xrightarrow{CH_3I} (B)$$

How many electron donating groups are attached with the carbon atom of unsaturated part of the product 'B'?

(a) Two (b) Three
(c) Four (d) None of these

JIPMER-2016

Ans. (a) :



$$CH_3-\underset{\underset{CH_3}{|}}{\overset{\overset{CH_3}{|}}{C}}-C\equiv C-H \xrightarrow[+liq.NH_3]{NaNH_2} CH_3-\underset{\underset{CH_3}{|}}{\overset{\overset{CH_3}{|}}{C}}-C\equiv C^{\ominus} \longrightarrow CH_3-I$$
$$(A)$$
$$CH_3-\underset{\underset{CH_3}{|}}{\overset{\overset{CH_3}{|}}{C}}-C\equiv C-CH_3$$

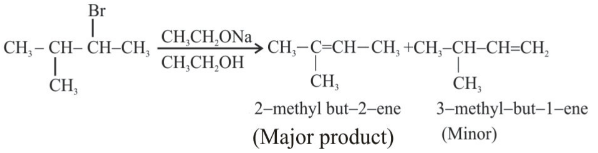
Two electron donating group are attached with the carbon atom of unsaturated part of the product 'B'.

586. When 2-methyl 3-bromo butane is treated with sodium ethoxide in ethanol, what will be the major product?

(a) 2-methyl but-2-ene
(b) 3-methyl but-1-ene
(c) 2-methyl but-1-ene
(d) 2-methyl sodium-butoxide

JIPMER-2016

Ans. (a) : When 2–emthyl 3–bromo butane is treated with sodium ethoxide in ethanol, two alkene are possible. The more substituted alkene are 2–methyl but–2–ene is the major product.



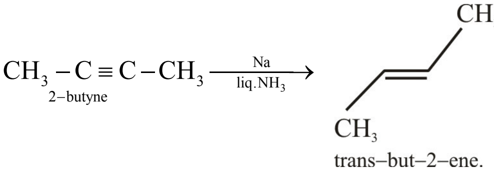
$$CH_3-\underset{\underset{CH_3}{|}}{CH}-\overset{\overset{Br}{|}}{CH}-CH_3 \xrightarrow[CH_3CH_2OH]{CH_3CH_2ONa} CH_3-\underset{\underset{CH_3}{|}}{C}=CH-CH_3 + CH_3-\underset{\underset{CH_3}{|}}{CH}-CH=CH_2$$

587. 2-butyne is reduced to trans-but-2-ene using

(a) $H_2|Ni$ (b) Na in liq.NH_3
(c) $H_2|Pd-C$ (d) Zn in dil. HCl

Karnataka-CET-2019
Kerala CEE-2014
NEET-1993

Ans. (b) :
When 2–butyne is reduced to trans but–2ene this reaction is known as Birch reduction reaction.



588. n-propyl chloride reacts with sodium metal in dry ether to give

(a) $CH_3–CH_2–CH_2–CH_2–CH_2–CH_3$
(b) $CH_3–CH_2–CH_3$
(c) $CH_3–CH_2–CH_2–CH_3$
(d) $CH_3–CH_2–CH_2–CH_2–CH_2–CH_2–CH_3$

Karnataka-CET-2018

Ans. (a) :

$$\underset{\text{n-propylchloride}}{2CH_3-CH_2-CH_2-Cl} + 2Na \xrightarrow{\text{dry ether}} CH_3-CH_2-CH_2-CH_2-CH_2-CH_3$$

589. Number of possible alkynes with formula C_5H_8 is

(a) 2 (b) 3
(c) 4 (d) 5

Karnataka-CET-2015
UPTU/UPSEE-2008, 2014

Ans. (b) :
The number of possible alkyne with formula C_5H_8 is three. The structure of different isomer of C_5H_8 are–

(i) $\underset{\text{1–Pentyne}}{CH_3-CH_2-CH_2-C\equiv CH}$

(ii) $\underset{\text{2–Pentyne}}{CH_3-CH_2-C\equiv C-CH_3}$

(iii) $CH_3-\underset{\underset{CH_3}{|}}{CH}-C\equiv CH$

3methyl -1-butyne

590. In acetylene molecule, between the carbon atoms there are

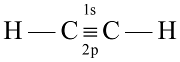
(a) three pi bonds
(b) one sigma and two pi bonds

@apna_pdf

(c) two sigma and one pi bonds
(d) three sigma bonds

Karnataka-CET-2007

Ans. (b) : The structure of acetylene is



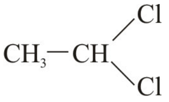
$$H - \overset{1s}{\underset{2p}{C \equiv C}} - H$$

Hence, in acetylene molecule, there are one σ and two π bonds are present between carbon atoms.

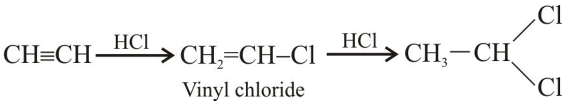
591. Ethylidene dichloride is obtained by the reaction of excess of HCl with
(a) ethylene
(b) acetylene
(c) propene
(d) methane

MHT CET-2009

Ans. (b) : Ethylidiene dichloride is also called as gem dihalide. Gem halogen mean the halogen atom present on the same carbon atom in the molecule.
The structure of ethylidene dichloride is–



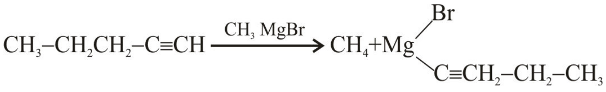
Acetylene reacts with on excess amount of HCl and form ethylidene dichloride as the product.



592. Which one of the following compounds will react with methyl magnesium iodide?
(a) $CH_3CH_2CH_2CH_2CH_3$
(b) $CH_3CH = CH - CH = CH_2$
(c) $CH_3 - C \equiv C - CH_2CH_3$
(d) $CH_3CH_2CH_2C \equiv CH$

MHT CET-2008

Ans. (d) : Methyl magnexium iodide react with terminal alkyne due to presence of acidic hydrogen.



593. Acetylenic hydrogen are acidic because
(a) sigma electron density of C–H bond in acetylene is nearer to carbon, which has 50% s-character
(b) acetylene has only open hydrogen in each carbon
(c) acetylene contains least number of hydrogens among the possible hydrocarbons having two carbons.
(d) acetylene belongs to the class of alkynes with molecular formula, C_nH_{2n-2}.

NEET-1989

Ans. (a) :
In acetylene has two acidic hydrogen atom and triple bond shared between two atoms of carbon which means there are three electron between the carbon atom. The C–H bond in acetylene involves sp–hybridized carbon atom. Since, s–electron are closer to the nucleus than p–electron sp hybrid orbital are more electronegative so, the hydrogen atom present or carbon atom can be easily removed.

594. A compound is treated with $NaNH_2$ to give sodium salt. Identify the compound.

(a) C_2H_2	(b) C_6H_6
(c) C_2H_6	(d) C_2H_4

NEET-1993

Ans. (a) : A compound is treated with $NaNH_2$ to give a sodium salt, the compound is acetylene.

$$CH \equiv CH \xrightarrow{NaNH_2} HC \equiv C^- Na^+$$

595. The cylindrical shape of an alkyne is due to
(a) two sigma C–C and one π C–C bonds
(b) one sigma C – C and two π C–C bonds
(c) three sigma C – C bonds
(d) three π C–C bonds

NEET-1997

Ans. (b) : In alkyne, two carbon atom constitutions the triple bond are sp–hybridized carbon undergoes sp–hybridization to form two sp–hybrid orbitals. The two 2p–orbital remain unhybridised. Hybrid orbitals form one sigma bond while two–bond are formed by unhybridised orbitals.

596. In the following reaction,

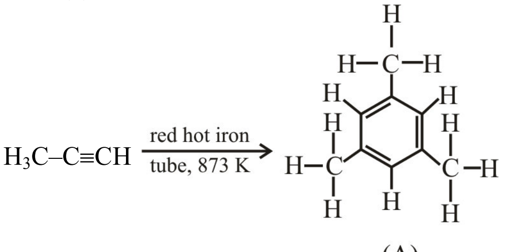
$$H_3C - C \equiv CH \xrightarrow[873\text{ K}]{\text{red hot iron tube}} A,$$

the number of sigms (σ) bonds present in the product A, is

(a) 21	(b) 9
(c) 24	(d) 18

Odisha NEET 2019

Ans. (a) :



(A)

The number of σ bond present in meistylene is 21.

597. Which one is the correct order of acidity?

(a) $CH \equiv CH > CH_3 - C \equiv CH > CH_2 = CH_2 > CH_3 - CH_3$

(b) $CH \equiv CH > CH_2 = CH_2 > CH_3 - C \equiv CH > CH_3 - CH_3$

(c) $CH_3 - CH_3 > CH_2 = CH_2 > CH_3 - C \equiv CH > CH - CH$

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(d) $CH_2 \equiv CH_2 > CH_3-CH=CH_2 > CH_3-C\equiv CH > CH\equiv CH$

NEET-2017

Ans. (a) :
The s–character of these compounds depends upon their saturation and hybridization and acidic character more for more s–character increasing the s–character the acidic strength increases.

$$\underset{sp}{CH}\equiv\underset{sp}{CH} > CH_3-\underset{sp}{C}\equiv\underset{sp}{C} > \underset{sp^2}{CH_2}=\underset{sp^2}{CH_2} > \underset{sp^3}{CH_3}-\underset{sp^3}{CH_3}$$

50% s–character   33.3% s–character   25% s–character

598. The pair of electrons in the given carbanion, $CH_3C\equiv C^-$, is present in which of the following orbitals?

(a) sp^2 (b) sp

(c) 2p (d) sp^3

NEET-I 2016

Ans. (b) : In carbanion $CH_3-C\equiv C^-$, the pair of electrons represent as the negative charge is present in sp-hybridised orbital $CH_3-\underset{sp}{C}\equiv \underset{sp}{C^-}$

599. In the reaction

$$H-C\equiv CH \xrightarrow[\text{(ii)}CH_3CH_2Br]{\text{(i)}NaNH_2/\text{liq.}NH_3} X \xrightarrow[\text{(ii)}CH_3CH_2Br]{\text{(i)}NaNH_2/\text{liq.}NH_3} Y.$$

X and Y are

(a) X = 2-butyne, Y = 2-hexyne

(b) X = 1-butyne, Y = 2-hexyne

(c) X = 1-butyne, Y = 3-hexyne

(d) X = 2-butyne, Y = 3-hexyne

NEET-I 2016

Ans. (c) :

$$\begin{tikzcd}
H-C\equiv C-H \arrow[r, "\text{(i)}NaNH_2", "\text{liq.}NH_3"'] & HC\equiv CNa \arrow[d, "\text{(ii)}CH_3CH_2Br", "-NaBr"'] \\
CH_3-CH_2-C\equiv CNa \arrow[d, "\text{(ii)}CH_3CH_2Br"'] & CH\equiv C-CH_2-CH_3\ (X) \arrow[l, "\text{(i)}NaNH_2"', "\text{liq.}NH_3"] \\
CH_3-CH_2-C\equiv C-CH_2-CH_3 &
\end{tikzcd}$$

3 – hexyne
(Y)

600. Which of the following organic compounds has same hybridization as the combustion product (CO_2)?

(a) Ethane (b) Ethyne

(c) Ethene (d) Ethanol

NEET-2014

Ans. (b) : The hybridization of combustion product CO_2 is-

$$O=\underset{sp}{C}=O$$

(i) $\underset{sp^3}{CH_3}-\underset{sp^3}{CH_3}$ Ethane   (ii) $\underset{sp}{CH}\equiv\underset{sp}{CH}$ Ethyne

(iii) $\underset{sp^2}{CH_2}=\underset{sp^2}{CH_2}$ Ethene   (iv) $\underset{sp^3}{CH_3}-\underset{sp^3}{CH_2}-OH$ Ethanol

Hence, Ethyne is same hybridization as the combustion product of CO_2.

601. In the following reaction :

$$HC\equiv CH \xrightarrow[Hg^{2+}]{H_2SO_4} \text{'p'}$$

product 'p' will not give

(a) Tollens' reagent test

(b) Brady's reagent test

(c) Vichor Meyer test

(d) Iodoform test

Karnataka NEET 2013

Ans. (c) :

$$HC\equiv CH \xrightarrow[Hg^{2+}]{H_2SO_4} CH_2=CH-OH \overset{\text{Tautomerisation}}{\rightleftharpoons} CH_3-CHO$$

Acetaldehyde

Acetaldehyde does not give victor Meyer test.

Note- Victor Meyer tesst is a chemical test that is done to different between the alcohols as primary, secondary and tertiary alcohols. The primary alcohol give red, the secondary alcohol give blue and the tertiary alcohol give colorless.

602. Considering the state of hybridization of carbon atoms, find out the molecule among the following which is linear?

(a) $CH_3-CH=CH-CH_3$

(b) $CH_3-C\equiv C-CH_3$

(c) $CH_2=CH-CH_2-C\equiv CH$

(d) $CH_3-CH_2-CH_2-CH_3$

NEET-2011

Ans. (b) : In molecule $CH_3-\underset{sp}{C}\equiv\underset{sp}{C}-CH_3$ has a linear due to sp hybridized carbon and bond angle is 180°.

603. The compound that will react more readily with gaseous bromine has the formula

(a) C_3H_6 (b) C_2H_2

(c) C_4H_{10} (d) C_2H_4

NEET-II 2016

Ans. (a) : Bromine gas reacts with alkene to give allylic substituted product by free radical mechanism. It mean reaction take place higher temperature so mechanism with Br_2 should be free radical substitution, which can take place in propene. Reaction of free radical depends upon stability of free radical, which will be stabilized by the conjugation with π-bond.

$$CH_3-CH=CH_2 \xrightarrow{Br_2\,(gas)} \underset{\displaystyle Br}{\underset{|}{CH_2}}-CH=CH_2$$

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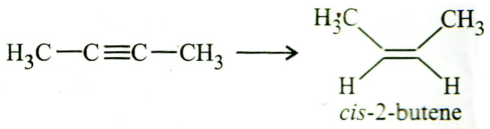
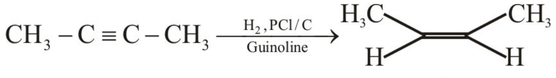
604. The most suitable reagent for the following conversion is


$H_3C-C\equiv C-CH_3$
H_3C
CH_3
H
H
cis-2-butene

(a) Hg^{2+}/H^+, H_2O (b) Na/liquid NH_3
(c) H_2, Pd/C, quionline (d) Zn/HCl

NEET-2019

Ans. (c) :


$CH_3-C\equiv C-CH_3$
H_2, PCl/C
Guinoline
H_3C
CH_3
H
H

cis-2-butene

605. The bond length between hybridised carbon atom and other carbon atom is minimum in

(a) propene (b) propyne
(c) propane (d) butane

NEET-1996

Ans. (b) :

In C – C bond length is 1.54 Å

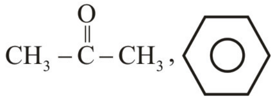
In C = C bond length is 1.34 Å and C ≡ C bond length is 1.20 Å.

Hence, propyne has a triple bond, therefore it has a minimum bond length.

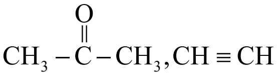
606. Identify the products (I) and (III) observing the following sequence of reactions:

$$CH_3-C\equiv C-H \xrightarrow[1\%HgSO_4,60°C]{20\%H_2SO_4} (I) \xrightarrow[(Colored\ Solid)]{NaOH/I_2(excess)} (II) \xrightarrow[\Delta]{Ag\ particle} (III)$$

(a) CH_3CH_2CHO, $CH\equiv CH$

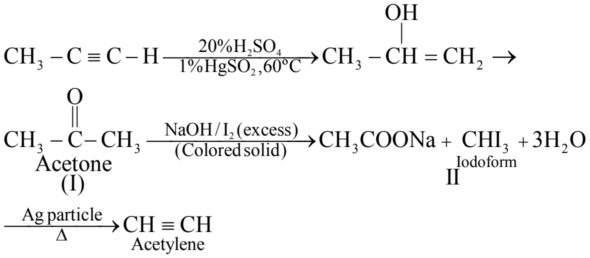
(b)

$CH_3-\overset{O}{\overset{\|}{C}}-CH_3$,

(c) CH_3CH_2CHO, $CH_3-C\equiv CH$

(d)

$CH_3-\overset{O}{\overset{\|}{C}}-CH_3, CH\equiv CH$

Tripura JEE-2022

Ans. (d):


OH
$CH_3-C\equiv C-H$
20%H_2SO_4
1%$HgSO_2$,60°C
$CH_3-CH=CH_2$
O
CH_3-C-CH_3
Acetone
(I)
NaOH/I_2(excess)
(Colored solid)
$CH_3COONa+CHI_3+3H_2O$
Iodoform
II
Ag particle
Δ
$CH\equiv CH$
Acetylene

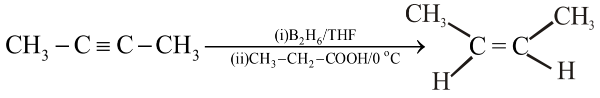
607. $CH_3-C\equiv C-CH_3 \xrightarrow[(ii)CH_3CH_2COOH,0°C]{(i)B_2H_6/THF} Y$

Compound Y will be

(a) 1-butyne (b) 2-butanol
(c) cis-2-butene (d) trans-2-butene

Tripura JEE-2019

Ans. (c) :


$CH_3-C\equiv C-CH_3$
(i)B_2H_6/THF
(ii)CH_3-CH_2-COOH/0 °C
CH_3
CH_3
H
H

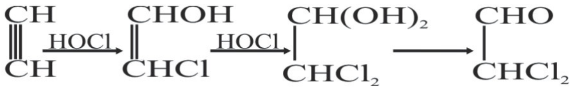
(cis-2-butene)

608. What is the product formed when acetylene reacts with hypochlorous acid?

(a) CH_3COCl (b) $ClCH_2CHO$
(c) Cl_2CH CHO (d) $ClCH_2COOH$

UP CPMT-2012

Ans. (c) :


CH
CH
HOCl
CHOH
CHCl
HOCl
$CH(OH)_2$
$CHCl_2$
CHO
$CHCl_2$

609. C_2H_2 molecule is

(a) linear (b) angular
(c) trigonal planar (d) pyramidal

UP CPMT-2012

Ans. (a) : C_2H_2(H–C=C–H) is linear in shape.

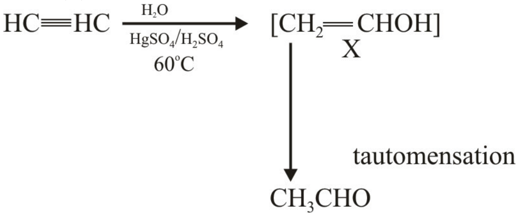
610. In the following reaction

$C_2H_2 \xrightarrow[HgSO_4/H_2SO_4]{H_2O} X$ CH_3CHO, What is X?

(a) CH_3CH_2OH (b) CH_3-O-CH_3
(c) CH_3CH_2CHO (d) $CH_2=CHOH$

UP CPMT-2006

Ans. (d) :

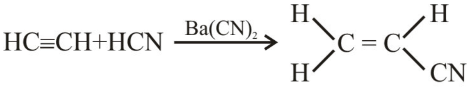

HC≡HC
H_2O
$HgSO_4/H_2SO_4$
60°C
[CH_2=CHOH]
X
tautomensation
CH_3CHO

611. Acetylene reacts with HCN in the presence of Ba $(CN)_2$ to yield:

(a) 1, 1-dicyanoethane (b) 1, 2-dicyanoethane
(c) Vinyl cyanide (d) None of the above

UPTU/UPSEE-2004

Ans. (c) :


HC≡CH+HCN
$Ba(CN)_2$
H
H
H
CN

Vinyl Cyanide

Acetylene react with HCN in the presence of $Ba(CN)_2$ to yield a vinyl cyanide.

612. Which one of the following represents the major product of the reaction of benzene with 2, 2-dimethylpropyl chloride in presence of anhydrous aluminium chloride?

(a) 2, 2-dimethylpropylbenzene
(b) 1, 1-dimethylpropylbenzene
(c) 1, 2- dimethylpropylbenzene
(d) 1, 2-dimethyl-1-propenylbenzene

UPTU/UPSEE-2011

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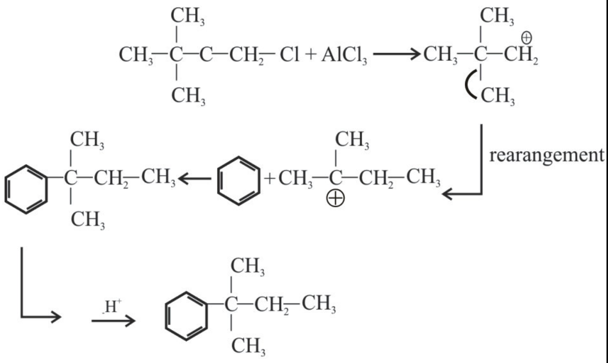
Ans. (b) :



613. Lewisite, a chemical used in chemical warfare, is obtained from

(a) phosphene (b) acetylene

(c) ethylene (d) zinc phosphate

UPTU/UPSEE-2010

Ans. (b) :
Lewisite is a dichloro (2-chlorovinyle) arsine, a liquid whose vapour is highly toxic when inhaled or when in direct contact with the skin. Lewisite has been used only as a chemical warfare agent.

$$CH \equiv CH + ASCl_3 \xrightarrow{\text{Anh.}AlCl_3} \underset{\text{Lewisite}}{ClCH = CH{\cdot}ASCl_2}$$

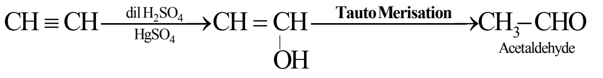
614. When acetylene is passed through dil H_2SO_4 in presence of $HgSO_4$, the compound formed is

(a) ether (b) acetaldehyde

(c) acetic acid (d) ketone

UPTU/UPSEE-2009

Ans.(b):



$$CH \equiv CH \xrightarrow[HgSO_4]{dil\,H_2SO_4} \underset{\displaystyle OH}{CH = CH} \xrightarrow{\textbf{Tauto Merisation}} \underset{\text{Acetaldehyde}}{CH_3{-}CHO}$$

When acetylene is passed through dil.H_2SO_4 in presence of $HgSO_4$, the compound formed is acetaldehyde (CH_3–CHO).

615. Ammoniacal silver nitrate form a white precipitate easily with

(a) $CH_3C{\equiv}CH$

(b) $CH_3C{\equiv}C\text{-}CH_3$

(c) $CH_3CH{=}CH_2$

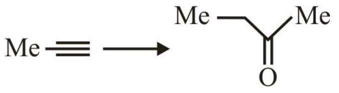
(d) $CH_2{=}CH_2$

UPTU/UPSEE-2008

Ans. (a) : Ammonical silver nitrate is also known as Tollen reagent. In terminal alkyne has acidic hydrogen to replace by ammonical silver nitrate form a white precipitate easily.

$$CH_3 - C \equiv C - H \xrightarrow{[Ag(NH4)_2]NO_3} \underset{\text{White ppt}}{CH_3 - C \equiv CAg}$$

616. The reagents to carry out the following conversion are



(a) $HgSO_4$/dil.H_2SO_4

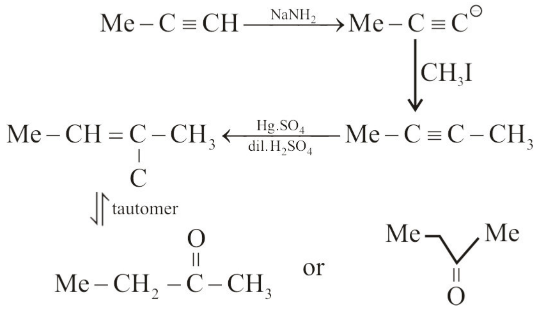
(b) BH_3;H_2O_2/NaOH

(c) OsO_4;HIO_4

(d) $NaNH_2$/CH_3I;$HgSO_4$/dil.H_2SO_4

WB-JEE-2014

Ans. (d) :



617. $CH_3–C{\equiv}C$ MgBr can be prepared by the reaction of

(a) $CH_3 - C \equiv C$ –Br with $MgBr_2$

(b) $CH_3 - C \equiv CH$ with $MgBr_2$

(c) $CH_3 - C \equiv CH$ with KBr and Mg metal

(d) $CH_3 - C \equiv CH$ with CH_3MgBr

WB-JEE-2018

Ans. (d) :
$CH_3 - C \equiv C$ MgBr can be prepared by the reaction of $CH_3 - C \equiv CH$ with CH_3MgBr.

$$CH_3 - C \equiv CH + CH_3MgBr \rightarrow CH_3 - C \equiv CMgBr + CH_4$$

4. Hybridisation

618. Allyl cyanide molecule contains

(a) 9 sigma bonds, 4 pi bonds and no lone pair

(b) 9 sigma bonds, 3 pi bonds and one lone pair

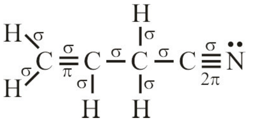
(c) 8 sigma bonds, 5 pi bonds and one lone pair

(d) 8 sigma bonds, 3 pi bonds and two lone pairs

(e) 6 sigma bonds, 2 pi bonds and four lone pairs

Kerala-CEE-2013

Ans. (b) : The structure of allyl cyanide is –



In allyl cyanide molecule contain 9 sigma bonds, 3□-bond and one lone pair respectively.

619. In dehydrolysing reaction,

$$CH_3CONH_2 \xrightarrow{P_2O_5} CH_3CN + H_2O$$

the hybridisation state of carbon is changed from

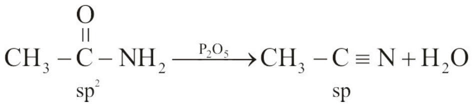
(a) sp^3 to sp^2 (b) sp to sp^2

(c) sp^2 to sp (d) sp to sp^3

CG PET -2008

@apna_pdf

Ans. (c) : The given dehydrolysing reaction –



$$\underset{sp^2}{CH_3-\overset{\overset{O}{||}}{C}-NH_2} \xrightarrow{P_2O_5} \underset{sp}{CH_3-C\equiv N}+H_2O$$

The hybridisation state of carbon is changed from sp^2 to sp.

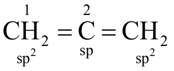
620. Hybridization of 1 and 2 carbon atom in $\overset{1}{C}H_2=\overset{2}{C}=CH_2$ are

(a) sp, sp (b) sp^2, sp^2

(c) sp^2, sp (d) sp^3, sp^2

JIPMER-2005

Ans. (c) :



$$\underset{sp^2}{\overset{1}{CH_2}}=\underset{sp}{\overset{2}{C}}=\underset{sp^2}{CH_2}$$

The hybridisation of 1 and 2 carbon atom are sp^2 and sp respectively.

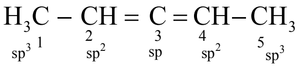
621. Hybridization of C_2 and C_3 of H_3C-CH =C=CH-CH_3 are

(a) sp, sp^3 (b) sp^2, sp

(c) sp^2, sp^2 (d) sp, sp

WB-JEE-2011

Ans. (b) : The hybridissation of C_2 and C_3 of



$$\underset{sp^3\ 1}{H_3C}-\underset{sp^2}{\overset{}{\underset{2}{CH}}}=\underset{sp}{\underset{3}{C}}=\underset{sp^2}{\underset{4}{CH}}-\underset{sp^3}{\underset{5}{CH_3}}$$

So C_2 and C_3 hybridization is sp^2 and sp.

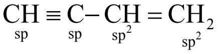
622. The hybridization of carbon atoms in C – C single bond of HC$\equiv$ C – CH = CH_2 is

(a) sp^3-sp^3 (b) sp^2-sp^2

(c) sp-sp^2 (d) sp^3-sp

J & K CET-(2003)

Ans. (c) :



$$\underset{sp}{CH}\equiv\underset{sp}{C}-\underset{sp^2}{CH}=\underset{sp^2}{CH_2}$$

In the hybridization of carbon atom in C–C single bond of $HC\equiv C-CH=CH_2$ is sp – sp^2.

623. The compound in which carbon atom uses sp^3 hybrid orbitals for bond formation?

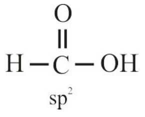
(a) HCOOH (b) NH_2CONH_2

(c) $(CH_3)_3COH$ (d) CH_3CHO

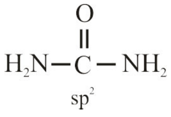
J & K CET-(2003)

Ans. (c) : The hybridisation of the following compound are –

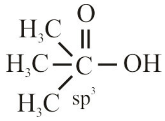
(i)



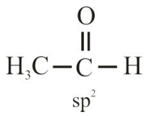
(ii)



(iii)



(iv)



In $(CH_3)_3COH$ has sp3 hybrid orbitals.

624. Which one of the following does not have sp^2 hybridised carbon?

(a) Acetone (b) Acetic acid

(c) Acetonitrile (d) Acetamide

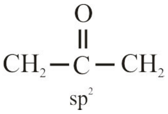
AIEEE-2004

JCECE-2008

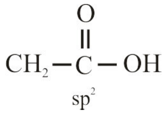
UPTU/UPSEE-2007

Ans. (c) : The hybridisation of carbon of the following are –

(i)

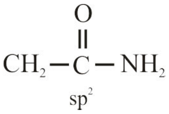


(ii)



(iii) $CH_3-\underset{sp}{C}\equiv N$

(iv)



Hence, the acetonitrile does not have sp^2 hybridised carbon.

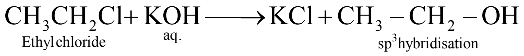
625. The hybridization state of carbon atoms in the product formed by the reaction of ethyl chloride with aqueous KOH, is

(a) sp (b) sp^2

(c) sp^3 (d) sp^3d

A.P. EAMCET-1997

Ans. (c) :



$$\underset{\text{Ethyl chloride}}{CH_3CH_2Cl}+\underset{aq.}{KOH}\longrightarrow KCl+\underset{sp^3\text{hybridisation}}{CH_3-CH_2-OH}$$

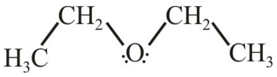
626. Hybridisation of oxygen in diethyl ether is

(a) sp (b) sp^2

(c) sp^3 (d) sp^3d

A.P.EAMCET/2007

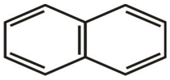
Ans. (c) :



The hybridisation of diethyl ether in oxygen is sp^3 hybridisation.

627. Which one of the following molecules is non-planar?

(a)



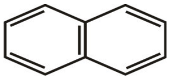
(b) $CH_2 = C = CH_2$

(c) $CH_2 = CH - CH = CH_2$

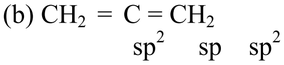
(d) $CH_2 = CH - CH_2 - C \equiv CH$

SCRA-2010

Ans. (d) : (a)



(b)



$$CH_2=\underset{sp^2\quad sp\quad sp^2}{C=CH_2}$$

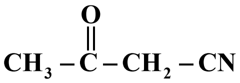
(c) $H_2C = CH - CH = CH_2$

(d) $CH_2 = CH - CH_2 - C \equiv CH$

In the option (d) is not planar because one C has sp^3 hybridised.

@apna_pdf

628. The hybridisation of each carbon in the following compound respectively is



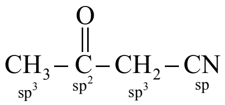
$CH_3-\overset{\overset{O}{\|}}{C}-CH_2-CN$

(a) sp^3, sp^2, sp^3, sp (b) sp^3, sp^3, sp^2, sp

(c) sp^3, sp, sp^3, sp^2 (d) sp^3, sp^2, sp, sp^3

TS-EAMCET-2016

Ans. (a) :



$\underset{sp^3}{CH_3}-\underset{sp^2}{\overset{\overset{O}{\|}}{C}}-\underset{sp^3}{CH_2}-\underset{sp}{CN}$

Hence, the option (a) is correct.

629. The hybridization involved in the six carbon atoms of benzene is:

(a) three sp^3 and three sp^2

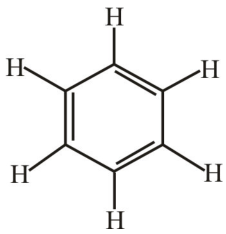
(b) three sp^3 and three sp

(c) all six sp

(d) all six sp^2

AP EAMCET (Medical) -1998

Ans. (d): The molecular formula of benzene is C_6H_6.



All six carbon has sp^2 hybridization and the usual valency angle among the sp^2 hybrid orbitals is 120º.

630. Match List-I with List-II. Select the correct answer using the codes given below the list:

List-I (Molecule/ion)	**List-II (Type of hybridization)**
(a) NH_4^+	1. sp^3d^3
(b) PCl_5	2. sp^3d
(c) CF_6	3. sp^3
(d) IF_7	4. sp^3d^2

Answer code:

	A	**B**	**C**	**D**
(a)	3	2	4	1
(b)	1	2	3	4
(c)	2	3	1	4
(d)	4	1	2	3

MPPET-2008

Ans. (a) :

Molecule	**Hybridisation**
NH_4^+	sp^3
PCl_5	sp^3d
CF_6	sp^3d^2
IF_7	sp^3d^3

631. Which of the following groups does not have sp^3d hybridization

(a) ClF_3, IF_3, XeF_3^+

(b) ICl_2^-, ClF_2^-, I_3^-

(c) ClF, BrF, IF

(d) PCl_3, $AsCl_3$, PF_5

MPPET-2008

Ans. (c,d) : ClF_3 – sp^3d
IF_3 – sp^3d
XeF_3^+ – sp^3d
ICl_2^- – sp^3d
ClF_2^- – sp^3d
I_3^- – sp^3d
ClF – sp^3
BrF – sp^3
IF – sp^3
PCl_3 – sp^3
$AsCl_3$ – sp^3
PF_5 – sp^3d

632. The correct order of electronegativity of carbon in various hybridization states:

(a) $sp < sp^2 < sp^3$ (b) $sp > sp^2 > sp^3$

(c) $sp > sp^2 < sp^3$ (d) $sp = sp^2 < sp^3$

AP EAPCET 20.08.2021 Shift-I

Ans. (b) : Electronegativity of hybridisation depend on the % s character. As % s character

Increase electronegativity increase.

In sp, % s character is 50%

In sp^2, % s character is 33.3 %

In sp^3, % s character is 25%

633. Hybridisation of oxygen in diethyl ether is

(a) sp (b) sp^2

(c) sp^3 (d) sp^3d

AP EAMCET (Engg.) -2007

Ans. (c) :

The Hybridisation of oxygen in diethyl ether is sp^3.

$CH_3-CH_2-\underset{sp^3}{\ddot{O}}-CH_2-CH_3$

634. The carbon atoms in ethane are

(a) sp^2 hybridised

(b) sp^3 hybridised

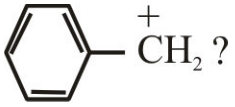
(c) sp hybridised

(d) dsp^2 hybridised.

COMEDK 2011

Ans. (b) : The structure of ethane is CH_3-CH_3 and the carbon atoms in ethane is sp^3 hybridised.

635. What is the hybridization state of benzyl carbonium ion

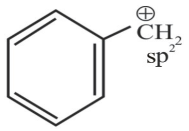


@apna_pdf

(a) sp^2 (b) spd^2
(c) sp^{2}d (d) sp^3

KARNATAKA NEET 2013

Ans. (a) :



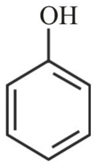
Benzyl carbonium ion

636. Hybridization shown by Carbon and Oxygen of –OH group in Phenol are respectively ....

(a) sp^2, sp^2 (b) sp^3, sp^2
(c) sp, sp^2 (d) sp^2, sp^3

GUJCET-2011

Ans. (d) :



Phenol

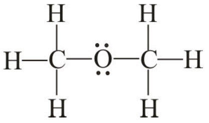
In phenol, carbon show hybridization is sp^2
and oxygen show hybridization is sp^3.

637. What is the hybridisation of Carbon and Oxygen in electronic structure of Ether?

(a) sp^2 and sp^2 (b) sp and sp
(c) sp^3 and sp^3 (d) sp^3 and sp^2

GUJCET-2008

Ans. (c) : The functional group of an ether is an oxygen atom bonded to two carbon atoms i.e. dimethylether.



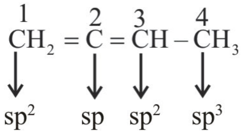
The hybridisation of carbon and oxygen in electronic structure of dimethylether is sp^3.

638. In $\overset{1}{C}H_2 = \overset{2}{C} = \overset{3}{C}H - \overset{4}{C}H_3$ molecule, the hybridization of carbon 1, 2, 3 and 4 respectively,

(a) sp^2, sp^2, sp^2, sp^3 (b) sp^3, sp, sp^3, sp^3
(c) sp^2, sp, sp^2, sp^3 (d) sp^2, sp^3, sp^2, sp^3

JEE Main 26.02.2021,Shift-II

Ans. (c) :



$$\underset{sp^2}{\overset{1}{CH_2}} = \underset{sp}{\overset{2}{C}} = \underset{sp^2}{\overset{3}{CH}} - \underset{sp^3}{\overset{4}{CH_3}}$$

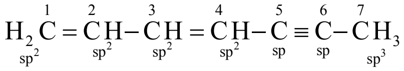
Carbon	Hybridization	Bonds
C_1	sp^2	3σ, 1π
C_2	sp	2σ, 2π
C_3	sp^2	3σ, 1π
C_4	sp^3	4σ, 0π

639. The number of sp and sp^2 carbon in Hepta-1, 3-dien-5-yne, respectively, are

(a) 2, 4 (b) 4, 3
(c) 2, 2 (d) 2, 5

TS EAMCET 04.08.2021, Shift-I

Ans. (a) :



$$\underset{sp^2}{H_2\overset{1}{C}} = \underset{sp^2}{\overset{2}{C}H} - \underset{sp^2}{\overset{3}{C}H} = \underset{sp^2}{\overset{4}{C}H} - \underset{sp}{\overset{5}{C}} \equiv \underset{sp}{\overset{6}{C}} - \underset{sp^3}{\overset{7}{C}H_3}$$

Hence, the number of 2sp and 4sp^2 carbon in Hepta-1, 3-dien-5-yne, respectively, are 2, 4.

640. Assertion : Energy of resonance hybrid is equal to the average of energies of all canonical forms.

Reason: Resonance hybrid cannot be presented by a single structure.

(a) If both Assertion and Reason are correct and the reason is the correct explanation of Assertion.
(b) If both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.
(c) If Assertion is correct but Reason is incorrect.
(d) If both the Assertion and Reason are incorrect.

[AIIMS-2016]

Ans. (d): The energy of the resonance hybrid is equal to the sum of the energies of the various canonical structures in proportion of their contribution towards the resonance hybrid. Resonance hybrid can be represented by the single structure.

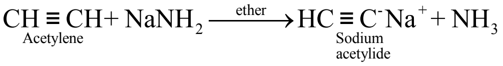
641. Assertion: Acetylene on reacting with sodamide gives sodium acetylide and ammonia.

Reason: sp hybridized carbon atoms of acetylene are considerably electronegative.

(a) If both Assertion and Reason are correct and the Reason is a correct explanation of the Assertion.
(b) If both Assertion and Reason are correct but Reason is not a correct explanation of the Assertion.
(c) If the Assertion is correct but Reason is incorrect.
(d) If both the Assertion and Reason are incorrect.
(e) If the Assertion is incorrect but the Reason is correct.

[AIIMS-2007]

Ans. (a): Acetylene on reacting with sodamide gives sodium acetylide and ammonia.



$$\underset{\text{Acetylene}}{CH \equiv CH} + NaNH_2 \xrightarrow{\text{ether}} \underset{\substack{\text{Sodium}\\\text{acetylide}}}{HC \equiv C^-Na^+} + NH_3$$

The C – H bond is strongly polar due to the high electro negativity of carbon atom.

Hence, it gives H$^+$ ion on reacting with a base or acetylene behaves as acid,

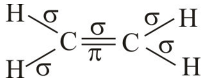
@apna_pdf

642. The number of σ and π bonds present in ethene is:

(a) 6σ (b) 3σ
(c) 4σ, 2π (d) 5σ, 1π

[AIIMS-1997]

Ans. (d):
The structure of ethene is –



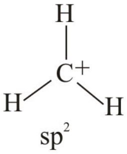
In ethene, number of σ bond is 5 and π-bond is 1.
Hence, ethane has 5σ and 1π bond.

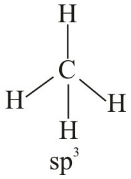
643. Hybridisation states of C in CH_3^+ and CH_4 are

(a) sp^2 and sp^3 (b) sp^3 and sp^2
(c) sp^2 and sp^2 (d) sp^3 and sp^3

(AIIMS-2017)

Ans. (a):

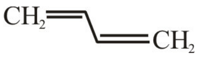




The hybridisation state of C in CH_3^+ and CH_4 are sp^2 and sp^3 respectively.

644. Which of the following represents the given mode of hybridization sp^2–sp^2–sp from left to right?

(a) $H_2C = CH–C \equiv N$ (b) $CH \equiv C–C \equiv CH$
(c) $H_2C = C = CH_2$ (d)



(AIIMS-2015)

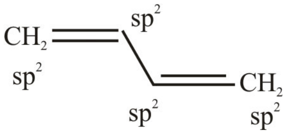
Ans. (a):
The given compound are –

(i) $\underset{sp^2}{CH_2} = \underset{sp^2}{CH} - \underset{sp}{C} \equiv N$

(ii) $\underset{sp}{HC} \equiv \underset{sp}{CH},$

(iii) $\underset{sp^2}{CH_2} = \underset{sp}{C} = \underset{sp^2}{CH_2}$

(iv)



Hence, the given mode of hybridisation $sp^2 - sp^2 - sp$ form left to right is

$CH_2 = CH - C \equiv N$

645. In the hydrocarbon $CH_3 \equiv C - CH_3$, hybridisation of carbon atoms in the molecule from left to right are respectively

(a) sp^3, sp^2, sp^2 and sp^3
(b) sp^3, sp, sp and sp^3
(c) sp^2, sp^2, sp^2 and sp^3
(d) sp, sp^2, sp and sp^2

SRMJEEE – 2013

Ans. (b) :

$$\underset{sp^3}{CH_3} - \underset{sp}{C} \equiv \underset{sp}{C} - \underset{sp^3}{CH_3}$$

Hence, hybridisation is sp^3, sp, sp, sp^3.

646. What is the hybridisation state(s) of the atoms in X formed in the following reaction?

$$\underset{(vapour)}{C_2H_5OH} \xrightarrow[260°C]{Al_2O_3} X$$

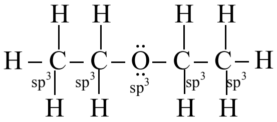
(a) sp^3 only (b) sp^2 and sp^3
(c) sp^2 only (d) sp only

AP - EAMCET(MEDICAL) - 2009

Ans. (a) : The vapour form of ethyl alcohol react with Al_2O_3 at 260°C then ether will be formed if temperature is increased by 360°C then ethene is formed.

$$\underset{(vapour)}{C_2H_5OH} \xrightarrow[260°C]{Al_2O_3} \underset{\substack{'X'\\(ether)}}{C_2H_5 - O - C_2H_5}$$

The structure of X is shown below–



So, hydridizaiton is sp^3 only.

647. The hydridization state of carbon atoms in the product formed by the reaction of ethyl chloride with aqueous KOH is:

(a) sp (b) sp^2
(c) sp^3 (d) sp^3d

AP – EAMCET - (Medical)-1997

Ans. (c) : When ethyl chloride react with aqueous KOH then alcohol is formed.

$$\underset{\text{Ethyl chloride}}{CH_3 - CH_2 - Cl} \xrightarrow{aqueous-KOH} \underset{\text{Ethyl alcohol}}{CH_3 - CH_2 - OH} + KCl$$

In ethyl alcohol all the four valencies of carbon are single bonded. So, the hybridization of carbon atom in $C_2H_5 - OH$ is sp^3.

648. 1, 2-dibromoethane reacts with alcoholic KOH to yield a product X. The hybridisation state of the carbons present in X-respectively are:

(a) sp, sp (b) sp^3, sp^3
(c) sp^2, sp^2 (d) sp^3, sp^2

AP-EAMCET (Engg.)-2005

Ans. (a) : 1, 2- dibromoethane reacts with alcoholic KOH to yield a product acetylene.

$$\underset{\text{1, 2- dibromoethane}}{Br—CH_2—CH_2—Br} \xrightarrow[\Delta]{alc.KOH} \underset{\text{Acetylene}}{\underset{sp}{CH} \equiv \underset{sp}{CH}}$$

Hence, both carbon has sp hybridization.

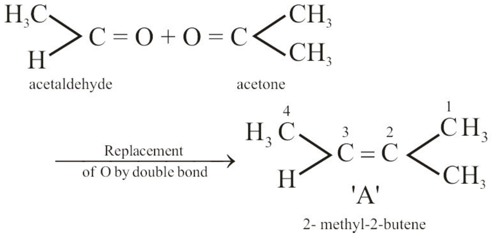
649. One mole of alkene X on ozonolysis gave one mole of acetaldehyde and one mole of acetone. The IUPAC name of X is

(a) 2-methyl-2-butene
(b) 2-methyl-1-butene
(c) 2-butene
(d) 1-butene

VITEEE- 2009

@apna_pdf

Ans. (a) : To determine the structure of alkene that undergoes ozonolysis, add the products and replace O by double (=) bond. Thus,



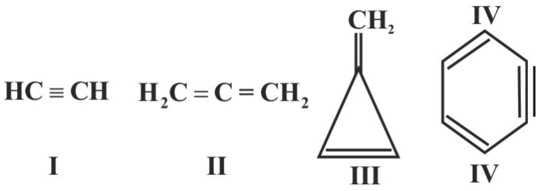
650. What is the hybridization of oxygen atom in an alcohol molecule?

(a) sp^3
(b) sp
(c) sp^2
(d) sp^2d

VITEEE- 2006

Ans. (a) : Oxygen atom in alcohol molecule is sp^3 hybridised.

651. Which of the following structure contains sp-hydridized carbon atom/s?



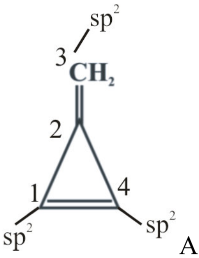
(a) I, II and III
(b) I, III and IV
(c) II, III and IV
(d) I, II and IV

AMU-2018

Ans. (d) : From I:- $\underset{sp}{HC}\equiv\underset{sp}{CH}$, Carbons are sp hybridised

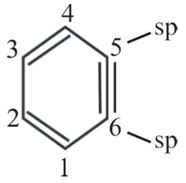
From II:- $H_2C=\underset{sp}{C}=CH_2$ middle carbon is sp hybridised.

From III :-



All carbon sp^2 hybridised.

From IV :-



Carbon 5, 6 are sp hybridised.

Hence by above explanation I, II and IV are sp-hybridised.

652. Which of the d-orbital is used in sp^3d hybridization?

(a) d_{xy}
(b) $d_{x^2-y^2}$
(c) d_{z^2}
(d) d_{yz}

AMU-2011

Ans. (c) : Hybridisation is defined as concept of mixing two atomic orbital's having the same energy levels to give a new degenerate orbital's. In sp^3d hybridisation five orbitals are degenerate that is their energies are the same but configurations are different. In this sp^3d hybridisation there are a total 5 orbital's which are s, px, py, pz and dz^2 orbital take part in hybridisation.

653. In the compound $CH_2=CH-CH_2-CH_2-C\equiv CH$, the pair of hybridized which involved in the formation of C_2-C_3 bond is

(a) $sp-sp^2$
(b) $sp-sp^3$
(c) sp^2-sp^3
(d) sp^3-sp^3

Assam CEE-2020

Ans. (c) : $CH_3=CH-CH_2-CH_2-C\equiv CH$
Hybridisation at $C_2 = sp^2$ and $C_3 = sp^3$

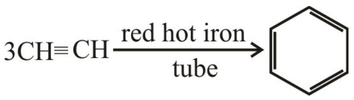
654. During polymerization of acetylene to benzene, the state of hybridization of carbon changes from

(a) sp^2 to sp
(b) sp^3 to sp
(c) sp to sp^3
(d) sp to sp^2

BCECE-2011

Ans. (d) : In acetylene is C_2H_2 has triple bond between the two carbon atoms and one hydrogen atom attached to each of the carbon,

When acetylene is passed through a red not iron tube to give a benzene.



In acetylene hybridisation of carbon is sp and hybridisation of benzene is sp^2.

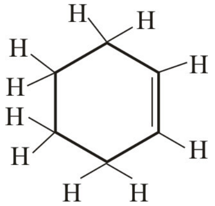
Therefore, the polymerisation of acetylene to benzene changes hybridisation form sp to sp^2.

655. The number of sp^3- hybridised carbon atoms in cyclohexene are

(a) 2
(b) 3
(c) 4
(d) 6

CG PET -2004

Ans. (c) : The structure of cyclohexene is –



In cyclohexene, the number of sp^3- hybridized carbon atom is 4 and sp^2-hybridised carbon atom is 2.

@apna_pdf

656. The number of sp^2-hybrid orbitals in a molecule of benzene is:

(a) 24 (b) 12

(c) 18 (d) 6

[JEE Main-2020, 9 Jan Shift-II]

Ans. (c) : Benzene (C_6H_6) has a $6sp^2$ hybridised carbons. Each carbon has 3 σ bond and 1 π bond. 3 bond means for each carbon.

Hence, the total number of sp^2 hybrid orbital's is 18.

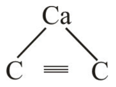
657. The number and type of bonds between two carbon atoms in calcium carbide are

(a) two sigma, two pi (b) two sigma, one pi

(c) one sigma, two pi (d) one sigma, one pi

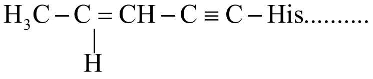
AIEEE 2005

Ans. (c) : The structure of calcium carbide is –



In calcium carbide, type of bonds between two carbon atom in calcium carbide are one sigma and two π – bond.

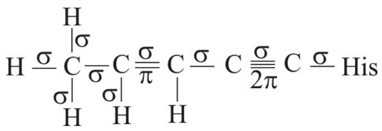
658. The number of sigma bonds in



$H_3C-\underset{\underset{H}{|}}{C}=CH-C\equiv C-H$ is..........

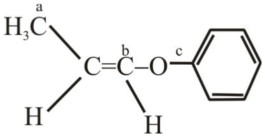
[JEE Main 2021, 25 July Shift-I]

Ans. (10) : The number of sigma bonds in given structure



No. of σ bond is 10 and 3π bonds.

659. In the following molecules,



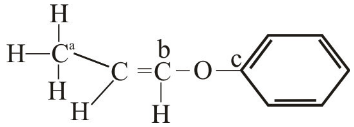
hybridization of carbon a, b and c respectively are

(a) sp^3, sp, sp (b) sp^3, sp^2, sp

(c) sp^3, sp^2, sp^2 (d) sp^3, sp, sp^2

[JEE Main 2021, 18 March Shift-II]

Ans. (c) : Given the molecules

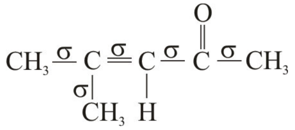


The hybridisation of carbon in a, b and c are sp^3, sp^2 and sp^2 respectively.

660. The total number of C–C sigma bond/s in mesityl oxide ($C_6H_{10}O$) is .... (Round off to the nearest integer).

[JEE Main 2021, 17 March Shift-II]

Ans. (5) : The structure of mesityl oxide ($C_6H_{10}O$) is –

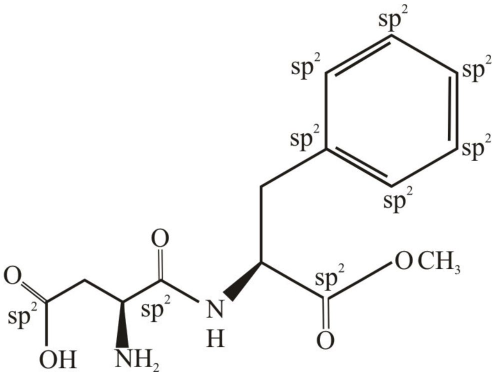


Hence, the total number of C – C sigma bonds in mesityl oxide ($C_6H_{10}O$) is 5.

661. The number of sp^2 – hybridised carbons present in "aspartame" is ....

JEE Main 2020, 7 Jan Shift-II

Ans. (9) : The structure of aspartame is –



In aspartame, the sp^2-hybridised carbon is 9.

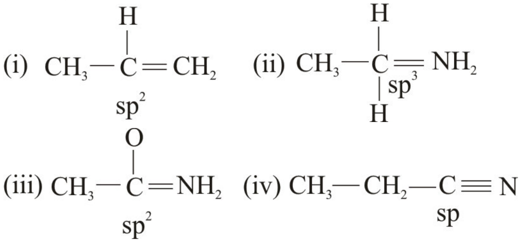
662. Underlined carbon is sp^3 hybridised in

(a) $CH_3\underline{C}H=CH_2$ (b) $CH_3\underline{C}H_2NH_2$

(c) $CH_3\underline{C}ONH_2$ (d) $CH_3CH_2\underline{C}N$

(AIEEE-2002)

Ans. (b) :



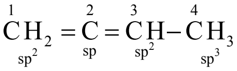
663. In $\overset{1}{C}H_2=\overset{2}{C}=\overset{3}{C}H-\overset{4}{C}H_3$ molecule, the hybridisation of carbon 1, 2, 3 and 4 respectively are

(a) sp^3, sp, sp^3, sp^3 (b) sp^2, sp^2, sp^2, sp^3

(c) sp^2, sp, sp^2, sp^3 (d) sp^2, sp^3, sp^2, sp^3

(JEE Main 2021, 26 Feb Shift-II)

Ans. (c) : The given molecule are –



$\underset{sp^2}{\overset{1}{C}H_2}=\underset{sp}{\overset{2}{C}}=\underset{sp^2}{\overset{3}{C}H}-\underset{sp^3}{\overset{4}{C}H_3}$

The hybridisation of carbon 1, 2, 3 and 4 are sp^2, sp, sp and sp^3 respectively.

664. What is the type of hybridisation found in methane?

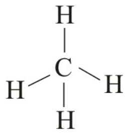
(a) sp^3 (b) sp^2

(c) sp^1 (d) None of these.

J & K CET-(2014)

@apna_pdf

Ans. (a) : The structure of methane is –



sp^3

In methane hybridisation found is sp^3.

665. The hybridization of carbon atoms in C–C single bond of $HC\equiv C–CH=CH_2$ is

(a) $sp^3 – sp^2$ (b) $sp^2 – sp^3$
(c) $sp – sp^2$ (d) $sp^3 – sp^3$

J & K CET-(2013)

Ans. (c): The given molecule are –

$HC\equiv \underset{sp}{C}-\underset{sp^2}{CH}-CH_2$

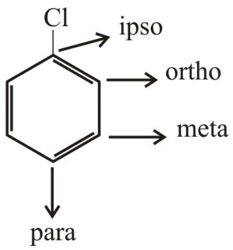
The hybridisation of carbon atom in C – C bond is sp – sp^2.

666. The hybridization of the ipso carbon in chlorobenzene is

(a) sp hybridisation (b) sp^2 hybridisation
(c) sp^2d hybridisation (d) sp^3 hybridisation

J & K CET-(2007)

Ans. (b) : The structure of chloro benzene is –



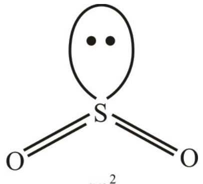
The hybridisation of ipso carbon in chlorobenzene is sp^2 hybridisation.

667. Which hybridization has sulphur is SO_2?

(a) sp^2 (b) sp^3d^2
(c) sp^3 (d) sp

JCECE - 2004

Ans. (a) : The structure of SO_2 is –



sp^2

The hybridisation of sulphur in SO_2 is SO_2.

668. Which of the following has a bond formed by overlap of sp-sp^3 hybrid orbitals?

(a) $CH_3 – C\equiv C – H$
(b) $CH_3 – CH = CH – CH_3$
(c) $CH_2 = CH– CH = CH_2$
(d) $HC\equiv CH$

JIPMER-2010

Ans. (a): The bond formed by overlap of sp – sp^3 hybrid orbital is –

$\underset{sp^3}{CH_3}-\underset{sp}{C}\equiv C-H$

669. Which of the following pair of compounds will have three sp^2 -hybrid orbitals?

(a) SO_2, CH_4
(b) SO_3, C_2H_4
(c) BF_3, SF_4
(d) I_3^- , SF_4

JIPMER-2016

Ans. (b) :

Molecule	Hybrid orbital
SO_2	sp^2
CH_4	sp^3
SO_3	sp^2
C_2H_4	sp^2
BF_3	sp^2
SF_4	sp^3d
I_3	sp^3d

670. All carbon atoms are sp^2-hybridised in

(a) 1, 3-butadiene
(b) $CH_2=C=CH_2$
(c) cyclohexane
(d) 2-butene
(e) $CH\equiv C-C\equiv CH$

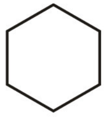
Kerala-CEE-2010

Ans. (a) : The hybridisation of given compound

(i) 1, 3 butadiene
$\underset{sp^2}{CH_2}=\underset{sp^2}{CH}-\underset{sp^2}{CH}=\underset{sp^2}{CH_2}$

(ii) $\underset{sp^2}{CH_2}=\underset{sp}{C}-\underset{sp^2}{CH_2}$

(iii)



sp^3 all carbon

(iv) 2– butene
$\underset{sp^3}{CH_3}-\underset{sp^2}{CH}=\underset{sp^2}{CH}-\underset{sp^3}{CH_3}$

(v) $\underset{sp}{CH}=\underset{sp}{C}-\underset{sp}{C}\equiv\underset{sp}{CH}$

671. In which of the following species, all the three types of hybrid carbons are present?

(a) $CH_2=C=CH_2$
(b) $CH_3-CH=CH-CH^+_2$
(c) $CH_3-C\equiv C-CH^+_2$
(d) $CH_3-CH=CH-CH^-_2$
(e) $CH_2=CH-CH=CH_2$

Kerala-CEE-2009

Ans. (c) :

(i) $\underset{sp^2}{CH_2}=\underset{sp}{C}=\underset{sp^2}{CH_2}$

(ii) $\underset{sp^3}{CH_3}-\underset{sp^2}{CH}=\underset{sp^2}{CH}-\underset{sp^2}{CH_2^+}$

(iii) $\underset{sp^3}{CH_3}-\underset{sp}{C}\equiv\underset{sp}{C}-\underset{sp^2}{CH_2^+}$

(iv) $\underset{sp^3}{CH_3}-\underset{sp^2}{CH}=\underset{sp^2}{CH_2}-\underset{sp^2}{CH_2^+}$

(v) $\underset{sp^2}{CH_2}=\underset{sp^2}{CH}-\underset{sp^2}{CH}-\underset{sp^2}{CH_2}$

@apna_pdf

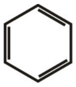
672. Consider the following compounds:
(i) chloroethene (ii) benzene
(iii) 1, 3-butadiene (iv) 1, 3, 5 -hexatriene
All the carbon atoms are sp^2 hybridised in:

(a) (i), (iii), (iv) only
(b) (i), (ii) only
(c) (ii), (iii), (iv) only
(d) (iii), (iv) only
(e) (i), (ii), (iii) and (iv)

Kerala-CEE-2006

Ans. (e) :

(i) $\underset{sp^2}{CH_2}=\underset{sp^2}{CHCl}$ (ii)



all sp^2 carbon atom

(iii) $\underset{sp^2}{CH_2}=\underset{sp^2}{CH}-\underset{sp^2}{CH}=\underset{sp^2}{CH_2}$

(iv) $\underset{sp^2}{CH_2}=\underset{sp^2}{CH}-\underset{sp^2}{CH}=\underset{sp^2}{CH}-\underset{sp^2}{CH}=\underset{sp^2}{CH_2}$

673. The molecule that contains only sp^2 hybrid carbon atoms is

(a) isoprene
(b) acrylonitrile
(c) but-1-ene
(d) 1, 3-butadiene
(e) isobutene

Kerala-CEE-2012

Ans. (d) : In structure of 1, 3 –butadiene

$$\underset{sp^2}{CH_2}=\underset{sp^2}{CH}-\underset{sp^2}{CH}=\underset{sp^2}{CH_2}$$

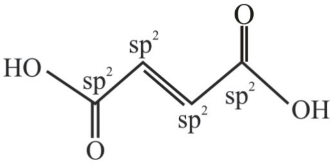
In 1, 3 -butadiene has all carbon atom is sp^2 hybridised.

674. The hybridization state of C atom in butendioic acid is

(a) sp^2
(b) sp^3
(c) Both (a) and (b)
(d) sp

MHT CET-2012

Ans. (a) : The structure of butendioic acid is –



In butendioic acid all the carbon is sp^2 hybridised.

675. Which of the following molecules represents the order of hybridisation sp^2, sp^2, sp, sp from left to right atoms?

(a) $HC\equiv C-C\equiv CH$
(b) $CH_2=CH-C\equiv CH$
(c) $CH_2=CH-CH=CH_2$
(d) $CH_3-CH=CH-CH_3$

NEET-2018

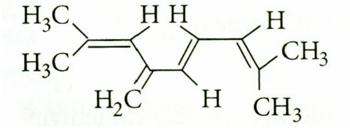
Ans. (b) :

(i) $\underset{sp}{CH_2}=\underset{sp}{C}-\underset{sp}{C}\equiv\underset{sp}{CH}$ (ii) $\underset{sp^2}{CH_2}=\underset{sp^2}{CH}-\underset{sp}{C}\equiv\underset{sp}{CH}$

(iii) $\underset{sp^2}{CH_2}=\underset{sp^2}{CH}-\underset{sp^2}{C}=\underset{sp^2}{CH_2}$ (iv) $\underset{sp^3}{CH_3}-\underset{sp^2}{CH}-\underset{sp^2}{CH}=\underset{sp^3}{CH_3}$

Hence, option (b) is sp^2, sp^2, sp, sp hybridised from left to right.

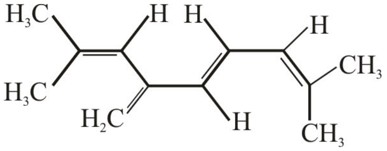
676. The total number of π-bond electrons in the following structure is



(a) 12
(b) 16
(c) 4
(d) 8

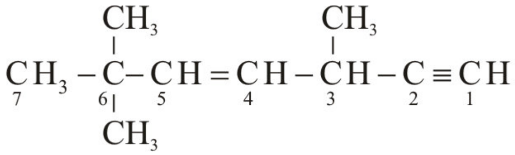
NEET-2015, cancelled

Ans. (d) : In the given structure –



The total number of π – bond is 4 and π-bond electron is 8.

677. The state of hybridization of C_2, C_3, C_5 and C_6 of the hydrocarbon,



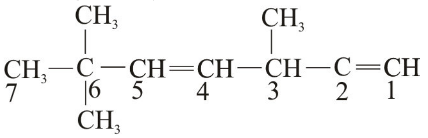
$$\underset{7}{CH_3}-\underset{\underset{CH_3}{|}}{\overset{\overset{CH_3}{|}}{\underset{6}{C}}}-\underset{5}{CH}=\underset{4}{CH}-\overset{\overset{CH_3}{|}}{\underset{3}{CH}}-\underset{2}{C}\equiv\underset{1}{CH}$$

is in the following sequence

(a) sp^3, sp^2, sp^2 and sp
(b) sp, sp^2, sp^2 and sp^3
(c) sp, sp^2, sp^3 and sp^2
(d) sp, sp^3, sp^2 and sp^3

NEET-2009

Ans. (d) : The given hydrocarbon is –



$$\underset{7}{CH_3}-\underset{\underset{CH_3}{|}}{\overset{\overset{CH_3}{|}}{\underset{6}{C}}}-\underset{5}{CH}=\underset{4}{CH}-\overset{\overset{CH_3}{|}}{\underset{3}{CH}}-\underset{2}{C}=\underset{1}{CH}$$

The hybridisation of C_2, C_3, C_5 and C_6 are sp, sp^3, sp^2 and sp^3.

678. In the hydrocarbon,

$$\underset{6}{CH_3}-\underset{5}{CH}=\underset{4}{CH}-\underset{3}{CH_2}-\underset{2}{C}\equiv\underset{1}{CH}$$

The state of hybridization of carbons 1, 3 and 5 are in the following sequence

(a) sp, sp^2, sp^3
(b) sp^3, sp^2, sp
(c) sp^2, sp, sp^3
(d) sp, sp^3, sp^2

NEET-2008

@apna_pdf

Ans. (d) : The given hydrocarbon is –

$$\underset{6}{CH_3} - \underset{5}{CH} = \underset{4}{CH} - \underset{3}{CH_2} - \underset{2}{C} \equiv \underset{1}{CH}$$

The hybridisation state of carbon 1, 3 and 5 are sp, sp^3 and sp^2.

679. In which of the following compounds there is more than one kind of hybridization (sp, sp^2, sp^3) for carbon?

(a) $CH_2 = CH - CH = CH_2$

(b) $H - C \equiv C - H$

(c) $CH_3CH_2CH_2CH_3$

(d) $CH_3 - CH = CH - CH_3$

NEET-1995

Ans. (d) :

(i) $\underset{sp^2}{CH_2} = \underset{sp^2}{CH} - \underset{sp^2}{CH} = \underset{sp^2}{CH_2}$ (ii) $H - \underset{sp}{C} \equiv \underset{sp}{C} - H$

(iii) $\underset{sp^3}{CH_3} - \underset{sp^3}{CH_2} - \underset{sp^3}{CH_2} - \underset{sp^3}{CH_3}$

(iv) $\underset{sp^3}{CH_3} - \underset{sp^2}{CH} = \underset{sp^2}{CH} - \underset{sp^3}{CH_3}$

680. A straight chain hydrocarbon has the molecular formula C_8H_{10}. The hybridization of the carbon atoms from one end of the chain to the other are respectively sp^3, sp^2, sp^2, sp^3, sp and sp. The structural formula of the hydrocarbon would be

(a) $CH_3C \equiv CCH_2 - CH = CHCH = CH_2$

(b) $CH_3CH_2 - CH = CHCH = CHC \equiv CH$

(c) $CH_3CH \equiv CHCH_2 - C \equiv CCH = CH_2$

(d) $CH_3CH \equiv CHCH_2 - CH = CHC \equiv CH$

NEET-1991

Ans. (d) : The given structural formula of the hydrocarbon is –

$$\underset{sp^3}{CH_3} - \underset{sp^2}{CH} = \underset{sp^2}{CH} - \underset{sp^3}{CH_2} - \underset{sp^2}{CH} = \underset{sp^2}{CH} - \underset{sp}{C} \equiv \underset{sp}{CH}$$

681. Which of the following possesses a sp-carbon in its structure?

(a) $CH_2 = CCl - CH = CH_2$

(b) $CCl_2 = CCl_2$

(c) $CH_2 = C = CH_2$

(d) $CH_2 = CH - CH = CH_2$

NEET-1989

Ans. (c) : The given species are –

(i) $\underset{sp^2}{CH_2} = \underset{sp^2}{CCl} - \underset{sp^2}{CH} = \underset{sp^2}{CH_2}$ (ii) $\underset{sp^2}{CCl_2} = \underset{sp^2}{CCl_2}$

(iii) $\underset{sp^2}{CH_2} = \underset{sp}{C} = \underset{sp^2}{CH_2}$ (iv) $\underset{sp^2}{CH_2} = \underset{sp^2}{CH} - \underset{sp^2}{CH} = \underset{sp^2}{CH_2}$

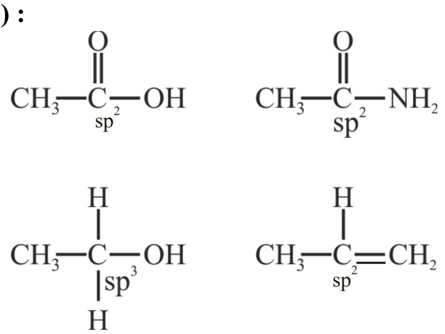
682. The compound in which underlined carbon uses only its sp^3 hybrid for bond formation is:

(a) $CH_3\underline{C}OOH$ (b) $CH_3\underline{C}ONH_2$

(c) $CH_3\underline{C}H_2OH$ (d) $CH_3\underline{C}H = CH_2$

UP CPMT-2006

Ans. (c) :



683. The correct sequence of hybridization of methane, ethene and acetylene is

(a) sp, sp^2, sp^3

(b) sp^2, sp^3, sp

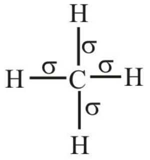
(c) sp^3, sp^2, sp

(d) sp^3, sp, sp^2

UP CPMT-2003

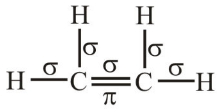
Ans. (c) : The first bond between any two atoms is sigma and rest are pi bonds.

Pi bond is formed by sideways overlapping of unhybridised p-orbital.



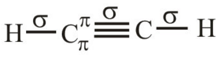
4 σ bonds

∴ sp^3 hybridisation



3 σ and 1 π bond

∴ sp^2 hybridisation



2 σ and 2 π bond

∴ sp hybridisation

684. $\overset{\ominus}{\underset{\cdot\cdot}{C}}H_3$ $H_2\overset{\ominus}{\underset{\cdot\cdot}{C}} - CH_2OCH_3$

(I) **(II)**

Hybridisation of the negative carbons in (I) and (II) are

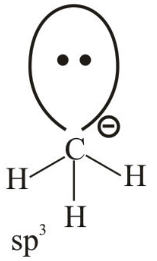
(a) sp^2 and sp^3 (b) sp^3 and sp^2

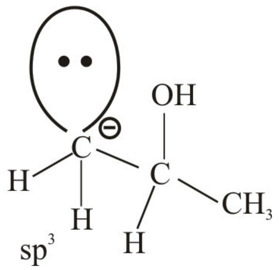
(c) both sp^2 (d) both sp^3

WB-JEE-30.04.2022

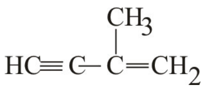
Ans. (d) :

(i) $\overset{\ominus}{\underset{\cdot\cdot}{C}}H_3$ (ii) $H_2\overset{\ominus}{C} - CHOCH_3$





@apna_pdf

685. **In the compound** 

$HC\equiv C-\overset{CH_3}{\overset{|}{C}}=CH_2$

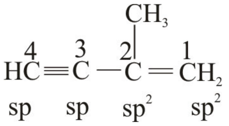
the hybridization of C-2 and C-3 carbons are respectively

(a) sp^3 and sp^3 (b) sp^2 and sp^3

(c) sp^2 and sp (d) sp^3 and sp

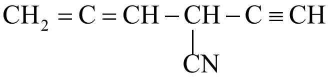
WB-JEE-2009

Ans. (c) : The given compound are –



The hybridisation of C – 2 and C – 3 carbon are sp^2, sp respectively.

686. **In the following compound, the number of sp-hybridised carbons are**



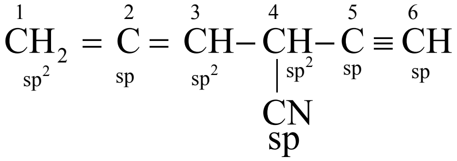
$CH_2=C=CH-\underset{CN}{\underset{|}{CH}}-C\equiv CH$

(a) 2 (b) 3

(c) 4 (d) 5

WB-JEE-2015

Ans. (c) : The given compound are –



Hence, the number of sp –hybridised carbon are 4.

5. Structure of Benzene

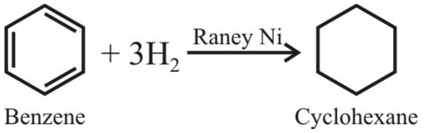
687. **Benzene reacts with H_2 at 150°C at 30 atm pressure in the presence of Ni catalyst to give–**

(a) Cyclohexene (b) Cyclohexane

(c) n – hexane (d) No reaction occur

CG PET-22.05.2022

Ans. (b) : Benzene treated with H_2 in the presence of Ni catalyst of 150°C and 30 atm then cyclo hexane is formed. This is the example of addition reaction.



688. **In benzene, the triple bond consists of**

(a) one sp-sp sigma bond and two p-p pi bonds

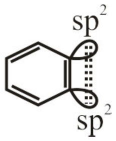
(b) two sp-sp sigma bonds and one p-p pi bond

(c) one sp^2-sp^2 sigma bond, one p-p pi bond

(d) one sp^2-sp^2 sigma bond, one sp^2-$sp^{2.}$ pi bond and one p-p pi bond

VITEEE-2021

Ans. (d)



Benzene is also know as 1,2-dehydrobenzeile of an aryne. It is a neutral and highly reactive reaction intermediate. It one sp^2 – sp^2 σ-bond, one sp^2 – sp^2, π-bond and one p–p–π bond.

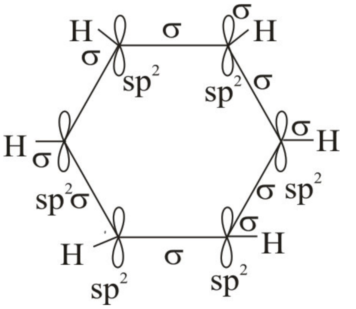
689. **The overlapping of orbitals in benzene is of the type**

(a) sp-sp (b) p-p

(c) sp^2 – sp^2 (d) sp^3 – sp^3

Karnataka-CET, 2008

Ans. (c) : The molecular orbital picture of benzene shows that in it all the six carbon atoms are sp^2 hybridised. Out of these three sp^2 hybrid orbitals of each C atom, two orbitals overlap with sp^2 hybrid orbitals of adjacent C atoms to form six C–C single bonds. The remaining sp^2 orbital of each C atom overlaps with s-orbital of each hydrogen atom to form six C – H single sigma bonds. Each C atom is now left with one unhybridised p-orbital perpendicular to the plane of the ring.



690. **How many litres of oxygen (at STP) are required for complete combustion of 39 g of liquid benzene?**

(atomic weights : C =12, O =16, H=1)

(a) 84 (b) 22.4

(c) 42 (d) 11.2

A.P.EAMCET-2001

Ans. (a)

$$C_6H_6(l)+\frac{15}{2}O_2(g)\rightarrow 6CO_2(g)+3H_2O(g)$$

Molar mass of C_6H_6 = 78 g/mol

39 gms of $C_6H_6(l)=\frac{39}{78}$ moles = 0.5 moles

For 2 moles, we require 15 moles of O_2, for 0.5 moles we will require–

$$\Rightarrow \frac{0.5}{2}\times 15=\frac{15}{4}\text{moles of } O_2$$

$$=\frac{15}{4}\times 22.4\,\text{litres}=84\,\text{litres}$$

@apna_pdf

13.

Environmental Chemistry

1. Water Pollution

1. Sulphur dioxide is one of the components of polluted air. SO_2 is also a major contributor to acid rain. The correct and complete reaction to represent acid and caused by SO_2 is

(a) $2SO_2 + O_2 \longrightarrow 2SO_3$

(b) $SO_2 + O_3 \longrightarrow SO_3 + O_2$

(c) $SO_2 + H_2O_2 \longrightarrow H_2SO_4$

(d) $2SO_2 + O_2 + 2H_2O \longrightarrow 2H_2SO_4$

JEE Main-29.06.2022, Shift-II

Ans. (d) : Sulphur dioxide is a air pollutant which is very harmful to plants and people both. It produced sulphuric acid, when it reacts with oxygen and water and cause acid rain.

The reaction is-

$$2SO_2 + O_2 + 2H_2O \longrightarrow 2H_2SO_4$$

2. Which one of the following statements is not true?

(a) Clean water would have a BOD value of 5 ppm.

(b) Fluoride deficiency in drinking water is harmful. Soluble fluoride is often used to bring its concentration upto 1 ppm.

(c) When the pH of rain water is higher than 6.5, it is called acid rain.

(d) Dissolved Oxygen (DO) in cold water can reach a concentration upto 10 ppm.

(JEE Main 2021, 25 Feb shift-2)
Karnataka-CET, 2013

Ans. (c): Rainwater with a pH less than 5.6 is called acid rain. Normal, clean rain has a pH value of between 5.0 and 5.5, which is slightly acidic. When Sulphur dioxide and nitrogen oxides are released into the air, they react with water and oxygen and produces sulphuric and nitric acids. Thus it forms acid rain.

3. When rain is accompanied by a thunderstorm the collected rain water will have a pH value

(a) Slightly lower than that of rain water without thunderstorm

(b) Slightly higher than that when the thunderstorm is not there

(c) Uninfluenced by occurrence of thunderstorm

(d) Which depends upon the amount of dust in air

[BITSAT – 2014]
AIEEE-2003

Ans. (a) : When rain is accompanied by a thunderstorm the collected rain water will have a pH value slightly lower than that of rain water without thunderstorm.

- During thunderstorm, acidic oxides are formed. They dissolve in rainwater to form acids. This increases the acidity of rain water and decreases the pH.

$$N_2 + O_2 \longrightarrow NO \xrightarrow{O_2} NO_2 \longrightarrow N_2O_5 \xrightarrow{H_2O} HNO_3 (pH < 7)$$

4. The substance having the largest concentration in acid rain?

(a) H_2CO_3 (b) HNO_3

(c) HCl (d) H_2SO_4

WB-JEE-2018
[BITSAT-2007]

Ans. (d) : Sulphuric acid (H_2SO_4) is present in a larger concentration in acid rain. Acid rain is formed due to the presence of oxides of sulphur & nitrogen in the atmosphere. Acid rain contains in order–

$$H_2SO_4 > HNO_3 > HCl > H_2CO_3$$

5. The reagent used in the determination of the chemical oxygen demand (COD) of water sample is

(a) Potassium permanganate

(b) Sulphuric acid

(c) Acidified Potassium dichromate

(d) Potassium dichromate

TS-EAMCET (Engg.), 07.08.2021 Shift-II

Ans. (c):

The most general COD determination uses potassium dichromate ($K_2Cr_2O_7$) in excess in an acidic medium with the aid of silver sulfate (Ag_2SO_4) as a catalyst, and mercuric sulfate ($HgSO_4$) added to remove interference of chlorides.

- COD is widely used as a measure of the susceptibility to oxidation of the organic and inorganic materials present in water bodies and in the municipal and industrial wastes.

6. The correct statement/ option about acid rain is

(a) The acid rain would not affect the fertility of the soil

(b) The acid rain contains HCl

(c) SO_2 and NO_2 are contributors to acid rain

(d) Acetic acid is the component of acid rain

TS EAMCET-10.08.2021, Shift-II

Ans. (c): Acid rain results when sulfur dioxide (SO_2) and nitrogen dioxides (NO_2) are emitted into the atmosphere and transported by wind and air currents.

$$SO_2 + \frac{1}{2}O_2 \rightarrow SO_3$$

$$SO_3 + H_2O \rightarrow \underset{\text{Sulphuric acid}}{H_2SO_4}$$

$$NO_2 + H_2O \rightarrow \underset{\text{Nitric acid}}{HNO_3}$$

@apna_pdf

7. **Given below are two statements.**

Statement I the pH of rain water is normally ~ 5.6.

Statement II if the pH of rain water drops below 5.6., it is called acid rain.

In the light of the above

Statements, choose the correct answer from the options given below.

(a) Both statements I and II are true
(b) Both statements I and II are false
(c) Statement I is true but statement II is false
(d) Statement I is false but statement II is true

[JEE Main-2021, 25 Feb Shift-II]

Ans. (a) : Normally rain water has pH of 5.6 due to the presence of H^+ ion formed by the reaction of rain water with carbon dioxide present in the atmosphere.

8. **Given below are two statements :**

Statements-I Chlorofluoro carbons break down by radiation in the visible energy region and release chlorine gas in the atmosphere which then reacts with stratospheric ozone.

Statement-II Atmospheric ozone reacts with nitric oxide to give nitrogen and oxygen gases, which add to the atmosphere.

For the above statements choose the correct answer from the options given below :

(a) Statement-I is incorrect but statement-II is true
(b) Both statement-I and II are false
(c) Statement-I is correct but statement-II is false
(d) Both statement-I and II are correct

[JEE Main-2021, 25 July Shift-II]

Ans. (b) : Statement I: Chlorofluoro Carbons (CFCs) are broken by powerful UV radiation and releases chlorine free radical which reacts with Ozone & state chain reaction.

$$CF_2Cl_2(g) \xrightarrow{UV} \dot{C}l(g) + CF_2Cl(g)$$

$$\dot{C}l(g) + O_3(g) \longrightarrow \dot{C}lO(g) + O_2(g)$$

$$\dot{C}l(g) + O_3(g) \longrightarrow \dot{C}l(g) + O_2(g)$$

Statement II: Atmospheric Ozone reacts with nitric oxide to produce nitrogen dioxide & oxygen.

$$NO(g) + O_3 \longrightarrow NO_2(g) + O_2(g)$$

9. **Biochemical oxygen demand (BOD) value can be a measure of water pollution caused by the organic matter. Which of the following statements is correct?**

(a) Polluted water has BOD value higher than 10 ppm
(b) Aerobic bacteria decreases the BOD value
(c) Anaerobic bacteria increases the BOD value
(d) Clean water has BOD value higher than 10 ppm

[BITSAT-2021]

Ans. (a) : Clean water has BOD less than 5 ppm whereas highly polluted water have BOD value of 17 ppm or more because the more organic matter there is (e.g, in sewage and polluted bodies of water), the greater the BOD; the lower the amount of dissolved oxygen available for higher animals such as fishes.

- The BOD is therefore a reliable gauge of the organic pollution of a body of water.

10. **Thermal power plants can lead to**

(a) acid rain
(b) blue baby syndorme
(c) ozone layer depletion
(d) eutrophication

[JEE Main-2020 3 Sep Shift-I]

Ans. (a) : Thermal power plants can lead to acid rain as it emits CO_2 that combines with moisture of atmosphere and forms H_2CO_3 (Carbonic acid).

- The thermal power plant has serious impacts on land, soil, air & various social impacts. These plants also emit large amount of mercury & generate large quantity of fly ash with destroys the surrounding environment.

11. **The incorrect statement(s) among (A)-(D) regarding acid rain is (are) :**

(A) It can corrode water pipes.
(B) It can damage structures made up of stone
(C) It cannot cause respiratory ailments in animals.
(D) It is not harmful for trees.

(a) (C) and (D)
(b) (A), (C) and (D)
(c) (C) only
(d) (A), (B) and (D)

[JEE Main-2020, 3 Sep Shift-II]

Ans. (a) : Effects of Acid rain:

- Acid rain damages the leaves of trees and plants, thus limiting their growth and exposing them to the metals in the air from the toxic rain.
- Acid rain increases the acidity of lakes and rivers that kills fish, bacteria & algae & the aquatic ecosystem collapses into sterility leaving a crystal clear but ultimately a dead lake.
- It affects both materials & organism. It attacks building materials principally sandstone, limestone, marble, steel and nickel.

12. **Level of Biochemical oxygen Demand indicates**

(a) Soil pollution
(b) Water pollution
(c) Air pollution
(d) Pollution by photochemical smog

Assam CEE-2019

Ans. (b) : Biochemical oxygen demand represent the amount of oxygen consumed by bacteria and other microorganisms while they decompose organic matter under aerobic conditions at a specified temperature.

13. **The maximum prescribed concentration of copper in drinking water is**

(a) 5 ppm
(b) 0.5 ppm
(c) 0.05 ppm
(d) 3 ppm

[JEE Main-2019, 8 April Shift-II]

@apna_pdf

Ans. (d) : Maximum prescribed concentration of copper metal in drinking water is 3ppm. Above this concentration water become toxic.

14. The concentration of dissolved oxygen (DO) in cold water can go upto

(a) 14 ppm (b) 10 ppm
(c) 8 ppm (d) 16 ppm

[JEE Main-2019, 11 Jan Shift-I]

Ans. (b) : The concentration range of dissolved oxygen (DO) in cold water reaches upto 10 ppm, but that in normal water (at room temperature) is within 5 ppm.

15. Taj Mahal is being slowly disfigured and discoloured. This is primarily due to

(a) water pollution (b) soil pollution
(c) global warming (d) acid rain

[JEE Main-2019, 11 Jan Shift-II]

Ans. (d) : Acid rain reacts with marble, $CaCO_3$ of Taj Mahal causing damage to monument and monument is being slowly disfigured the marble is getting discolored and lusterless.

$$CaCO_3 + H_2SO_4 \rightarrow CaSO_4 + H_2O + CO_2$$

16. Which cleaning agent gets precipitated in hard water?

(a) Sodium lauryl sulphate
(b) Sodium stearate
(c) Cetyl trimethyl ammonium bromide
(d) Sodium dodeyle benzene sulphonate

Karnataka-CET-2019

Ans. (b) : Sodium stearate is the cleaning agent that gets precipitated in hard water.

$$\underset{\text{Sodium Stearate}}{2C_{17}H_{35}COONa} + CaCl_2 \longrightarrow 2NaCl + \underset{\text{insoluble calcium stearate (soap)}}{(C_{17}H_{35}COO)_2Ca}$$

- Sodium stearate is a versatile, material used as an emulsifier, dispersant, gelling agent.

Stabilizer, binder, viscosity modifier and more. It is a major component of many soaps, cosmetics and food additives.

17. The process of 'eutrophication' is due to :

(a) increase in concentration of radioactive substances in water
(b) the reduction in concentration of the dissolved oxygen in water due to phosphate pollution in water
(c) increase in concentration of fluoride ion in water
(d) increase in concentration of insecticide in water

Manipal-2016

Ans. (b) : The process of eutrophication is due to the reduction in the concentration of dissolved oxygen in water due to phosphate pollution in water.

- Harmful algal blooms, dead zones & fish kills are the results of a process called eutrophication which occurs when the environment becomes enriched with nutrients, increasing the amount of plant and algae, increasing the amount of plant and algae growth to estuaries and coastal waters.

18. The wrong statement among the following is

(a) acid rain is mostly because of oxides nitrogen and sulphur
(b) green house effect is responsible for global warming
(c) ozone layer does not permit infrared radiation from the sun to reach earth
(d) chlorofluorocarbons are responsible for ozone layer depletion.

J & K CET-(2015)

Ans. (c) : Ozone layer acts as a shield and does not allow ultraviolet radiation from sun to reach earth. It does not prevent infra-red radiation from sun to reach earth.

All the energy from the sun that reaches the Earth arrives as solar radiation, part of a large collection of energy called the electromagnetic radiation spectrum. Solar radiation includes visible light, ultraviolet light, infrared, radio waves, X-rays, and gamma rays. Radiation is one way to transfer heat.

19. BOD is a measure of

(a) ozone depletion in the stratosphere due to too many free radicals
(b) suspended particulate matter in the air causing lung problems
(c) pesticides which are non-biodegradable in the soil and water
(d) organic material present in water needing dissolved oxygen to break them down depleting oxygen content in water.

COMEDK-2015

Ans. (d): Biochemical oxygen demand (BOD) is the amount of dissolved oxygen needed by aerobic biological organisms to break down organic material present in a given water sample at certain in a given water sample at certain temperature over a specific time period.

- A low BOD is an indicator of good quality water, while a high BOD indicates polluted water.

20. Rain water is called acid rain when its pH

(a) falls below zero
(b) falls below 5.6
(c) is above 5.6 but less then 10
(d) is above 10.

COMEDK-2014

Ans. (b): With a pH range of 5 to 6, natural rain water is mildly acidic. It becomes acid rain when the pH level of rainwater falls below this range. Therefore, the pH of acid rain is approximately 4 to 5.

21. Match the following

List I	**List II**
(A) pH of unpolluted rain water	(I) $H_2C{=}CH{-}CHO$
(B) Acid rain	(II) 5.6
(C) Acrolein	(III) NO_2, CO_2
(D) Freon	(IV) CF_2Cl_2
	(V) $CaOCl_2$

	(A)	**(B)**	**(C)**	**(D)**
(a)	(II)	(I)	(III)	(IV)
(b)	(I)	(II)	(III)	(IV)
(c)	(III)	(II)	(IV)	(I)
(d)	(II)	(III)	(I)	(IV)

AP EAMCET (Medical)-2013

@apna_pdf

Ans. (d): The pH of unpolluted rain water is 5.6. Thus, it is slightly acidic in nature.

- Acid rain is due to the presence of NO_2 and CO_2. It follows the following reaction.

$$2NO + O_2 \longrightarrow 2NO_2$$

$$2NO + H_2O \longrightarrow HNO_3 + HNO_2$$

$$\text{(Nitric acid)}$$

And $$2SO_2 + O_2 \longrightarrow 2SO_3$$

- The chemical formula of acrolein is $H_2C = CH - CHO$.

→ Acrolein is a colorless or yellow liquid with a disagreable odour. It dissolves in water very easily and quickly changes to a vapor when heated.

→ Acrolein is a simplest unsaturated aldehyde and is highly flammable, very reactive, is fatal when swallowed, and causes burns to skin and eye. It is simplest unsaturated aldehyde, also known as propanal

- Freon's are colorless, odorless, nonflammable, and noncorrosive gases or liquids belonging to the class of chlorofluorocarbons (CFCs). Due to their low boiling points and low viscosity, they are mainly used as refrigerants in refrigerators and air-conditioning systems. It is also known as chlorofluorocarbon.

22. Which one of the following statement is not true?

(a) pH of drinking water should be between 5.5-9.5.

(b) Concentration of DO below 6 ppm is good for the growth of fish

(c) Clean water would have a BOD value of less than 5 ppm

(d) Oxides of sulphur, nitrogen and carbon, are the most widespread air pollutant

NEET-2011

Ans. (b) : Concentration of DO below 6 ppm is not good for the growth of fished because the growth of fishes get hindered if the concentration of DO is below 6 ppm. The ideal value of DO for growth of fishes 8 mg/I.

DO = Dissolved oxygen

Hence, statement B is not true.

23. Most abundant water pollutant is

(a) detergents (b) industrial wastes

(c) pesticides (d) oil spills

BCECE-2011

Ans. (b) : Industrial wastes are the most abundant water pollutant.

- The waste from industries containing poisonous chemicals enter the ponds, lakes, rivers, and seas and degrade the oxygen level in the water, blocking the sunlight affecting the growth of aquatic species.

24. Minamata disease is due to pollution of

(a) aresenic into the atmosphere

(b) organic waste into drinking water

(c) oil spill in water

(d) industrial waster mercury into fishing water

[BITSAT-2010]

Ans. (d) : The minamata disease is a kind of organic mercury poisoning induced by the intake of polluted fish & shellfish caught in Minamata Bay. It is a neurological disease caused by the release of mercury/methyl mercury from the industries into the fresh water bodies and the subsequent consumption of the water.

25. Phosphate pollution is caused by:

(a) Sewage and agricultural fertilizers

(b) Weathering of phosphate rocks only

(c) Agricultural fertilizers only

(d) Phosphate rocks and sewage

[BITSAT-2010]

Ans. (a) : Phosphate pollution in the water is directly related to the release of the untreated sewage and agriculture fertilizers into the water body. This result in excessive algal bloom that forms a thick layer on the surface of the water and prevent the sunlight and oxygen from getting into the water.

26. The water pollutants mainly responsible for eutrophication are

(a) Cd, Pb and Hg present in industrial waste

(b) heavy metals present in mining waste

(c) detergents and fertilizers containing phosphate anion

(d) polychlorinated biphenyls

AMU-2005

Ans. (c) : Detergents and fertilizers containing phosphate anion are the water pollutants mainly responsible for eutrophication. The addition of phosphorous water in the form of phosphate ion. encourages the formation of algae, which reduce of DO of water. This process known as eutrophication.

- Eutrophication is the gradual increase in the concentration of phosphoros, nitrogen, and other plants nutrients in an aging aquatic ecosystem such as a lake.

27. Water is considered to be polluted if the dissolved oxygen (DO) content is less than….ppm.

(a) 5 (b) 10

(c) 15 (d) 100

AP EAMCET-2003

Ans. (b): Water is considered to be polluted if the dissolved oxygen (DO) content is less than 10 ppm.

- Water pollution is the contamination of water sources by substances which make the water unusable for drinking, cooking, clearing, swimming, and other activities.

28. Amongest

$\mathbf{NO_3^-, AsO_3^{3-}, CO_3^{2-}, ClO_3^-, SO_3^{2-}}$ **and** $\mathbf{BO_3^{3-}}$

the non-planar species are

(a) CO_3^{2-}, SO_3^{2-}, and BO_3^{2-}

(b) AsO_3^{3-}, ClO_3^-, and SO_3^{2-}

(c) NO_3^-, CO_3^{2-}, and BO_3^{3-}

(d) SO_3^{2-}, NO_3^-, and BO_3^{3-}

VITEEE, 2017

Ans.(b): AsO_3^{3-}, ClO_3^- and SO_3^{2-} undergoes sp^3 hybridisation and its geometry is pyramidal with one lone pair and hence, are non-planer species while NO_3^-, CO_3^{2-} and BO_3^{3-} have sp^2 hybridisation and its geometry is trigonal planer, with no lone pair.

@apna_pdf

2. Air Pollution

29. The pollution due to oxides of sulphur gets enhanced due to the presence of:

(I) particulate matter (II) ozone
(III) hydrocarbons (IV) hydrogen peroxide

Choose the most appropriate answer from the options given below

(a) (II), (III), (IV) only (b) (I), (III) (IV) only
(c) (I), (IV) only (d) (I), (II), (IV) only

NEET-17.07.2022

Ans. (d) : Particulate matter, O_3, H_2O_2 enhance oxidation process.

(i) $2SO_2(g) + O_2(g) \rightarrow 2SO_3(g)$

(ii) $SO_2(g) + O_3(g) \rightarrow SO_3(g) + O_2(g)$

(iii) $SO_2(g) + H_2O_2(l) \rightarrow H_2SO_4(aq)$

30. The smog is essentially caused by the presence of

(a) O_2 and O_3
(b) O_2 and N_3
(c) Oxides of sulphur and nitrogen
(d) O_3 and N_2

JCECE - 2008
UPTU/UPSEE-2007, AIEEE 2004

Ans. (c) : Smog is a type of air pollution. Smog is going to form by the mixture of smoke and fog in the air.

- Due to the photochemical reaction between volatile organic compounds (fuels), oxides of sulphur, and oxides of nitrogen, a large amount of ozone and fine particles are released into the air.
- The fuels, oxides of sulphur and oxides of nitrogen are called precursors because they are reasonable for the formation of the smog.

31. Which one of the following is not a common component of photo-chemical smog?

(a) Ozone
(b) Acrolein
(c) Peroxy acetyl nitrate
(d) Chlorofluorocarbons

Karnataka-CET-2017
NEET-2014

Ans. (d): Chlorofluorocarbons (CFCs) is not a common component of photo-chemical smog.

- The major components of photochemical smog are nitrogen dioxide (NO_2), Ozone (O_3), PAN (peroxyacetylinitrate), and chemical compounds that contain the CHO group (aldehydes).

32. Identify the incorrect statement from the following

(a) Oxides of nitrogen in the atmosphere can cause the depletion of ozone layer
(b) Ozone absorbs the intense ultaviolet radiations of the sun
(c) Depletion of ozone layer is because of its chemical reactions with chlorofluoro alkanes
(d) Ozone absorbs infrared radiations

[BITSAT-2018]
AIEEE-2011

Ans. (d) : The ozone layer, existing between 20 to 35km above the earth's surface, shield the earth from the harmful ultraviolet radiations from the sun.

33. Which of the following is not an air pollutant?

(a) N_2 (b) N_2O
(c) NO (d) CO

AP - EAMCET (Medical)-2007
AP EAMCET-2005

Ans. (a) : Nitrogen is not an air pollutant as the atmospheric composition contains 78% nitrogen and 21% oxygen by proportion. Oxides of nitrogen from external sources and carbon monoxide are various exhaust gases from vehicles which are air pollutants causing damage to the atmosphere.

- The six major air pollutants are particulate matter, Ground level zone, carbon Monoxide, Sulfur oxides, Nitrogen oxides and lead.

34. Which of the following is not involved in the formation of photochemical smog?

(a) Hydrocarbon (b) NO
(c) SO_2 (d) O_3

[BITSAT-2017, 2005]

Ans. (c) : SO_2 is not involved in the formation of photochemical smog.

- Photochemical smog, also called 'Los Angeles smog', is brown in colour and observed in sunny and densely populated cities.

35. Which of the following acts as a sink for CO?

(a) Plants
(b) Haemoglobin
(c) Microorganisms present in the soil
(d) Oceans

NEET-2017
[BITSAT-2008]

Ans. (c) : Since, soil also acts as a sink for Carbon monoxide and is a natural medium. Microorganism present in soil also act as a sink for carbon monoxide (CO).

- Don't mix up with plant and soil. Plants act as sink for carbon dioxide and soil act as sink for carbon monoxide.

36. Eutrophication causes reduction in

(a) Dissolved oxygen (b) Nutrients
(c) Dissolved salts (d) All the above

Karnataka-CET-2019
[BITSAT-2010]

Ans. (a) : Eutrophication is the process of enriching water bodies with phosphates like nutrient. It support the abnormal growth of algae & the lakes and ponds become marshy. As the algae increases, it consumes more dissolve oxygen and therefore level of dissolve oxygen decreases.

37. Air pollution that occurs in sunlight is:

(a) Reducing smog (b) Acid rain
(c) Oxidizing smog (d) Fog

AIIMS 25 May 2019 (Morning)
JEE Main-10.04.2019, Shift-II

@apna_pdf

Ans. (c): Oxidizing smog is the air pollution that occurs in sunlight.

• Photochemical smog form when primary pollutants are transformed through photo chemical reactions into secondary pollutants, the most important which are the strong oxidant gases, ozone and peroxyacetyl nitrate (PAN).

• $\text{Hydrocarbons} + O_2 + NO_2 \xrightarrow{\text{Sunlight}} \underset{\text{PAN}}{CH_3COONO_2}$

38. Decomposition of ozone can be caused by
(a) atomic helium (b) water vapour
(c) dust particles (d) atomic chlorine

SRMJEEE-2013, 2012

Ans. (d) : Decomposition of ozone can be caused by atomic chlorine which leads to depletion of ozone layer in the stratosphere.

• The thinning of the ozone layer, is mainly due to the action of the chlorine cycle during which, the presence of one chlorine atom in the stratosphere can cause the decomposition of 100000 ozone molecules.

39. Given below are two statements:

Statement I An allotrope of oxygen is an important intermediate in the formation of reducing smog.

Statement II Gases such as oxides of nitrogen and sulphur present in troposphere contribute to the formation of photochemical smog.

In the light of the above statements, choose the correct answer from the options given below.
(a) Both statement I and statement II are true
(b) Both statement I and statement II are false
(c) Statement I is true but statement II is false
(d) Statement I is false but statement II is true

[JEE Main-2021, 25 Feb Shift-I]

Ans. (b) : Reducing smog is a mixture of smoke, fog and Sulphur dioxide.
Troposphere contribute to the formation of chemical smog due to presence of Sulphur dioxide and carbon particles. Troposphere pollutants such as hydrocarbon and nitrogen oxide contribute to the formation of photochemical smog.

40. The gas released during anaerobic degradation of vegetation may lead to
(a) acid rain
(b) global warming and cancer
(c) corrosion of metals
(d) ozone hole

[JEE Main-2021, 24 Feb Shift-I]

Ans. (b): Anaerobic degradation means the breakdown in the absence of oxygen. During anaerobic degradation of vegetation, CH_4 is produced, which is responsible for global warming as it absorbs sun's heat. It is also known to cause cancer.

41. The statements that are true.
(A) Methane leads to both global warming and photochemical smog.
(B) Methane is generated from paddy fields
(C) Methane is a stronger global warming gas than CO_2
(D) Methane is a part of reducing smog

Choose the most appropriate answer from the options given below
(a) (A), (B), (C) only (b) (A) and (B) only
(c) (B), (C), (D) only (d) (A), (B), (D) only

[JEE Main-2021, 18 March Shift-I]

Ans. (a) The statements (A), (B) & (C) are true regarding to methane.

• Contribution of global warming gas

$CO_2 > CH_4 > CFCs > O_3 > N_2O > H_2O$

But CH_4 is 40 times stronger greenhouse gases than CO_2. It has more heating effects.

• Methane is not a part of reducing smog.

42. Reducing smog is mixture of
(a) smoke, fog and O_3
(b) smoke, fog and SO_2
(c) smoke, fog and $CH_2 = CH - CHO$
(d) smoke, fog and N_2O_3

[JEE Main-2021, 17 march Shift-I]

Ans. (b): Reducing smog is mixture of smoke, fog and SO_2.

43. Which of the following statement (s) is/are incorrect?
(a) A sink of SO_2 pollutant is O_3 in the atmosphere
(b) FGD is a process of removing NO_2 from atmosphere
(c) NO_x in fuel gases can be removed by alkaline scrubbing
(d) The catalyst to convert CCl_4 to CF_4 by HF is SbF_5

WB-JEE-2020

Ans. (b & c): Statements (b and c) are incorrect whereas statement (a & d) is correct. The corrected form as follows:–

- FGD is a set of technologies used to remove SO_2 from exhaust flue gasses of fossil fuel power plant and from the emission of other SO_2 emitting.
- NOx in fuel gases can be removed by pyrolusite slowly.

44. Which of the following is a greenhouse gas?
(a) Methane (b) Ethane
(c) Hydrogen sulphide (d) Acetylene
(e) Ethylene

Kerala-CEE-2020

Ans. (a): Green house gases are gases that cause a green house effect. They absorb and emit infrared radiation. Water vapour, carbon dioxide, methane, nitrous oxide, and ozone are green house gases.

45. The condition that indicates a polluted environment is
(a) pH of rain water to be 5.6
(b) eutrophication
(c) BOD value of 5 ppm
(d) 0.03% of CO_2 in the atmosphere

[JEE Main-2020, 5 Jan Shift-II]

Ans. (b) : Eutrophication is the condition that indicates a polluted environment.

• Eutrophication is the condition in which excessive richness of nutrients in a lake or water body, which causes dense growth of plant life and BOD increases.

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46. The molecule that has minimum/no role in the formation of photochemical smog, is

(a) N_2 (b) $CH_2 = O$

(c) NO (d) O_3

[JEE Main-2019, 12 Jan Shift-I]

Ans. (a) : NO_2, O_3 and hydrocarbon is main resource for the build-up smog.

And other compound which are responsible for photochemical smog is HCHO, O_3 and NO.

So, N_2 has no role in the formation of photochemical smog.

47. The correct set of species responsible for the photochemical smog is

(a) N_2, NO_2 and hydrocarbons

(b) CO_2, NO_2, SO_2 and hydrocarbons

(c) NO, NO_2, O_3 and hydrocarbons

(d) N_2, O_2, O_3 and hydrocarbons

[JEE Main-2019, 12 April Shift-I]

Ans. (c) : Photochemical smog is mixture of pollutants that are formed when nitrogen oxides and volatile organic compounds (VOCs) react to sunlight, creating a brown haze above cities.

Photochemical smog is an oxidizing smog and occurs in warm atmospheric condition.

Common component of photochemical smog are ozone nitric oxide acrolein PAN.

48. The primary pollutant that leads to photochemical smog is

(a) acrolein (b) nitrogen oxides

(c) ozone (d) sulphur dioxide

[JEE Main-2019, 12 April Shift-II]

Ans. (b) : Nitrogen oxide is the primary pollutant. Again if we observe the reaction mentioned above we can observe the reaction mentioned above we can observe that the whole set reaction information of photochemical smog revolves around nitrogen oxide without the presence of higher concentration of nitrogen oxide in one place, the formation of photochemical smog is impossible.

49. Assertion (A) Ozone is destroyed by CFCs in the upper stratosphere.

Reason (R) Ozone holes increase the amount of UV radiation reaching the earth

(a) Assertion and Reason are incorrect

(b) Assertion and Reason are both correct and the Reason is the correct explanation for the Assertion.

(c) Assertion and Reason are correct, but the Reason is not the explanation for the Assertion.

(d) Assertion is false, but the Reason is correct

[JEE Main-2019, 8 April Shift-I]

Ans. (c) : Ozone is present in the atmosphere in the upper part of the atmosphere called the stratosphere.

Ozone (O_3) which protect us from harmful ultraviolet (UV) radiations coming from the sun.

And CFCs when react with ozone (O_3) it breaks the molecules of ozone resulting in ozone layer depletion.

50. Which one of the following is the major constituent of biogas?

(a) Carbon dioxide (b) Nitrous oxide

(c) Methane (d) Oxygen

NDA (II)-2019

Ans : (c) Biogas is the mixture of gases produced by the breakdown of organic matter in the absence of oxygen. The main component of biogas is 'methane' (CH_4) about 75%.

51. Carbon monoxide is a pollutant as it

(a) inactivates nerves

(b) inhibits glycolysis

(c) combines with oxygen

(d) combines with haemoglobin

Assam CEE-2018

Ans. (d) : Carbon monoxide (CO) - a colourless, orderless, tasteless, and toxic air pollutant-is produced in the incomplete combustion of carbon-containing fuels, such as gasoline natural gas, oil, Coal and wood.

CO affects human health by impairing the ability of the blood to bring O_2 to body tissue, when CO is in fated, it rapidly crosses the alveolar epithelium to such the blood, where it binds to haemoglobin to Carboxyhemoglobin (COHb), a useful maker for predicting the health effects of CO. CO has an affinity for haemoglobin more than 200 times greater than O_2, the present of CO in the lung will displace O_2 from the heamoglobin.

52. Which oxide of nitrogen is not a common pollutant introduced into the atmosphere both due to natural and human activity?

(a) N_2O_5 (b) NO_2

(c) N_2O (d) NO

NEET-2018

Ans. (a) : Dinitrogen Pentaoxide (N_2O_5) is an oxide of Nitrogen which is not a common pollutent. It is an unstable and dangerous oxides, which have only nitrogen and oxygen. This is not a common pollutant introduced into the atmosphere both due to natural and human activity.

53. SO_2 is considered as airpollutant because

(a) Its concentration increases with temperature increase of atmosphere

(b) It is used as insecticide, which is airpollutant

(c) It reacts with O_2 and H_2O to produce acid rain

(d) It is a strong oxidant and oxidised other components of atmosphere

UPTU/UPSEE-2018

Ans. (c): SO_2 is considered as air pollutant because it reacts with O_2 and H_2O to produce acid rain.

- Acid rain is caused by a chemical reaction that begins when compounds like sulfur dioxide and nitrogen oxide (are released into air). These substances can rise very high into the atmosphere, where they mix and react with water, oxygen and other chemicals to form more acidic pollutants known as acidic rain.

54. The photochemical smog is

(a) formed due to oxidation of hydrocarbons trapped in flowing air in the presence of sunlight

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(b) formed due to oxidation of smoke trapped in stagnant air mass in the presence of sunlight
(c) formed due to heterogeneous combination of smoke and fog in air in the presence of sunlight
(d) formed due to oxidation of hydrocarbons trapped in stagnant air mass in the presence of sunlight.

AMU-2017

Ans. (d) : Photochemical smog is a brownish-gray haze caused by the action of solar ultra radiation on atmosphere polluted with hydrocarbons and oxides of nitrogen.

- It contains anthropogenic air pollutants, mainly Ozone, nitric acid, and organic compounds, which are trapped near the ground by temperature inversion.
- Photochemical smog formation reaction is as follows

$$\underset{\substack{\text{(Voltile organic}\\\text{compound)}}}{\text{VOCs}} + \text{NO} \xrightarrow{\text{Sunlight}} O_3 + HNO_3 + \text{Organics}$$

55. In environmental chemistry, the medium which is affected by a pollutant is called as the ....
(a) sink (b) slag
(c) solvent (d) receptor

TS-EAMCET-2016

Ans. (d) : In environmental chemistry a receptor is any organism or object affected by the pollution of the environment around the organism.

- **Receptor:** The medium which is effected by the pollutant is called receptor. Eg: Our eyes become red with burning sensation due to the smike released from automobiles.

56. Freon 12 is manufactured from CCl_4 by
(a) Wurtz reaction
(b) Swarts reaction
(c) Fittig reaction
(d) Wurtz-Fittig reaction
(e) Sandmeyer reaction

Kerala-CEE-2016

Ans. (b): Freon-12 is manufactured from CCl_4 by Swarts reaction.

$$3CCl_4 + 2SbF_3 \longrightarrow \underset{\text{(Freon-12)}}{3CCl_2F_2} + 2SbCl_3$$

57. Which of the following statement(s) is not correct?
(a) Suspended particulate matter is an important pollutant released by diesel vehicles
(b) Soot particles (size<5μ) cause fibrosis of the lung living
(c) H_2SO_4 particulates have size of 500–1000nm
(d) Photochemical smog is formed by oxides of sulphur, smoke and dust particles

JIPMER-2016

Ans. (d): Statement (d) is not correct.

- Photochemical smog is produced when sunlight reacts with nitrogen oxides and at least one volatile organic compound (VOC) in the atmosphere.
- Nitrogen oxides come from vehicle exhaust, cool power plants, and factory emissions.
- VOCs are released from gasoline, paints, and many cleaning solvents.

58. Which of the following oxides of nitrogen is not an air pollutant?
(a) NO_2 (b) N_2O
(c) N_2O_5 (d) NO

AMU-2015

Ans. (c) : N_2O_5 is not a common pollutant introduced into the atmosphere both due to natural and human activity.

N_2O, NO and NO_2 are common pollutants introduced into the atmosphere both due to natural and human activity.

59. Assertion (A) Nitrogen and oxygen are the main components in the atmosphere but these do not react to form oxides of nitrogen.
Reason (R) The reaction between nitrogen and oxygen requires high temperature
(a) Both Assertion and Reason are correct and the reason is the correct explanation for the Assertion.
(b) Both Assertion and Reason are correct but the reason is not the correct explanation for the Assertion.
(c) The Assertion is incorrect but reason is correct.
(d) Both the Assertion and reason are incorrect.

JEE Main-2015

Ans. (a) : Nitrogen and Oxygen are the main components in the atmosphere but these do not react to form oxides of nitrogen.

This is because the reaction between nitrogen and oxygen requires high temperature to overcome the activation energy barrier.

Thus both Assertion and reason as correct and reason is the correct explanation of Assertion.

60. Which of the following pollutants is main product of automobiles exhaust?
(a) CO (b) CO_2
(c) NO (d) Hydrocarbons

[BITSAT-2015]

Ans. (c) : Nitric oxide (NO) pollutant is the main product of automobiles exhaust Nitrogen dioxide (NO_2) pollutant is also the product of aoutomobiles exhaust. These oxides destroy ozone layer.

- Pollutants produced by vehicle exhaust include carbon monoxide, hydrocarbons, nitrogen oxides, particles, volatile organic compounds and sulfur dioxide.

61. The disease caused the high concentration of hydrocarbon pollutants in atmosphere is / are
(a) silicosis (b) TB
(c) Cancer (d) asthma

[BITSAT-2015]

Ans. (c) : The high concentration of hydrocarbon pollutants in atmosphere causes cancer. In plants, hydrocarbons cause ageing, shading of leaves, flowers and twigs. Hydrocarbons are produced due to incomplete combustion of fuel used in automobiles.

- Hydrocarbons are majorly used as the source of combustible fuel source. They are also beneficial in production of many consumer products used to manufacture plastics, synthetic rubbers, synthetic fibres, fertilizers. etc.

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62. In an atmosphere with industrial smog, copper corrodes to

I. $Cu_2(OH)_2SO_4$ **II. $Cu_2(OH)_2CO_3$**
III. $CuSO_4$ **IV. $CuCO_3$**
(a) I and III (b) II and IV
(c) I and IV (d) I and II

BCECE-2013

Ans. (d) : Corrosion of Copper gives $Cu_2(OH)_2SO_4$ & $Cu_2(OH)_2CO_3$.

$2Cu + H_2O + SO_3 + O_2 \rightarrow Cu_2(OH)_2\ SO_4$

$2Cu + H_2O + CO_2 + O_2 \rightarrow Cu_2(OH)_2\ CO_3$

- Copper corrodes to a mixture of carbonate & sulphate compounds in various amounts, depending upon environmental conditions such as sulphur containing acid rain.

63. Freon used as refrigerant is

(a) $CF_2 = CF_2$ (b) CH_2F_2
(c) CCl_2F_2 (d) CF_4

JCECE-2012

Ans. (c) : Freon used as refrigerant is CCl_2F_2.

$$CCl_4 + 2HF \xrightarrow{Sb_2F_5} \underset{freon}{CF_2Cl_2} + 2HCl$$

64. The gas emitted by supersonic jet planes that slowly depletes the concentration of ozone layer is

(a) CO (b) NO
(c) SO_2 (d) O_2
(e) HF

Kerala-CEE-2012

Ans. (b): The gas released into upper atmosphere from engine of supersonic jet plane is nitric oxide (NO). It reaches into the stratosphere, reacts with ozone and cause its depletion.

$$NO + O_3 \longrightarrow NO_2 + O_2$$

$$O_2 \xrightarrow{UV} [\dot{O}] + [\dot{O}]$$

$$NO_2 + [\dot{O}] \longrightarrow NO + O_2$$

65. Which one of the following statements regarding photochemical smog is not correct?

(a) Carbon monoxide does not play any role in photochemical smog formation.
(b) Photochemical smog is an oxidizing agent in character.
(c) Photochemical smog is formed through photochemical reaction involving solar energy
(d) Photochemical smog does not cause irritation in eyes and throat

NEET-2012

Ans. (d): Photochemical smog is the chemical reaction of sunlight, nitrogen oxides and volatile organic compounds in the atmosphere. Which leaves airborne particles and ground level ozone.

Being an irritant of the eyes, nose throat, and lungs, ozone is known to particularly affect asthmatics and people with respiratory problems.

66. CCl_4 and freons

(a) are green compounds because they are green coloured
(b) depletes ozone concentration
(c) causes increase in ozone concentration
(d) have no effect on ozone concentration.

J & K CET-(2012)

Ans. (b): CCl_4 and freons depletes ozone concentration. freon-12 (dichlorodiflooro-methane, CF_2Cl_2) is commonly known as CFC. It is used as a refrigerant in refrigerators and air conditioners.

It is also used in aerosol spray propellants such as body sprays, hair sprays etc.

CFCS & CCl_4 released to atmosphere -Ozone layer depletion takes place which prevent us from UV rays.

UV rays-released to atmosphere - skin cancer and eye infection or other diseases.

67. CO_2 goes to air, causes green house effect and gets dissolved in water. What will be the effect on soil fertility and pH of the water?

(a) Increases (b) Decreases
(c) Remain same (d) None of these

[BITSAT-2012]

Ans. (b) : Carbon dioxide dissolves in water to form carbonic acid

$$H_2O + CO_2 \rightarrow H_2CO_3$$

Due to this pH of the water will decrease (it will become more acidic and soil fertility will decrease).

68. Which one of the following statements about ozone and ozone layer is true?

(a) Ozone layer is beneficial to us because ozone cuts out the ultraviolet radiation of the sun.
(b) The conversion of ozone to oxygen is an endothermic reaction
(c) Ozone has a triatomic linear molecule
(d) None of the above

[BITSAT-2011]

Ans. (a) : The ozone layer protects the Earth against most UV ray coming from the sun. It is always important to protect oneself against UV radiation, even in the absence of Ozone depletion, by wearing heat, sunglasses, and sunscreen. However, these precautions will become more important as ozone depletion worsens.

- It helps in polar ice shifting.
- Help to reduce temperature.

69. Producer gas is the mixture of

(a) $CO + N_2$ (b) $CO + H_2$
(c) CO + water vapour (d) $N_2 + CH_4$

JCECE-2010

Ans. (a): Producer gas is combustible mixture of nitrogen (N_2), carbon monoxide (CO) and Hydrogen (H_2).

Uses :

- Producer gas is utilised as a fuel in a variety of sectors, including iron producing industries.
- To remove the carbon dioxide gas from the fuel cells, producer gas is used.
- Producer gas is used in the production of fuel gas.

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70. The statements which is not correct about control of particulate pollution is:
(a) In electrostatic precipitator, the particulates are mode to acquire positive charge which are then attracted by the negative electrode and removed
(b) Gravity settling chamber removes larger particles from the air
(c) Cyclone collector removes fine particls in the diameter range 5-20 microns
(d) Wet scrubbers are used to wash away all types of particulates

[BITSAT-2009]

Ans. (a) : In electrostatic precipitation, the particulates are mode to acquire negative charge which are them attracted by the positive electrode & removed.

Hence, the option (a) is not correct.

71. Chief source of soil and water pollution is:
(a) Mining (b) Agro industry
(c) Thermal power plant (d) All of the above

[BITSAT-2009]

Ans. (d) : Mining, Agro industry, Thermal power plant all are the chief source of soil & water pollution.

• Soil pollution is often caused by the uncontrolled disposal of sewage and other liquid wastes resulting from domestic uses of water, industrial wastes containing a variety of pollutants, agricultural and drainage of irrigation water.

72. The false statement among the followings:
(a) The average residence time of NO is one month
(b) Limestone acts as a sink for SO_x.
(c) SO_x can be removed from flue gases by passing through a solution of citrate ions.
(d) Ammonia acts as a sink for NO_x.

[BITSAT-2008]

Ans. (a) : Residence time means the lifetime amount of chemicals in the atmosphere divided by the rate at which the chemicals are eliminated from the atmosphere. The average residence time of NO is 0.5 to 2 days.

Hence, average residence time of NO is one Months it is false statements.

• Nitrous oxide (NO_2) has a long residence time in the atmosphere and average of about 120 years.

73. Sewage mostly constitutes:
(a) Non-biodegradable pollutants
(b) Biodegradable pollutants
(c) Effluents
(d) Air pollutants

[BITSAT-2008]

Ans. (c) : Sewage mostly constitutes Effluents Effluent is sewage that has been treated in a septic tank or sewage treatment plant. It is also referred to as "trade effluent" or "wastewater". Effluent is waste other than waste from kitchens or toilets, surface water or domestic sewage. It can be produced and discharged by an industrial or commercial premises.

74. BOD is connected with:
(a) Microbes and organic matter
(b) Organic matter
(c) Microbes
(d) None of the above

[BITSAT-2008]

Ans. (a) : Biological oxygen demand measures the amount of oxygen consumed by microorganism as they break down organic matter within small water samples, which are analyzed in a Laboratory. The BOD of non-polluted water is above 17 ppm.

• When the BOD is high, the dissolved oxygen (DO) content of the water may become too low to support life in water.

75. The type of pollution caused by spraying of DDT
(a) Air and soil (b) Air and water
(c) Air (d) Air, water and soil

[BITSAT-2007]

Ans. (d) : Spraying of DDT chemicals reacts to the pollution of the air, soil and water soil is the main polluting part when DDT is sprayed to the crops.

• DDT or dichlorodiphenyltrichloroethane, is a chemical compound with the formula $C_{14}H_9Cl_5$.

• DDT and other agrochemicals are release greenhouse gasses to the environment which causes ozone depletion.

• Water may also get polluted by this which destroy all aquatic organisms in the water.

76. Presence of which fuel gas in the exhaust fumes shows incomplete combustion of fuel
(a) Sulphur dioxide
(b) Carbon monoxide and water vapour
(c) Carbon monoxide
(d) Nitrogen dioxide

[BITSAT-2007]

Ans. (c) : Carbon monoxide is formed when carbon reacts with oxygen in limited supply of air i.e. when its incomplete combustion occurs.

• Carbon monoxide (CO) is slightly less dense, colorless, odorless, and tasteless gas than oxygen.

• This gas affects the oxygen capacity of Red Blood Cells.

77. Bhopal gas tragedy of 1984 was caused by
(a) Carbon monoxide (b) Phosgene
(c) Methyl cyanate (d) Methyl isocyanate

AP EAMCET-2007

Ans. (d) : On the night of December 2, 1984, chemical, methyl isocyanate (MIC) split out from Union carbide India Ltd's (UCIL's) pesticide factory turned the city of Bhopal into a colossal gas chamber. It was India's first major industrial disaster.

• When MIC and water mixed, an exothermic chemical reaction started, which produced a lot of heat. As a result, the safety valve of the tank burst because of the increase in pressure.

78. $CFCl_3$ is responsible for the decomposition of ozone to oxygen. Which of the following reacts with ozone to form oxygen?

@apna_pdf

(a) Cl_2 (b) Cl^-

(c) F^- (d) Cl^*

AP-EAMCET-2006

Ans. (d) : According to the question

$$CFCl_3 \xrightarrow{hv} \dot{C}l + \dot{C}FCl_2$$

Hence, $\dot{C}$ reacts with O_3 through a chain reaction as follows-

$$\dot{C}l + O_3 \longrightarrow Cl\dot{O} + O_2$$

$$\dot{C}l + O \longrightarrow \dot{C}l + O_2$$

Hence, option (d) is correct.

79. Which of the following is not a consequence of greenhouse effect?

(a) Climatic conditions will be changed

(b) Plants in warmer climates with adequate rainfall would grow faster

(c) The incidence of infectious diseases is likely to increase

(d) Malaria will be controlled as the mosquitoes will not survive

[BITSAT-2006]

Ans. (d) : Malaria will be controlled as the mosquitoes will not survive. It is not consequence of green house effect.

Consequence of green house effect is-

- Causes global warming which result in making holes in the ozone layer.
- Climatic condition will be changed.

80. Pick up the correct statement :

(a) CO which is major pollutant resulting from the combustion of fuels in automobiles plays a major role in photochemical smog

(b) Classical smog has an oxidizing character while the photochemical smog is reducing in character

(c) Photochemical smog occurs in day time whereas the classical smog occurs in early morning hours

(d) During formation of smog the level of ozone in the atmosphere goes down

(e) Classical smog is good for health but not photochemical smog

Kerala-CEE-2005

Ans. (c): Classical smog occurs in cold and humid climate photochemical smog occurs in warm dry and sunny climate. Photochemical smog is an oxidizing smog whereas classical smog is an reducing smog.

81. Poisonous gas present in the exhaust fumes of an automobile is

(a) C_2H_6 (b) CO_2

(c) CO (d) CH_4

AP-EAMCET-1996

Ans. (c) : Carbon monoxide (CO) is a poisonous gas that is emitted from the exhaust system of a combustible engine of an automobile that uses petrol or diesel as a fuel. It is an odourless, colourless, tasteless, non-irritating and poisonous gas.

3. Types of Pollution and Pollutants

82. Give below ate two statements:

Statement I: Classical smog occurs in cool humid climate. It is a reducing mixture of smoke, fog and sulphur dioxide

Statement II: Photochemical smog has components, ozone, nitric oxide, acrolein, formaldehyde, PAN etc.

In the light of the above statements, choose the most appropriate answer form the options given below.

(a) Both statement I and statement II are correct

(b) Both statement I and statement II are incorrect

(c) Statement is correct but statement II is incorrect

(d) Statement I is incorrect but statement II is correct

JEE Main-27.06.2022, Shift-I

Ans. (a) : Both the given statements about classical smog and photochemical somog are correct.

So, the correct option is (a).

83. Match the Column I and II and pick the correct matching from the codes given below.

Column I		**Columan II**	
A	Polycylic aromatic hydrocarbons	**1**	Global warming
B	Dioxins	**2**	Photochemical
C	IR active molecules	**3**	Carcinogens
D	Peroxy acetyl nitrate	**4**	Waste incineration

	A	**B**	**C**	**D**
(a)	3	4	1	2
(b)	4	3	2	1
(c)	3	4	2	1
(d)	1	2	3	4

Manipal-2016, BCECE-2014

Ans. (a)

Colum-I	**Colum-II**
Polycyclic aromatic hydrocarbons	Carcinogens
Dioxins	Waste incineration
IR active molecules	Global warming
Peroxy acetyl nitrate	Photochemical

84. Which one of the following gases is reported to retard photosynthesis?

(a) CO (b) CFCs

(c) CO_2 (d) NO_2

[JEE Main-2021, 20 July Shift-II]

Ans. (d) : NO_2 gas is reported to retard photosynthesis as its higher concentrating damage the leaves of plants and retard the rate of photosynthesis:

- NO_2 is a lung irritant that can lead to an acute respiratory disease in children.
- It is also toxic to living tissues.
- Also, it is harmful to various textile fibres and metals.

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85. The gas 'A' is having very low reactivity reaches to stratosphere. It is non-toxic and non-flammable but dissociated by UV-radiations in stratosphere. The intermediates formed initially from the gas 'A' are

(a) $Cl\dot{O}+\dot{C}CF_2Cl$ (b) $Cl\dot{O}+C\dot{H}_3$

(c) $\dot{C}H_3+C\dot{F}_2Cl$ (d) $\dot{C}l+C\dot{F}_2Cl$

[JEE Main-2021, 27 Aug Shift-I]

Ans. (d) : In stratosphere, CFCs get broken down by powerful UV radiation releasing $\dot{C}l$,

$$CF_2Cl_2(g)\xrightarrow{UV}\dot{C}l(g)+CF_2\dot{C}l(g)$$

86. Match List I with List - II

	List-I (Compound)		**List II (Effect/affected species)**
A.	Carbon monoxide	1.	Carcinogenic
B.	Sulphur dioxide	2.	Metabolised by pyrus plants
C.	Polychlorinated biphenyls	3.	Haemoglobin
D.	Oxides of nitrogen	4.	Stiffness of flower buds

Choose the correct answer from the options given below :

	A	**B**	**C**	**D**
(a)	III	IV	I	II
(b)	IV	I	III	II
(c)	I	II	III	IV
(d)	III	IV	II	I

[JEE Main-2021, 27 July Shift -II]

Ans. (a):

List-I	**List-II**
Carbon monoxide	Hemoglobin
Sulphur dioxide	Stiffness of flower buds
Polychlorinated biphenyls	Carcinogenic
Oxides of nitrogen	Metabolised by pyrus plants.

87. Given below are two statements. One is labelled as Assertion (A) and the other is labelled as Reason (R).

Assertion (A) Photochemical smog causes cracking of rubber.

Reason (R) Presence of ozone, nitric oxide, acrolein,

formaldehyde and peroxyacetyl nitrate in photochemical smog makes it oxidizing.

Choose the most appropriate answer from the options given below.

(a) Both (A) and (R) are true but (R) is not the correct explanation of (A)

(b) Both (A) and (R) are true and (R) is the correct explanation of (A)

(c) (A) is false but (R) is true

(d) (A) is true but (R) is false

[JEE Main-2021, 26 Aug Shift-II]

Ans. (b) : Photochemical smog causes cracking of rubber, the common component of photochemical smog are ozone, nitric oxide, acrolein, form aldehyde and peroxyacetyl nitrate (PAN).

88. Water sample is called cleanest on the basis of which one of the BOD values given below

(a) 11 ppm (b) 15 ppm

(c) 3 ppm (d) 21 ppm

[JEE Main-2021, 1 Sep Shift-II]

Ans. (c): Biological Oxygen Demand (BOD) is difined as the amount of dissolved oxygen required by aerobic microrganisms to breakdown the organic materials.

Note- Clean water could have BOD value of less than 5 ppm while highly polluted water have BOD value of 17 pmm or more

89. BOD values (in ppm) for clean water (A) and polluted water (B) are expected respectively

(a) $A > 50, B < 27$ (b) $A > 25, B < 17$

(c) $A < 5, B > 17$ (d) $A > 15, B > 47$

[JEE Main-2021, 31 Aug Shift-I]

Ans. (c): BOD value of clean water (A) is less than 5.

It means $A < 5$.

And, BOD values of polluted waste water (B) is greater than 17 ppm.

It means– $B > 17$

90. Which one of the following statements is not correct?

(a) Eutrophication indicates that water body is polluted

(b) The dissolved oxygen concentration below 6 ppm inhibits fish growth

(c) Eutrophication leads to increase in the oxygen level in water

(d) Eutrophication leads to anaerobic conditions

[JEE Main-2021, 27 July Shift-I]

Ans. (c): Eutrophication is when the environment becomes enriched with nutrients. This can be problem in marine because habitats such as lakes can cause algal blooms. Some algae even produce toxins that harmful to higher forms of life. This can cause a decrease of oxygen levels in the lake or pond which can cause problems along the food chain and affect any animal that feeds on them.

Statement (c) in context of Eutrophication is not correct.

91. Given below are two statements

Statements-I Non-biodegradable wastes are generated by the thermal power plants.

Statement-II Bio-degradable detergents leads to eutorphication. In the light of the above statements, choose the most appropriate answer from the option given below

(a) Both statements I and II are false.

(b) Statement I is true but statement II is false

(c) Statement I is false but statement II is true

(d) Both statements I and II are true

[JEE Main-2021, 18 March Shift-II]

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Ans. (d): Both statements I & II are true.

- Non-biodegradable waste are generated by thermal power plants that is fly ash. Fly ash is a waste byproduct material generated from thermal power plants by the combustion of polarized coal.
- Detergents which are bio-degradable leads to eutrophication that kills animal life by deprieving it of oxygen

92. Which of the following statement(s) is (are) incorrect reason for eutrophication?

A. Excess usage of fertilisers

B. Excess usage of detergents

C. Dense plant population in water bodies.

D. Lack of nutrients in water bodies that prevent plant growth

Choose the most appropriate answer from the options given below.

(a) Only A (b) Only C

(c) B and D (d) Only D

[JEE Main-2021, 17 March Shift-II]

Ans. (d): Lack of nutrients in water bodies that prevent plant growth is incorrect reason for eutrophication.

The process in which nutrient enriched water bodies support a dense plant population. Which kills animal life by depriving oxygen and results in subsequent loss of biodiversity is known as eutrophication.

93. Given below are two statements.

Statement-I The value of the parametere 'Biochemical Oxygen Demand (BOD)' is important for survival of aquatic life.

Statement-II The optimum value of BOD is 6.5 ppm. In the light of the above statements, choose the most appropriate answer from the options given below.

(a) Statement I is false but statement II is true

(b) Both statements are true

(c) Statement I is true but statement II is false

(d) Both statements are false

[JEE Main-2021, 24 Feb Shift-II]

Ans. (c): Clean water would have BOD value of less than 5ppm whereas highly polluted water could have a BOD value of 17ppm or more.

Hence, the value of parameter 'BOD' is important for survival of aquatic life but optimum value of BOD is 17ppm or more.

So, statement II is incorrect.

94. Identify the structure of the compound responsible for Bhopal disaster:

(a) $H_3C-C\equiv N$ (b) $H_3C-N=C=O$

(c) $N\equiv C-O-CH_3$ (d) $H_3C-N^+\equiv C^-$

AP-EAPCET 23-08-2021 Shift-I

Ans. (b) : For Bhopal disaster more than 40 tons of methyl isocyanate gas leaked from a pesticide plant.

The structure of methyl isocyanate is-

$H_3C-N=C=O$

95. The type of pollution that gets increased during the day time and in the presence of O_3 is:

(a) Reducing smog (b) Oxidizing smog

(c) Acid rain (d) Global warming

JEE Main-16.03.2021, Shift-I

Ans. (b): The following reaction takes place-

$$\underset{\text{Nitric oxide}}{NO}+\frac{1}{2}O_2\longrightarrow NO_2$$

$$NO+\underset{\text{Ozone}}{O_3}\longrightarrow NO_2+O_2$$

$$\underset{\text{Nitrogen dioxide}}{NO_2}\xrightarrow{hv}NO+[O]$$

$$O+O_2\longrightarrow O_3$$

In presence of ozone (O_3), oxidizing smog gets increased during the day time because automobile and factories produce main components and factories produce main components of the photochemical smog (oxidizing smog) result from the action of sunlight on unsaturated hydrocarbon and nitrogen oxide.

96. The gas released during anaerobic degradation of vegetation may lead to :

(a) Acid rain

(b) Global warming and cancer

(c) Corrosion of metals

(d) Ozone hole

JEE Main-24.02.2021, Shift-I

Ans. (b): During the anaerobic degradation of vegetation, CH_4 gas is evolved which is responsible for global warming and cancer.

97. Which among the following has the highest concentration of PAN?

(a) Acid Rain (b) Photochemical Smog

(c) Reducing Smog (d) Ozone

AP-EAPCET 19-08-2021, Shift-II

Ans. (b) : The main component of photochemical smog is peroxyacetyl nitrate (PAN). The other component are ozone. nitric oxide, acrolein and formaldehyde.

98. Match following :

Pollutants	**Effects**
(a) Chloro fluro carbon	(i) BOD level of water increases
(b) Methane in air	(ii) Acid rain
(c) Synthetic detergents in water	(iii) Global warming
(d) Nitrogen oxides in air	(iv) Depletion of ozone layer

(a) (a – iii), (b – iv), (c – i), (d – ii)

(b) (a – iv), (b – iii), (c – i), (d – ii)

(c) (a – iv), (b – ii), (c – i), (d – iii)

(d) (a – iii), (b – ii), (c – i), (d – iv)

AP- EAPCET- 07-09-2021, Shift-I

Ans. (b) :

(a) Chlorofluorocarbon depletion of ozone (O_3) layer

(b) Methane in air cause global warming

(c) Synthetic detergents in water effect BOD level of water increases

(d) Nitrogen oxides in air causes acid rain

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99. Match List-I with List-II

	List I		List- II
(A)	$2SO_{2(g)} + O_{2(g)} \rightarrow 2SO_{3(g)}$	(i)	Acid rain
(B)	$HOCl_{(g)} \xrightarrow{hv} OH + Cl$	(ii)	Smog
(C)	$CaCO_3 + H_2SO_4 \longrightarrow CaSO_4 + H_2O + CO_2$	(iii)	Ozone depletion
(D)	$NO_{2(g)} \xrightarrow{hv} NO_{(g)} + O_{(g)}$	(iv)	Tropospheric pollution

Choose the correct answer from the options given below :

(a) (A)-(iii), (B)-(ii), (C)- (iv), (D)- (i)
(b) (A)-(i), (B)-(ii), (C)- (iii), (D)- (iv)
(c) (A)-(ii), (B)-(iii), (C)- (iv), (D)- (i)
(d) (A)-(iv), (B)-(iii), (C)- (i), (D)- (ii)

NEET-2021

Ans. (d):

List-I	List-II
$2SO_2(g) + O_2(g) \rightarrow 2SO_3\ (g)$	Troposphoric pollution
$HOCl\ (g) \xrightarrow{hv} \dot{O}H + \dot{C}l$	Ozone depletion
$CaCO_3H_2SO_4 \rightarrow CaSO_4 + H_2O + CO$	Acid rain
$NO_2\ (g) \xrightarrow{hv} \dot{N}O(g) + \dot{O}(g)$	Smog

100. Which of the following is not correct about carbon monoxide?

(a) It forms carboxyhaemoglobin
(b) It reduces oxygen carrying ability of blood
(c) The carboxyhaemoglobin (haemoglobin boud to CO) is less stable than oxyhaemoglobin
(d) It is produced due to incomplete combustion

NEET-2020

Ans. (c)

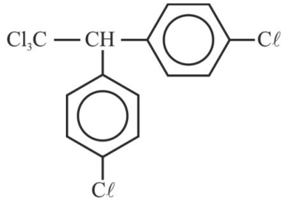
- When Co (Carbonmonoxide) combine with hemoglobin it produced carboxyhaemoglobin.
- Carboxyhaemoglobin reduce the oxygen carrying ability of blood.
- Oxyhaemoglobin is 300 times less stable then carboxyhaemoglobin.
- Carbonmonoxide produce due to incomplete combustion.

101. The insecticide DDT is considered as ....

(a) greenhouse gas
(b) biodegradable pollutant
(c) non-biodegradable pollutant
(d) a fertiliser

AP EAMCET (Engg.) 17.09.2020 Shift-I

Ans. (c) : The insecticide, DDT is consider as non-biodegradable pollutant.



DDT

DDT, plastic, polythene, bags, insecticides, pesticides, mercury, lead, arsenic, metal articles like aluminium cans, synthetic fibers, glass objects, iron products, and silver foils are non biodegradable pollutants.

102. Biochemical oxygen demand (BOD) is the amount of oxygen required (in ppm)

(a) for the photochemical breakdown of waste present in 1 m^3 volume of a water body.
(b) for sustaining life in a water body.
(c) by anaerobic bacteria to breakdown inorganic waste present in a water body.
(d) by bacteria to breakdown organic waste in a certain volume of a water sample

[JEE Main-2020 Jan Shift-II]

Ans. (d): Biochemical Oxygen Demand (BOD) is the amount of oxygen required (in ppm) by bacteria to breakdown organic waste in a certain volume of a water sample.

103. Among the gases (A)-(E), the gases that cause greenhouse effect are :

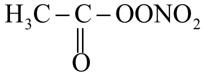
(A) CO_2 **(B) H_2O**
(C) CFCs **(D) O_2**
(E) O_3

(a) (A), (B), (C) and (D)
(b) (A) and (D)
(c) (A), (B), (C) and (E)
(d) (A), (C), (D) and (E)

[JEE Main-2020, 8 Jan Shift-I]

Ans. (c) : $CO_2, H_2O, CFCs, O_3$ are the gases that cause green house effect.
O_2 is not green out gases hence it is not causes green house effects.

104. The compound that is not a common component of photochemical smog is

(a) CF_2Cl_2 (b)

$H_3C-\underset{\underset{O}{\|}}{C}-OONO_2$

(c) $CH_2 = CHCHO$ (d) O_3

[JEE Main-2019, 12 Jan Shift-II]

Ans. (a): Among the given chlorofluorocarbons (CF_2Cl_2) are the compounds that are responsible for ozone depletion which degrades ozone into molecular oxygen. It is not a components of photochemical smog.

105. Which is wrong with respect to our responsibility as a human being to protect our environment?

(a) Restricting the use of vehicles
(b) Avoiding the use of floodlighted facilities
(c) Setting up compost tin in gardens
(d) Using plastic bags

[JEE Main-2019, 8 April Shift-I]

Ans. (d): Using plastic bags, a non-biodegradable pollutant, is wrong w.r.t. our responsibility as a human being to protect our environment.

- As a residents of planet of Earth, humans have a responsibility to take care of the natural environment.
- Our Cognitive ability & understanding of nature obliges us to maintain the integrity of the environment.

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106. A water sample has ppm level concentration of the following metals: Fe = 0.2; Mn = 5.0; Cu = 3.0; Zn = 5.0. The metal that makes the water sample unsuitable for drinking is

(a) Cu (b) Fe
(c) Mn (d) Zn

[JEE Main-2019, 9 Jan Shift-I]

Ans. (c): According to the question, Mn with concentration 5 ppm makes the water sample unsuitable for drinking as it must be 0.05 ppm.

Permissible concentration of following Metals in Drinking water:-

Metal		**Maximum Concentration (ppm)**
Zn	....	5·0
Fe	....	0·2
Mn	**.......**	**0·05**
Cu	....	3·0
Al	....	0·2
Cd	....	0·005

107. The condition for methemoglobinemia by drinking water is

(a) > 50 ppm nitrate (b) > 50 ppm chloride
(c) > 50 ppm lead (d) > 100 ppm sulphate

[JEE Main-2019, 9 Jan Shift-II]

Ans. (a): The concentration of nitrate > 50 ppm in drinking water caused methemoglobinemia which is blood disordes in which an abnormal amount of methemoglobin is produced.

108. Water filled in two glasses A and B have BOD values of 10 and 20, respectively. The correct statement regarding them, is

(a) A is more polluted than B
(b) A is suitable for drinking, whereas B is not
(c) Both A and B are suitable for drinking
(d) B is more polluted than A

[JEE Main-2019, 10 Jan Shift-I]

Ans. (d): The glasses 'A' & 'B' have BOD values '10' & '20', respectively.

Hence 'glass 'B' is more polluted than glass 'A'.

As we learnt in BOD:–
3–5 ppm is clean
6–19 ppm is polluted

109. Peroxyacetyl nitrate (PAN), an eye irritant is produced by

(a) organic waste (b) acid rain
(c) classical smog (d) photochemical smog

[JEE Main-2019, 11 Jan Shift-I]

Ans. (d): Peroxyacetyl nitrate (PAN), an eye irritant is produced by the photochemical smog.

- In photochemical smog, photo means light & smog are a mixture of smoke & fog.
- In the morning hours, the NO & hydrocarbon level increases followed by an increase in the nitrogen dioxide.

110. Water samples with BOD values of 4 ppm and 18 ppm, respectively, are

(a) clean and clean
(b) highly polluted and clean
(c) highly polluted and highly polluted
(d) clean and highly polluted

[JEE Main-2019, 12 Jan Shift-I]

Ans. (d): Water samples with BOD values of 4ppm & 18 ppm are clean and highly polluted respectively.

- The amount of oxygen required by bacteria to break down the organic matter present in a certain value of x sample of water is called chemical oxygen demand (BOD).

111. Match column-I with column-II and select the correct option.

Column-I (Pollutant)	**Column-II (Source)**
(A) Microorganisms	**1.Chemical Fertilizers**
(B) Plant nutrients	**2. Abandoned Coal mines**
(C) Sediments	**3. Domestic Sewage**
(D) Mineral acids mining	**4. Erosion of soil by strip**

(a) A-3, B-1,C-4,D-2 (b) A-2,B-4,C-3,D-1
(c) A-1,B-3,C-2,D-4 (d) A-4,B-2,C-1,D-3

COMEDK-2017

Ans. (a):

Column-I (pollutant)	**Column-II (Source)**
Microorganism	Domestic sewage
Plant nutrients	Chemical fertilizers
Sediments	Erosion of soil by strip
Mineral acids mining	Abandoned coal mines.

112. A water sample has ppm level concentration of following anions :

$$F^- = 10,\ SO_4^{2-} = 100,\ NO_3^- = 50$$

The anion/anions that make/makes the water sample unsuitable for drinking is/are

(a) Only NO_3^- (b) Both SO_4^{2-} and NO_3^-
(c) Only F^- (d) Only SO_4^{2-}

JEE Main-2017

Ans. (c): The permissible limit of F^- in drinking water is up to 1ppm. Hence, excess of concentration of F^- in the given sample of water makes it unsuitable for drinking.

- Excess concentration of $F^- >$ 1ppm causes decay of bones.

113. DDT is

(a) 2,2-di(p-chlorophenyl)-1, 1,1-trichloroethane
(b) 2,2-di(m-chlorophenyl)-1,1,1-trichloroethane
(c) 2,2-di(o-chlorophenyl)- 1,1,1-trichloroethane
(d) 2,2-di(p-chlorophenyl)- 1,1,1-trichloroethane

AMU-2016

Ans. (a): The IUPAC name of DDT is 2,2-di(p-chlorophenyl)-1, 1,1-trichloroethane

- DDT or dichlordiphenyl trichloerothane, is a chemical compund with formula $C_{14}H_9Cl_5$.
- Under STP, the chemical compound exists as a colour less & tasteless crytalline solid.

@apna_pdf

114. The concentration of fluoride, lead nitrate and iron in a water sample from an underground lake was found to be 1000 ppb, 40 ppb, 100 ppm and 0.2 ppm, respectively. This water is unsuitable for drinking due to high concentration of

(a) lead
(b) nitrate
(c) iron
(d) fluoride

JEE Main-2016

Ans. (b):

Concentration of Fluoride $=1000\text{ppb}=\frac{1000}{1000}=1\text{ppm}$

Concentration of Lead = 40ppb$=\frac{40}{1000}\text{ppm}=0\cdot04\text{ppm}.$

Concentration of Nitrate = 100 ppm.

We can see that concentration of nitrate is maximum.

- Concentration of nitrate > 40 ppm gives blue body syndrome disease.

Hence, this water is unsuitable for drinking due to the high concentration of nitrate.

115. Match the Column I and Column II and pick the correct matching from the codes given below.

Column-I	Column-II
A. Peroxy acetyl nitrate	1. Waste incineration
B. Polycyclic aromatic	2. Global warming
C. Dioxins	3. Photochemical smog
D. Indigo	4. Carcinogens
E. IR active molecules	5. Vat dye

	A	B	C	D	E
(a)	3	4	1	5	2
(b)	1	2	3	4	5
(c)	3	5	1	2	4
(d)	5	3	1	2	4

Manipal-2016

Ans. (a) : Photochemical Smog–Photochemical smog consist of primary and secondary pollution's. Secondary pollutants consist of PAN and ozone.

Carcinogenicity–Aromatic hydrocarbons containing two or more fused ring are called polycyclic aromatic hydrocarbons. Methoxy in these compounds give rise to carcinogenicity.

Dioxins–Dioxins are a group of chlorinated organic compounds that are formed in waster incineration.

Indigo–Indigo is a vat dye. Dyeing with indigation was carried out in the wooden vats in the form of water soluble indigotin white.

IR Active–IR active molecules such as HCl, CO and NO absorb the radiation from the infrared region and causes global warming.

116. Assertion: Suspended particulate matter (SPM) is an important pollutant released by diesel vehicles.

Reason: Catalytic converters greatly reduce pollution caused by automobiles.

(a) If both Assertion and Reason are correct and the Reason is the correct explanation of Assertion.
(b) If both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.
(c) If Assertion is correct but Reason is incorrect.
(d) If both the Assertion and Reason are incorrect.

[AIIMS-2015]

Ans. (b): Suspended particular matter (SPM) is an important pollutant released by diesel vehicles. It have particles with a diameter below 10μm. SPM is generated from natural sources such as volcanoes or dust stroms and human activities such as vehicles, industrial plants etc. Catalystic converter is filters in the vehicle which convert nitrogen oxides (NO_x) to nitrogen and reduce potential hazards of nitrogen oxides.

117. When heat rays are reflected from Earth, gases like Carbon dioxide, Nitrous oxide do not allow them to escape back to the space causing our planet to heat up. These gases are known as:

(a) Noble gas
(b) Green-house gas
(c) Hot gas
(d) Blue gas

NDA (I)-2015

Ans : (b) : Green house gases allow the incoming sunlight to pass through the atmosphere, but the heat of sunlight get trapped due to these green house gases such as carbon dioxide, nitrous oxide etc.

118. Which of the following statements are correct?

(A) Ocean is sink for CO_2.
(B) Greenhouse effect causes lowering of temperature of earth's surface.
(C) To control CO emission by automobiles usually catalytic convertor are fitted into exhaust pipes.
(D) H_2SO_4, herbicides and insecticides form mist.

(a) C and D
(b) A and B
(c) B and D
(d) A and D

AP-EAMCET (Engg.) 2015

Ans. (d) : Ocean is sink for CO_2 because the microscopic marine algae and bacteria play a huge role in the world's. H_2SO_4, herbicides and insecticides form mist.

119. The gas leaked from a storage tank of the Union Carbide plant in Bhopal gas tragedy was

(a) Methylisocyanate
(b) Methylamine
(c) Ammonia
(d) Phosgene

JEE Main-2013

Ans. (a): Methyl isocyanate ($CH_3–N = C = O$) gas was leaked from the storage tank of the union carbide plant in Bhopal gas tragedy.

120. Freon, culprits in depletion of ozone layer are industrially produced from

(a) CF_4
(b) CH_2Cl_2
(c) Hexachlorobenzene
(d) $CHCl_3$ and CCl_4

SCRA-2012

Ans. (b) : The chlorofluorocarbons is also known by Freon- The Freon are product by chloroform and carbon tetrachloride which is given as:

@apna_pdf

$$\underset{\text{Chloroform}}{CHCl_3} + 2HF \rightarrow \underset{\text{Chlorodifluoromethane}}{CHCl_2F_2} + 2HCl$$

Freon-1, 2, CCl_2F_2 is prepared from CCl_4 by reaction with HF.

$$\underset{\text{Carbontetrachloride}}{CCl_4} + 2HF \rightarrow \underset{\text{Dichlorodifluoromethane}}{CCl_2F_2} + 2HCl$$

121. What is DDT among the following?

(a) Green house gas

(b) A fertilizer

(c) Biodegradable pollutant

(d) Non-biodegradable pollutant

AIEEE-2012

Ans. (d): DDT (Dichlorodiphenyltrichloroethane) is a non-biodegradable pollutant.

Ex:- DDT, plastics, polythene, bags, insecticide, pesticides, mercury, lead, arsenic etc.

122. Which of the following oxides finally dissolve in water to cause acid rain?

(a) NO, NO_2 (b) NO_2, SO_2

(c) NO_3, SO_3 (d) N_2O_5, SO_3

AP - EAMCET(MEDICAL) - 2009

Ans. (b) : The following reaction occur during the process–

$$\underset{\substack{\text{nitrogen}\\\text{dioxide}}}{NO_2} + H_2O \longrightarrow \underset{\text{nitric acid}}{HNO_3} + \underset{\text{nitrous acid}}{HNO_2}$$

And,

$$\underset{\substack{\text{sulphur}\\\text{dioxide}}}{SO_2} + H_2O \longrightarrow \underset{\text{sulfuric acid}}{H_2SO_4}$$

123. Which of the following is secondary pollutant?

(a) CO_2 (b) N_2O

(c) PAN (d) SO_2

JIPMER-2006

Ans. (c) : Secondary pollutants are type of pollutant that is farmed in the atmosphere from the combustion of primary pollutants.

Here, PAN (Peroxyacetyl nitrate) is secondary pollutant.

124. The substance which is not regarded as a pollutant?

(a) NO_2 (b) CO_2

(c) O_3 (d) Hydrocarbons

[BITSAT-2005]

Ans. (b): CO_2 is generally not regarded as pollutant.

- A pollutant is a substance that is present in concentrations that may harm orgnisms or exceed an environmental quality standard.
- These can be both naturally forming or anthropognic in origin.

4. Layer of Atmosphere

125. Which of the following is responsible for depletion of the ozone layer in the upper strata of the atmosphere?

(a) Polyhalogens (b) Ferrocenes

(c) Fullerenes (d) Freons

JCECE - 2008

NEET-2004

UPTU/UPSEE-2007

Ans. (d): Freons are chlorofluorocarbons and are responsible for depletion of ozone layer in the upper strata of the atmosphere.

126. Identify the wrong statements in the following

(a) Chlorofluorocarbons are responsible for ozone layer depletion

(b) Green house effect is responsible for global warming

(c) Ozone layer does not permit infrared radiation from the sun to reach the earth

(d) Acid rain is mostly because of oxides of nitrogen and sulphur

[BITSAT-2014]

AIEEE-2008

Ans. (c) : Ozone layer permit infrared radiation from the sun to reach the earth. It absorbs Ultra voilet (UV) radiation.

127. In stratosphere most of the ozone formation is assisted by

(a) cosmic rays (b) γ-rays

(c) ultaviolet radiations (d) visible radiations

[JEE Main-2021, 27 Aug Sbift-II]

Ans. (c) : Ozone in stratosphere is a product of UV radiations acting on dioxygen (O_2) molecules.

$$O_2(g) \xrightarrow{UV} \dot{O}(g) + \dot{O}(g)$$

$$O(g) + O_2(g) \overset{UV}{\rightleftharpoons} \underset{\text{(Ozone)}}{O_3(g)}$$

128. In winter season of Antarctica, the depletion of ozone layer by the radical species ClO is mainly due to the formation of

(a) Polar troposphere clouds

(b) Polar stratospheric clouds

(c) Polar mesospheric clouds

(d) Methane

TS EAMCET-10.08.2021, Shift-I

Ans. (b) : The severe depletion of the Antarctic ozone layer known as the "ozone hole" occurs because of the special atmospheric and chemical conditions that exist there and nowhere else on the globe. The very low winter temperatures in the Antarctic stratosphere cause polar stratospheric clouds (PSCs) to form.

- The clouds are responsible for chemical changes that promote production of chemically active chlorine and bromine. This chlorine and bromine activation then leads to rapid ozone loss when sunlight returns to Antarctica in September and October of each year, which then result in the Antarctic ozone hole.

129. The statement that is not true about ozone is

(a) In the stratosphere, CFCs release chlorine free radicals (Cl), which reacts with O_3 to give chlorine dioxide radicals

(b) In the atmosphere, it is depleted by CFCs

(c) In the stratosphere, it forms a protective shield against UV radiation.

(d) It is a toxic gas and its reaction with NO gives NO_2

[JEE Main-2020, 2 Sep Shift-I]

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Ans. (a): In the stratosphere, CFCs release chlorine radical ($\dot{Cl}$)

$$CF_2Cl_2(g)\xrightarrow{UV}\dot{Cl}(g)+\dot{C}F_2Cl(g)$$

which react with O_3 to give chlorine oxide (ClO) radical not chlorine dioxide (ClO_2) radical.

$$Cl(g)+O_3(g)\longrightarrow \dot{Cl}O(g)+O_2(g)$$

130. Ozone in stratosphere is depleted by

(a) CF_2Cl_2 (b) C_7F_{16}

(c) $C_6H_6Cl_6$ (d) C_6F_6.

COMEDK-2019

Ans. (a) : Ozone in stratosphere is depleted by CF_2Cl_2 . They are used as coolants in refrigerators, coolers etc. The CFCs cause the breaking of the ozone molecule which forms the oxygen radical and O_2. The depletion of the ozone layer results in the penetration of the harmful UV radiations from the sun into the Earth's atmosphere.

131. The reaction that is not involved in the ozone layer depletion mechanism in the stratosphere is

(a) $CH_4 + 2O_3 \rightarrow 3CH_2 = O + 3H_2O$

(b) $Cl\dot{O}(g)+O(g)\longrightarrow\dot{Cl}(g)+O_2(g)$

(c) $HOCl(g)\xrightarrow{hn}\dot{O}H(g)+\dot{Cl}(g)$

(d) $CF_2Cl_2(g)\xrightarrow{hn}\dot{Cl}(g)+\dot{C}F_2Cl(g)$

[JEE Main-2019, 10 Jan Shift-II]

Ans. (a) : Reactions involved in the ozone layer depletion mechanism is as follows:-

$$O_2\xrightarrow{UV}O(g)+O(g)$$

$$O_2(g)+O(g)\longleftrightarrow O_3(g)$$

$$CF_2Cl_2(g)\xrightarrow{UV}Cl(g)+CF_2Cl(g)$$

$$Cl(g)+O_3(g)\longrightarrow ClO(g)+O_2(g)$$

$$ClO(g)+O(g)\longrightarrow Cl(g)+O_2(g)$$

Therefore it is clear to the above reaction CH_4 is not responsible for ozone layer depletion.

132. The layer of atmosphere between 10 km to 50 km above the sea level is called as

(a) stratosphere (b) mesosphere

(c) thermosphere (d) troposphere

[JEE Main-2019, 9 April, Shift-II]

Ans. (a) : The layer of atmosphere between 10 km to 50 km above the sea level is called as stratosphere.

- Ozone lays lies in the stratosphere.
- Stratasphere holds 19% of atmosphere's gases.

133. The regions of the atmosphere, where clouds form and where we live, respectively, are

(a) stratosphere and stratosphere

(b) troposphere and troposphere

(c) troposphere and stratosphere

(d) stratosphere and troposphere

[JEE Main-2019, 10 April, Shift-I]

Ans. (b) Troposphere is the lowest layer of our atmosphere. It extends upward from the ground to about 10 km above the sea level.

- Clouds formation & all whether of occurs hands humans live in this layer.

134. The upper stratosphere consisting of the ozone layer protects us from the sun's radiation that falls in the wavelength region of

(a) 600-750 nm (b) 400-550 nm

(c) 0.8-1.5 nm (d) 200-315 nm

[JEE Main-2019, 12 Jan Shift-II]

Ans. (d) : The ozone layer absorbs 97 to 99% of sun's medium frequencies ultraviolet light (from 200-315 nm wavelength).

135. Excessive release of CO_2 into the atmosphere results in

(a) formation of smog (b) depletion of ozone

(c) polar vortex (d) global warming

[JEE Main-2019, 9 April Shift-I]

Ans. (d) : Global warming is caused by the emission of greenhouse gases. 72% of the totally emitted greenhouse gases is CO_2. Therefore, excessive release of CO_2 is the main cause of global warming.

- CO_2 absorbs and emits infrared radiation at wavelengths of 4.26μm and 14.99 μm and consequently is a greenhouse gas that plays a significant role in influencing Earths surface temperature through the greenhouse effect.

136. Ozone layer of stratosphere requires protection from indiscriminate use of

(a) pesticides

(b) atomic explosions

(c) aerosols and high flying jets

(d) balloons

JCECE-2015

Ans. (c): Ozone layer of stratosphere requires protection from indiscriminate use of aerosols and high flying jets because aerosols and high flying jets release nitric oxide into the upper atmosphere which leads to the distruction of ozone layer.

137. Formation of ozone in the upper atmosphere from oxygen takes place by the action of

(a) Nitrogen oxides (b) Ultraviolet rays

(c) Cosmic rays (d) Free radicals

[BITSAT-2012]

Ans. (b) : Ozone is formed in the upper atmosphere from oxygen by the action of ultraviolet rays. Ozone can absorb UV light to reform oxygen. Thus, the ozone layer acts as a screen and prevents then harmful UV radiations from reaching the surface of earth.

- The "Ozone layer", approximately 6 to 30 miles above the Earth's surface.

138. The ozone layer forms naturally by

(a) The interaction of CFC with oxygen

(b) The interaction UV radiation with oxygen

(c) The interaction of IR radiation with oxygen

(d) The interaction of oxygen and water vapour

WB-JEE-2011

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Ans. (b): Stratospheric ozone is formed naturally through the interaction of solar ultraviolet (UV) radiation with molecular oxygen (O_2). The "ozone layer" approximately 6 to 30 miles above the Earth's surface. It reduces the amount of harmful UV radiation reaching the Earth's surface.

139. Which of the following statements about polar stratosphere clouds (PSCs) is not correct?

(a) PSCs do not react with chlorine nitrate and HCl

(b) Type I clouds are formed at about – 77°C and contain solid $HNO_3.3H_2O$

(c) Type II clouds are formed at about – 85°C and contain some ice

(d) A tight whirlpool of wind called Polar Vortex is formed which surrounds Antarctica

[BITSAT-2011]

Ans. (a) : Polar stratospheric clouds (PSCs) play a central role in the formation of the ozone hole in the Antarctic and Arctic. PSCs provide surfaces upon which heterogenous chemical reaction take place. PSCs react with chlorine nitrate and HCl to give HOCl and Cl_2.

140. Among the following compounds, which one is not responsible for depletion of ozone layer?

(a) CH_4 (b) $CFCl_3$

(c) NO (d) Cl_2

AP EAMCET-2008

Ans. (a) : In stratosphere, the following reaction take place which are responsible for depletion of ozone layers.

(i) $CF_2Cl_2 \xrightarrow{hv} \dot{C}F_2Cl + \dot{C}l$

$CFCl_3 \xrightarrow{hv} \dot{C}FCl_2 + \dot{C}l$

(ii) $\dot{C}l + O_3 \longrightarrow \dot{C}lO + O_2$

$\dot{C}lO + \dot{O} \longrightarrow \dot{C}l + O_2$

(iii) $\dot{N}O + O_3 \longrightarrow NO_2 + O_2$

Therefore, CH_4 is not responsible for ozone layer depletion.

141. In Antarctica ozone depletion is due to the formation of following compound:

(a) acrolein (b) peroxyacetyl nitrate

(c) SO_2 and SO_3 (d) chlorine nitrate

(e) formaldehyde

Kerala-CEE-2005

Ans. (d): CFCs is caused the depletion of ozone layer. Chlorine nitrate, which is found in the stratosphere in the reason of antarctica causes break down of the ozone layer.

In Antarctica ozone depletion is caused due to the formation of chlorine nitrate.

142. Identify the correct decreasing order of the following with respect to altitude from atmosphere.

I.Troposphere
II. Mesosphere
III. Thermosphere

(a) II, III, I (b) III, II, I

(c) I, II, III (d) I, III, II

AP EAMCET-2004

Ans. (b) : Atmosphere is divided into four category
(i) Troposphere (0 – 10 km)
(ii) Stratosphere (10 – 50 km)
(iii) Mesosphere (50 – 85 km)
(iv) Thermosphere (85----- km)
(v) Exosphere (700-10000 km)
Therefore, the order is
III > II > I

143. Which one of the following regions atmosphere contains ozone?

(a) Troposphere (b) Thermosphere

(c) Mesosphere (d) Stratosphere

AP-EAMCET (Medical), 2001

Ans. (d) : Most atmospheric ozone is concentrated in a stratosphere layer about 9 to 18 miles (10 to 50 km) above the Earth's surface. Ozone is a molecule that contains three oxygen atoms.

- Ozone layer protects us from the harmful ultraviolet ray.

144. Which one of the following is mainly responsible for depletion of ozone layer?

(a) Methane (b) Cabon dioxide

(c) Water (d) Chlorofluoro carbons

AP EAMCET (Engg.) 2001

Ans. (d) : CFCs (Chlorofluoro carbons) is responsible for the depletion of ozone layers. Gaseous CFCs can deplete the ozone layer when they slowly rise into the stratosphere, are broken down by strong ultraviolet radiation, release chlorine atoms, and then react with ozone molecules.

145. About 20 km above the earth, there is an ozone layer. Which one of the following statements about ozone and ozone layer is true?

(a) It is beneficial to us as it stops UV radiation.

(b) Conversion of O_3 to O_2 is an endothermic reaction

(c) Ozone is a triatomic molecule

(d) It is harmful as it stops useful radiation

NEET-1995

Ans. (a) : Ozone is an allotropic form of oxygen. It is present in the upper atmosphere (about 20 km above the surface of the earth). It is believed to be formed in the upper atmosphere by the action of UV-rays on oxygen as–

$3O_2 + \text{UV-rays} \rightarrow 2O_3 \quad \Delta H = 142.7 \text{ kJ mol}^{-1}$

There for UV-rays, which are harmful to human being are absorbed by oxygen to form ozone.

5. Green Chemistry

146. The acid that is believed to be mainly responsible for the damage of Taj Mahal is:

(a) Sulfuric acid (b) hydrofluoric acid

(c) phosphoric acid (d) hydrochloric acid

JEE Main-29.06.2022, Shift-I

@apna_pdf

Ans. (a) : The acid that is believed to be mainly responsible for the damage of Taj Mahal is sulphuric acid. It is produced by sulphur dioxide which is a air pollutant. When SO_2 comes in contact of atmospheric oxygen and water it gives sulphuric acid, which is a component of acid rain.

147. The greenhouse effect is because of the

(a) presence of gases, which in general are strong inferred absorbers, in the atmosphere
(b) presence of CO_2 only in the atmosphere
(c) pressure of O_3 and CH_4 in the atmosphere
(d) N_2O and chlorofluorohydrocarbons in the atmosphere

[BITSAT-2020, 2013]

Ans. (a) : In Earth, greenhouse gases trap heat in the atmosphere and warm the planet. The main gases responsible for the greenhouse effect include carbon dioxide, methane, nitrous oxide, and water vapour (which all occur naturally), and fluorinated gases.

The major causes of the greenhouse effect are:

- Deforestation
- Industrial waste and Landfills
- Global warming
- Acidification of water Bodies

148. Which of the following is not a green house gas?

(a) CFC (b) CO_2
(c) O_2 (d) NO_2

Karnataka-CET-2020
Assam CEE-2020
WB-JEE-2014

Ans. (c): Oxygen (O_2) is not a green house gas while CFC, CO_2, NO_2, SO_2, are major green house gases.

149. Which gas among the following has the maximum global warming potential?

(a) CO_2 (b) SF_6
(c) CH_4 (d) N_2O

AP EAPCET 23-08-2021 Shift-I

Ans. (b) : The maximum global warming potential is SF_6. CO_2 is a primary green house gas is used as the base for all the calculation. The order of maximum global warming is-

$$SF_6 > N_2O > CH_4 > CO_2.$$

150. The greenhouse gas/es is (are)

(A) carbon dioxide (B) oxygen
(C) water vapour (D) methane

Choose the most appropriate answer from the options given below.

(a) Only (A) and (C) (b) Only (A)
(c) (A), (C) and (D) (d) Only (A) and (B)

[JEE Main-2021, 16 March Shift-II]

Ans. (c): A green house gas is a gas that absorbs and emits radiant energy with in the thermal infrared range, causing the greenhouse effect.

The greenhouse gas/es is (are) water vapour, carbon dioxide (CO_2), methane (CH_4).

151. Which among the following is not a greenhouse gas?

(a) Nitrous oxide (b) Water vapour
(c) Sulphur dioxide (d) Methane

AP EAPCET 20.08.2021 Shift-I

Ans. (c) : Green house gases are carbon dioxide (CO_2), methane (CH_4), Water vapour, nitrogen oxides (NOx), CFCs and ozone.

Hence, its is clear that sulphur dioxide is not a green house gas.

- Greenhouse gases caused green house effect.

152. Greenhouse gases show their activity by confining in the air-zone of

(a) mesosphere (b) stratosphere
(c) troposphere (d) thermosphere

Tripura JEE-2019

Ans. (c): Green house gases show their activity by confining in the air-zone of upper troposphere, and increased concentration will reduce the amount of heat radiated up into the upper atmosphere (and into space) until Earth heats up.

153. Among the following, the one that is not a greenhouse gas is

(a) sulphur dioxide **(b) nitrous oxide**
(c) methane **(d) ozone**

NEET-2019

Ans. (a): Sulphur dioxide (SO_2) is not a green house gas.

- The primary green house gases in earth's atmosphere are water vapour, CO_2, CH_4, nitrous oxide & ozone.

154. Which one of the following is not a green house gas?

(a) Methane (b) Ozone
(c) Carbon dioxide (d) Nitrogen

J & K CET-(2011)

Ans. (d): A greenhouse gas is a gas that absorbs and emit radiant energy within the thermal infrared range causing the greenhouse effect.

Greenhouse gas in earth's atmosphere are water vapor (H_2O), carbon dioxide (CO_2) methane (CH_4), nitrous oxide (N_2O) and ozone (O_3).

155. Green house effect is caused by

(a) NO_2 (b) CO
(c) NO (d) CO_2

JCECE-2010

Ans. (d) : Green house gases cause the green house effect on planets. The primary green house gases in earth's atmosphere are water vapor (H_2O), carbon dioxide (CO_2), methane (CH_4), nitrogen oxide (N_2O), ozone (O_3) and CFC's.

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14.

The Solid State

1. Amorphous and Crystalline Solids

1. How many number of atoms are there in a cube based unit cell, having one atom on each corner and 2 atom on each body diagonal of cube ?

(a) 4 (b) 9

(c) 8 (d) 6

Karnataka CET-17.06.2022, Shift-II

Ans. (b) : Given,

One atom on each corner

two atom on each body diagonal

total = 4 × 2 = 8

At corner $= \frac{1}{8} \times 8 = 1$ atom.

total no. of atoms = 8 + 1 = 9

2. Which of the following is NOT true about the amorphous solids ?

(a) Amorphous solids can be moulded by heating

(b) They are anisotropic in nature

(c) On heating they may become crystalline at certain temperature

(d) They may become crystalline on keeping for long time.

Karnataka CET-17.06.2022, Shift-II

Ans. (b) : Amorphous solids are isotropic in nature because there is short range order and arrangement is irregular along all directions. The property remains the same in all direction. This property is known as isotropy.

3. Graphite is a

(a) molecular solid (b) covalent solid

(c) ionic solid (d) metallic solid

BITSAT-2015, JIPMER-2012

Ans. (b) : Graphite is a covalent solid. Each carbon atom is bonded into its layer with three strong covalent bonds. It is a good conductor of heat as well as good conductor of electricity.

4. Which is network solid from following?

(a) SiC (b) $I_2(s)$

(c) $CO_2(s)$ (d) $H_2O(s)$

GUJCET-2021

Ans. (a) : Any chemical compound in which covalent bonds bind the atoms in a continuous network extending throughout the material is called **network solid**, or **covalent network solid** or **atomic crystalline solid**. Silicon carbide (SiC) is a covalent network solid. The atoms of silicon are joined together with carbon atoms with the help of a covalent bond tetrahedral.

Note:- Silicon (Si), Boron nitride (BN), Quartz (SiO_2) Germanium (Ge) are other example of network solids.

5. If an element in group-2 formed a compound with an element in group 17 of the periodic table, the compound formed is likely to _____.

(a) Conduct electricity in the solid state

(b) have a low boiling point

(c) dissolve in non-polar solvents

(d) be a crystalline solid

AP-EAMCET 25-08-2021 Shift - I

Ans. (d) : Group-2 elements are metal and 17 group elements are nonmetal. Metal donates e^- form cation whereas non metal receives e^- form anion. So there are formation of ionic bond and ionic compound form a crystalline solid.

• Ionic compounds conduct electricity in molten state.

• Ionic compounds have high boiling point.

• Ionic compounds are soluble in polar solvent due to polar nature of the bond.

Ionic compounds come in classification of crystalline solid, so the compound formed is likely to be a crystalline solid.

6. Given below are two statements :

Statement I :

α and β forms of sulphur can change reversibly between themselves with slow heating or slow cooling.

Statement II :

At room temperature the stable crystalline form of sulphur is monoclinic sulphur.

In the light of the above statements, choose the correct answer from the options given below :

(a) Both Statement I and Statement II are true.

(b) Both Statement I and Statement II are false.

(c) Statement I is true but Statement II is false.

(d) Statement I is false but Statement II is true.

JEE Main 25.02.2021, Shift-II

Ans. (c) : α and β forms of sulphur can change reversibly between themselves with slow heating or slow cooling.

$$\alpha\text{-sulphur} \xrightleftharpoons[<369\text{ K}]{>369\text{ K}} \beta-\text{sulphur}$$

Monoclinic sulphur is also called β - sulphur or prismatic sulphur. It is stable only above 396K and changes into rhombic sulphur below this temperature.

Monoclinic sulphur is heated slowly in a evaporating dish till it melts.

The molten sulphur is then allowed to cool slowly. During the cooling process, a solid crust will be formed over the surface. As this crust is being formed, two holes are made in the crust. The molten sulphur is then poured out of these holes. The crust is then removed.

@apna_pdf

On the lower side of the crust, long needle-shaped crystals of monoclinic sulphur are formed.
The stable form of sulphur at room temperature is rhombic sulphur (α-sulphur).

7. Select the correct statements.
(A) Crystalline solids have long range order.
(B) Crystalline solids are isotropic.
(C) Amorphous solids are sometimes called pseudo solids.
(D) Amorphous solids soften over a range of temperatures.
(E) Amorphous solids have a definite heat of fusion.
Choose the most appropriate answer from the options given below.

(a) (A), (B), (E) only (b) (B), (D) only
(c) (C), (D) only (d) (A), (C), (D) only

[JEE Main 2021, 27 July Shift-II]

Ans. (d) :
(A) Crystalline solids have definite arrangement of constituents particles and have long range order. There is a regular pattern of arrangement of particals.
(C) Amorphous solid is also called pseudo solid.
(D) Different constituent particles of an amorphous solid have different bond strengths and soften over a range of temperatures.

8. Which of the following statements is true with regards to crystalline solids?

(a) Crystalline solids possess blunt melting points characteristic of absence of long range order.
(b) When cut or hammered gently, they break in an irregular manner.
(c) The mechanical properties depend upon the direction along which they are measured.
(d) They are isotropic in nature, having identical properties along all taxes.

J & K CET-(2019)

Ans. (c) : Properties of Crystalline solids.
(i) They have a definite shape and geometrical form.
(ii) They have sharp (definite) melting point.
(iii) They are rigid and incompressible.
(iv)They are anisotropic, i.e mechanical (physical) properties depend upon the direction along which they are measured. Rest all are not properties of crystalline solid.

9. Silicon carbide is example of

(a) molecular solid (b) metallic solid
(c) ionic crystal (d) covalent solid

JIPMER-2019

Ans. (d) : Silicon carbide (SiC) is covalent solid which is a subtype of crystalline solid. It is covalent solid since the atoms of silicon are connected with carbon through covalent bonds tetrahedrally.

10. Which among the following compounds in crystalline form is used for making Nicol's prism?

(a) $CaSO_4$ (b) Na_2AlF_6
(c) $CaCO_3$ (d) Al_2O_3

MHT CET-02.05.2019, SHIFT-III

Ans. (c) : A Nicol prism is a type of polarizer, an optical device made from calcite crystal used to produce and analyse plane polarized light. It is made in such a way that it eliminates one of the rays by total internal reflection.
Calcite crystal (i.e. calcium carbonate in crystalline form) is generally know as calc-spar and is used to produce and analyse plane polarised light.

11. Which among the following pairs of compounds is not isomorphous?

(a) $NaNO_3$ and $CaCO_3$
(b) K_2SO_4 and K_2SeO_4
(c) NaCl and KCl
(d) NaF and MgO

MHT CET-02.05.2019, SHIFT-III

Ans. (c) : Two crystal are said to be isomorphous-
• Both have the same space group and unit cell dimension.
• The type and position of atoms in both are the same NaCl and KCl have the same atomic ratio similar molecular formula and similar chemical properties.
But they have different crystal structure.

12. Which among the following solid is a non-polar solid?

(a) Hydrogen chloride
(b) Sulphur dioxide
(c) Water
(d) Carbon dioxide

MHT CET-2016

Ans. (d) : Non-polar solids have evenly distribution of electric charge across the molecule. Some example of non-polar solids are carbon dioxide, benzene, methane, diatomic gases (N_2, O_2, Cl_2) as we know non-polar compounds have symmetry that means all of the sides around the centre are identical. CO_2 is covalently bonded. Here carbon is the central atom and both sides around carbon atom is identical so it is a non-polar molecule.

13. Which one is not the property of crystalline solid?

(a) A definite and regular geometry
(b) High intermolecular forces
(c) Isotropic
(d) Sharp melting point

UPTU/UPSEE-2016

Ans. (c): We know that crystalline solids are solids that have closely packed atom and molecules. They are harder than amorphous solid and have a definite pattern. They show anisotropy and give more properties of solid than that by amorphous solids.

14. Consider the following for alumina:
1. In crystalline form, it exists in α and γ forms.
2. α form is the strongest and is known as corundum.
3. α form can be converted to γ form by heating at 1000°C.
Which of the above statements is/are correct?

(a) 1 only (b) 2 only
(c) 1 and 2 (d) 2 and 3

SCRA-2015

@apna_pdf

Ans. (c): Alumina (Al_2O_3) is a crystalline form and it exists in a α and γ form. α form is the strongest and is known as corundum.

15. Consider the following statements for $MgSO_4$
1. It crystallizes in a form with seven water molecules
2. Aqueous solution of $MgSO_4$ when treated with NaCl gives white precipitate.
Which of the above statement is/are correct?
(a) 1 only (b) 2 only
(c) Both 1 and 2 (d) Neither 1 nor 2

SCRA-2015

Ans. (c): (1) Magnesium sulfate heptahydrate, is a hydrous magnesium sulfate mineral with formula $MgSO_4.7H_2O$
(2) $MgSO_4$ is a crystalline solid in a form with seven water molecules. The colour of $MgSO_4$ is white crystalline solid, soluble in water.

16. Amorphous solids are characterized by property as
(a) isotropic (b) anisotropic
(c) sharp melting point (d) true solids

AMU-2015

Ans. (a) : Amorphous solids are isotropic i.e. they exhibit uniform properties in all directions. Amorphous solids have only short range order of arrangement. The structure of amorphous solids are similar to that of liquids. The thermal and electrical conductivity, coefficient of thermal expansion and refractive index of an amorphous solid have the same value in whatever direction.

17. Which one of the following has a different crystal lattice from those of the rest?
(a) Ag (b) V
(c) Cu (d) Pt
(e) Au

Kerala-CEE-2015

Ans. (b) : The crystal lattice is the symmetrical three-dimensional structural arrangements of atoms ions or molecules (constituent particle) inside a crystalline solid as points. So, Vanadium (V) crystallizes in BCC structures while silver (Ag), Copper (Cu), Platinum (Pt) and gold (Au) crystallize in CCP structures.

18. Which is the correct statement about solid?
(a) Very high compressibility
(b) Maximum intermolecular distance
(c) Definite mass but no definite volume
(d) Maximum intermolecular force of attraction

J & K CET-(2014)

Ans. (d) : Solid has maximum intermolecular force of attraction. In solid form, molecules are very tightly packed that there is very less intermolecular space and there is high intermolecular force of attraction. They have definite shape and volume and they are incompressible.

19. A crystalline solid X reacts with dil. HCl to liberate a gas Y. Y decolourises acidified $KMnO_4$. When a gas 'Z' is slowly passed into an aqueous solution of Y, colloidal sulphur is obtained X and Z could be respectively
(a) Na_2S, SO_3 (b) Na_2SO_4, H_2S
(c) Na_2SO_3, H_2S (d) Na_2SO_4, SO_2

Karnataka-CET-2014

Ans. (c) : X and Z could be Na_2SO_3, H_2S
Na_2SO_3 (Crystalline solid) reacts with dil. HCl to liberate SO_2.

$$\underset{X}{Na_2SO_3} + 2HCl(dil.) \rightarrow 2NaCl + SO_2\uparrow + H_2O$$

SO_2 decolourises acidified $KMnO_4$.

$$\underset{(Y)}{5SO_2} + 2KMnO_4 + 2H_2O \rightarrow K_2SO_4 + 2MnO_4 + 2H_2SO_4$$

When H_2S gas is slowly passed into an aqueous solution of SO_2 colloidal sulphur is obtained.

$$SO_2 + \underset{(Z)}{2H_2S} \rightarrow 2H_2O + 3S\downarrow$$

20. Which one of the following metals has a different lattice from those of the others?
(a) Fe (b) Co
(c) Ni (d) Cu
(e) Ag

Kerala-CEE-2013

Ans. (a) : Given metals in the option–
Co, Cu and Ag possess CCP (FCC) lattice at room temperature.
But Fe has BCC lattice at normal room temperature but it is changes into FCC lattice when temperature increases at 912°C.

21. Ionic solid are generally:
(a) good conductor of electricity
(b) soft
(c) volatile
(d) brittle

MPPET - 2012

Ans. (d) : Ionic solid are hard and brittle and have high melting and boiling point because ionic solid are composed of cations and anions by strong electrostatic forces. Ionic crystals having strong interaction between the ions (cation and anion)
It conducts electricity in molten state and aqueous form.

22. The property of crystalline solid is not
(a) anisotropic (b) isotropic
(c) hardness (d) denseness

CG PET- 2012

Ans. (b) : Crystalline solid shows anisotropic property not isotropic property.
Isotropic property are shown by amorphous solid, properties are same in all the direction.
Anisotropic property are shown by crystalline solid, properties are change in different directions.

23. Dry ice is
(a) Solid CO_2 (b) Solid camphor
(c) Solid SO_2 (d) Solid NO_2

JCECE - 2007

Ans. (a) : Dry ice is the common name of solid carbon dioxide (CO_2). It gets this name because it does not melt into a liquid when heated. Instead, it changes directly into a gas. It is used primary as cooling agent.

24. Which one of the following is amorphous?
(a) Polystyrene (b) Table salt
(c) Silica (d) Diamond

VITEEE- 2006

Ans. (a) : In Amorphous solid, constituent particle are not arranged in any regular fashion example –glass, rubber, quartz, polystyrene.

@apna_pdf

25. Crystalline form of silica is called:
(a) crystalline silicon (b) quartz
(c) rock (d) talc

UPTU/UPSEE-2006

Ans. (b) : Quartz is crystalline form of silica .It is most common form of crystalline silica and is the second most common mineral on the earth's surface.

26. Which one of the following allotropic forms of carbon is isomorphous with crystalline silicon?
(a) Graphite (b) Coal
(c) Coke (d) Diamond

AP-EAMCET (Medical), 2001

Ans. (d) : In crystalline silicon, all Si atom is bonded to four another Si atoms arranged tetrahedral as in diamond.

In crystallography, Crystals are described as isomorphous if they are closely similar in shape. Diamond and crystalline silicon are isomorphous because both have three dimensional tetrahedral structure.

Diamond and fullerence are pure forms of carbon.

27. Quartz is a crystalline variety of
(a) Sodium silicate (b) Silicon carbide
(c) Silicon (d) Silica

AP EAMCET- 1997

Ans. (d) : Quartz is a crystalline variety of silica. It is a covalent crystal having a framework of silicates or silica. It is a hard crystalline mineral composed of silica. It is a three-dimensional network where all the four oxygen atoms of each SiO_4 tetrahedron are shared.

28. For two ionic solids CaO and KI, identify the wrong statement among the following.
(a) CaO has high melting point.
(b) Lattice energy of CaO a much larger than that of KI.
(c) KI has high melting point.
(d) KI is soluble in benzene.

NEET-(1997)

Ans. (d) : (a) CaO has high melting point. It is true because the size of Ca is less than K.

(b) Lattice energy of CaO is much higher than that of KI. True because CaO is covalent in nature where as KI is ionic.

(c) KI has high melting point. It is true because lattice energy leads to high melting point.

(d) KI is insoluble in benzene. False because KI is ionic compound so it is not soluble in non polar solvent. (i.e. dipole moment (μ) for benzene = 0)

29. The Pure crystalline substance on being heated gradually first forms a turbid liquid at constant temperature and still at higher temperature turbidity completely disappears. The behaviour is a characteristic of substance forming
(a) Allotropic crystals
(b) Liquid crystals
(c) Isomeric crystals
(d) Isomorphous crystals

NEET-(1993)

Ans. (b) : Liquid crystals on heating firs become turbid and then on further heating turbidity completely disappears.

30. Glass a
(a) Liquid
(b) Solid
(c) Supercooled liquid
(d) Transparent organic polymer

NEET-(1991)

Ans. (c) : Glass is a supercooled liquid because glass is an amorphous solid have the tendency to flow but slowly.

31. Most crystals show good cleavage because their atoms, ions or molecules are
(a) weakly bonded together
(b) strongly bonded together
(c) spherically symmetrical
(d) arranged in planes.

NEET-(1991)

Ans. (d) : In crystals, the constituents are arranged in orderly pattern i.e. in plane. Thus they show good cleavage.

32. The ability of a substance to assume two or more crystalline structures is called
(a) Isomerism (b) polymorphism
(c) Isomorphism (d) amorphism

NEET-(1990)

Ans. (b) : The phenomenon of occurrence of a substance in two or more crystalline structure is called polymorphism. But the ability of two or more substance having the same crystal structure is called isomorphism.

2. Crystal Structure

33. Vacant space in body centered cubic lattice unit cell is about
(a) 23% (b) 46%
(c) 32% (d) 10%

Karnataka CET-17.06.2022, Shift-II

Ans. (c) : A body-centered unit cell structure consists of atoms arranged in a cube where each corner of the cube shares an atom and with one atom positioned at the center. If bcc structure efficiency is 68%. So, vacant space in body centered cubic lattice unit cell is about 32%.

34. A metal 'X' crystallises in a body centred cubic structure and its metallic radius is 346.4 pm. The length (in pm) of the unit cell is
(a) 200 (b) 800
(c) 600 (d) 500
(e) 400

Kerala CEE -03.07.2022

Ans. (b) : Given that,
Metal 'x' crystallizes is body centered cubic structure.
Radius (r) = 346.4 pm.
We know that –

$$\text{For bcc } = \frac{4r}{\sqrt{3}\,a}$$

$$a = \frac{4 \times 346.4}{\sqrt{3}}$$

$$= 799.076 = 800 \text{ pm.}$$

@apna_pdf

35. An element 'A' has face centred cubic structure with edge length of 361 pm. The radius of atom 'A' is:

(a) 127.6 pm (b) 180.5 pm
(c) 160.5 pm (d) 64 pm

CG PET-22.05.2022

Ans. (a) : Here, given element 'A' has face centred cubic structure.

Edge length = 361 pm

Then, for face centred cubic structure –

$$a\sqrt{2}=4r$$
$$361\sqrt{2}=4r$$
$$r=\frac{361\sqrt{2}}{4}=127.6\,\text{pm}$$

36. How many unit cells are present in a cubic shaped ideal crystal of NaCl of mass 1.0 g?

(a) 1.28×10^{21} unit cells
(b) 1.71×10^{21} unit cells
(c) 2.57×10^{21} unit cells
(d) 5.14×10^{21} unit cells

AP-EAPCET, 24.08.2021-Shift-I

CG PET -2019
UP CPMT-2013
JCECE - 2008
UPTU/UPSEE-2007
[AIEEE 2003]

Ans. (c) : NaCl has FCC structure, hence, n = 4 for NaCl.

Also number of atoms in 58.5g (1 mole) NaCl $= 6.023 \times 10^{23}$

∴ Number of unit cells present in 1 mol (58.5g)

$$\text{NaCl}=\frac{6.023\times10^{23}}{4}$$

and number of unit cells in 1g NaCl

$$=\frac{6.023\times10^{23}}{4\times58.5}$$

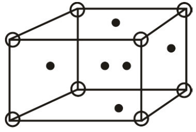
$= 2.57 \times 10^{21}$ unit cells

37. In FCC, the unit cell is shared equally by how many unity cells?

(a) 10 (b) 8
(c) 6 (d) 2

Karnataka-CET-2018, 2013
Manipal-2017
JIPMER-2007
NEET-2005

Ans. (c) : In a face–centered cubic lattice, consists of 6 faces so it is equally shared by 6 unit cell



38. Sodium atom crystallizes in bcc lattice with cell edge a=4.29Å, the radius of sodium atom is

(a) 18.6 Å (b) 1.86 Å
(c) 0.186 Å (d) 37.2 Å

AIIMS-2017
JEE MAIN-2015
Karnataka-CET-2015
CG PET- 2013

Ans. (b) : In a body – centered cubic lattice, atom touch along the body diagonal of cube Thus

$$4r=\sqrt{3}a$$
$$r=\frac{\sqrt{3}}{4}a$$

Edge length 'a' = 4.29 Å

$$r=\frac{\sqrt{3}\times4.29\,\text{Å}}{4}$$
$$r=\frac{1.732\times4.29\,\text{Å}}{4}$$
$$r=1.86\,\text{Å}$$

39. An ionic compound has a unit cell consisting of A ions at the corners of a cube and B ions the centres of the faces of the cube. The empirical formula for this compound would be

(a) AB (b) A_2B
(c) A_3B (d) AB_3

UP CPMT-2011
AIEEE-2005
(NEET-2000)

Ans. (d) : A atoms are at eight corners of the cube.

Therefore, the number of A atoms in a unit cell $=\frac{8}{8}=1$

B atoms are at the face centre of six faces.

Hence, its share in the unit cell $=\frac{6}{2}=3$.

Therefore, the formula of the compound is AB_3.

40. The number of atoms in a body centred cubic unit cell is

(a) 1 (b) 2
(c) 3 (d) 4

BITSAT-2017
UPTU/UPSEE-2016
AMU-2004

Ans. (b) : Since, the structure possesses 8 corner atoms and one body centre, the contribution will be

$=8\times\frac{1}{8}+1=2$ atoms per unit cell.

41. The metal that crystallises in simple cubic system is

(a) Po (b) Na
(c) Cu (d) Ag

MHT CET-2016
VITEEE- 2006

Ans. (a) : • Polonium (Po) is simple cubic structure.
• Sodium (Na) is Body centered cubic (bcc)
• Copper (Cu) and Silver (Ag) is face centered cubic (fcc) lattice.

@apna_pdf

42. A solid compound XY has NaCl structure. If the radius of the cation is 100 pm, the radius of the anion (Y^-) will be

(a) 275.1 pm (b) 322.5 pm
(c) 241.5 pm (d) 165.7 pm

VITEEE- 2012
NEET Mains-2011

Ans. (c) : Given:– radius of cation (r^+) = 100 pm

$$\text{Radius ratio} = \frac{\text{radius of cation }(r^+)}{\text{radius of anion }(r^-)}$$

We know that for NaCl like crystal

$$0.414 = \frac{100}{r^-}$$

$$\Rightarrow \quad r^- = 241.5 \text{ pm}$$

43. The number of atoms contained in a fcc unit cell of a monoatomic substance is

(a) 1 (b) 2
(c) 4 (d) 6

JIPMER-2012
(NEET-1993)

Ans. (c) : In the fcc or ccp arrangement. It has atoms at the corners as well as at the centre of each of the face. There is one atom at each of eight corners in this arrangement and each of them contributes one–eight to the unit cell, and one at each face centre of the cube and each of them contributed ½ to the unit cell.

The number of atoms present at corner $= \frac{1}{8} \times 8 = 1$

And the number of atoms present in face centre $= \frac{1}{2} \times 6 = 3$

∴ Total number of atoms in ccp or fcc arrangement = 1+3 = 4

So,

The number of atoms contained in one face–centred cubic unit cell of monoatomic substance is 4.

44. The ionic radii of A^+ and B^- ions are 0.98×10^{-10} m and 1.81×10^{-10} m. The coordination number of each ion in AB is

(a) 8 (b) 2
(c) 6 (d) 4

(NEET-I-2016)
J & K CET-2005

Ans. (c) : Given that —

Radius of A^+ (r_A^+) = 0.98×10^{-10}m

Radius of B^- (r_B^-) = 1.81×10^{-10}m

So,

The radius ratio

$$\frac{r_A^+}{r_B^-} = \frac{0.98\times10^{-10}\text{ m}}{1.81\times10^{-10}\text{ m}}$$

$$\frac{r_A^+}{r_B^-} = \frac{0.98}{1.81}\times10^{-10}\times10^{+10}$$

$$\frac{r_A^+}{r_B^-} = 0.54$$

This corresponds to octahedral coordination with coordination number 6.

For octahedral coordination, the radius ratio is in the range 0.414 to 0. 732.

45. Copper crystallises in FCC lattice with a unit cell edge of 361 pm. The radius of copper atom is

(a) 181 pm (b) 108 pm
(c) 128 pm (d) 157 pm

[AIEEE 2011, 2009]

Ans. (c) : The atoms on face diagonal will be touching each other. Let, the radius of the atom be r and edge length is 'a'.

Face diagonal of cube = $\sqrt{2}\,a$

$$\Rightarrow r + 2r + r = \sqrt{2}\,a$$

$$4r = \sqrt{2}\,a$$

$$r = \frac{\sqrt{2}}{4}a$$

Given that –

Edge length 'a' = 361 pm

So,

$$r = \frac{\sqrt{2}}{4}a$$

$$r = \frac{\sqrt{2}}{4}\times361\,\text{pm}$$

$$r = \frac{1.414\times361}{4}\text{pm}$$

$$r = 127.61\,\text{pm}$$

$$r \simeq 128\,\text{pm}$$

46. How many lattice points belong to a face centered cubic cell?

(a) 1 (b) 2
(c) 4 (d) 3

J&K CET-2012
VITEEE- 2006

Ans. (c) : In face centred cubic lattice, the atoms are present at eight corners of faces and one each at 6 faces.

∴ Lattice points belonging to face centred

cubic unit cell $= 8\times\frac{1}{8}+6\times\frac{1}{2} = 4$

47. Percentage of free space in bcc lattice is

(a) 24 (b) 32
(c) 48 (d) 52

COMEDK-2016
CG-PET-2015

Ans. (b) : We know that,

For bcc, number of atoms = 2

$$\text{Percentage packing fraction} = \frac{V_{\text{sphere}}}{V_{\text{unit cell}}}\times100$$

$$= \frac{2\times\frac{4}{3}\pi r^3}{\left(\frac{4}{\sqrt{3}}r\right)^3}\times100$$

@apna_pdf

$$= \frac{\frac{8}{3}\pi r^3}{\frac{64}{3\sqrt{3}}r^3}\times 100$$

$= 68\%$

∴ Fraction of free space in bcc = 100 – 68

= 32%

48. The dimensions of a unit cell of a crystal are a = 0.387, b = 0.387, c = 0.504 and $\alpha = \beta = 90°$, $\gamma = 120°$ the crystal system is

(a) cubic (b) hexagonal
(c) orthorhombic (d) rhombohedral

CG PET- 2013
AIIMS-2004

Ans. (b) : Given that –
a = 0. 387, b= 0.387 and c= 0.504
$\alpha = \beta = 90^0$, $\gamma = 120^0$.
For the crystal system –
$a = b \neq c$, $\alpha = \beta = 90^0$, $\gamma = 120^0$
These are the characteristic of hexagonal system.

49. The number of octahedral sites per sphere arranged in a face centered cubic structure, is

(a) 1 (b) 2
(c) 3 (d) 4

UPTU/UPSEE-2010
CG PET -2005

Ans. (b) : The octahedral sites will be equal to the number of spheres present in the unit cell. Hence, the total number of octahedral sites will be equal to the number of packing spheres. A fcc unit cell contains 4 atoms (sphere) per unit cell. Hence, the total number of octahedral sites per unit cell in fcc structure are 4.

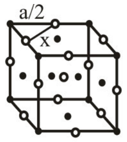
50. An element crystallises in a face-centered cubic (fcc) unit cell with cell edge a. The distance between the centers of two nearest octahedral voids in the crystal lattice is

(a) $\frac{a}{\sqrt{2}}$ (b) a
(c) $\sqrt{2a}$ (d) $\frac{a}{2}$

[JEE Main 2020, 5 Sep Shift-II]
WB-JEE, 2020

Ans. (a) : Distance between nearest octahedral voids (O.V)

$$= x = \sqrt{\left(\frac{a}{2}\right)^2 + \left(\frac{a}{2}\right)^2} = \frac{a}{\sqrt{2}}$$



x= Distance between to nearest octahedral voids
● = face-centered cubic
○ = octahedral voids

51. If a, b, c are the lengths of three edges of unit cell, α is the angle between side b and c, β is the angle between side a and c and γ is the angle between side a and b, what is the Bravais Lattice dimensions of a tetragonal crystal?

(a) $a = b = c$ and $\alpha = \beta = \gamma = 90°$
(b) $a = b \neq c$ and $\alpha = \beta = \gamma = 90°$
(c) $a = b = c$ and $\alpha = \beta = \gamma \neq 90°$
(d) $a \neq b \neq c$ and $\alpha = \beta = \gamma = 90°$

J & K CET-(2019, 1999)

Ans. (b) : In tetragonal Bravais lattices, the following relations are observed:
$a = b \neq c$ and $\alpha = \beta = \gamma = 90°$

52. Cell edge length in bcc, ccp and simple cubic unit cell is respectively as _____.

(a) $2r, \frac{4r}{\sqrt{3}}, 2\sqrt{2}r$ (b) $2r, 2\sqrt{2}r, \frac{4r}{\sqrt{3}}$
(c) $2\sqrt{2}r, \frac{4r}{\sqrt{3}}, 2r$ (d) $\frac{4r}{\sqrt{3}}, 2\sqrt{2}r, 2r$

GUJCET-2021, 2022

Ans. (d) : In bcc (body centered cubic), the atoms at the body diagonal touch each other.

So, $\sqrt{3}a = 4r$

$a = \frac{4}{\sqrt{3}}r$

In ccp or fcc the atoms at the face diagonals touch each other. If a is the edge length of cube and r is the radius of the atom.

So, $\sqrt{2}\,a = 4r$

$a = 2\sqrt{2}r$

In simple cubic the atoms at the corners touch each other.

So, $a = 2r$

Hence, $\frac{4r}{\sqrt{3}}, 2\sqrt{2}r, 2r$ are correct.

53. The number of atoms in body centred and face centred cubic unit cell respectively are

(a) 2 and 4 (b) 4 and 3
(c) 1 and 2 (d) 4 and 6

WB-JEE-30.04.2022

Ans. (a) : In bcc (body centred cubic) structure atoms present in corners and body centre. There are 8 corner and contribution of each corner is $\frac{1}{8}$ and body center has 1 atom.

So, number of atom in bcc = $\frac{1}{8} \times 8 + 1$

$= 1 + 1 = 2$

In the fcc (face centred-cubic) unit cell the atom present in corners and face centre. There are 8 corner and contribution of each corner is $\frac{1}{8}$ and 6 face centre and contribution of each face centre is $\frac{1}{2}$

So, Number of atom in fcc = $\frac{1}{8} \times 8 + \frac{1}{2} \times 6$

$= 1 + 3$

$= 4$

Hence, option (a) 2 and 4 are correct.

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54. How many unit cells are present in a cube shaped ideal crystal of NaCl of mass 1 g?

(a) 5.14×10^{21} (b) 1.28×10^{24}

(c) 1.71×10^{21} (d) 2.5×10^{21}

AP EAPCET 24.08.2021, Shift-I

Ans. (d) : Given, M = 1g

Molecular weight of NaCl = 58.5

No. of moles in 1g NaCl = $\frac{1}{58.5}$

No. of crystal present in NaCl = $\frac{1}{58.5} \times 6.022 \times 10^{23}$

$= 0.1029 \times 10^{23}$

$= 1.029 \times 10^{22}$

Na^+ occupy the Octahedral site = 4 ion of Na^+

$\because$ 1 unit cell contain 4 molecules of NaCl.

$\therefore$ 1 molecule contain $\frac{1}{4}$ unit cell.

$\therefore$ 1.02×10^{22} crystal contains = $\frac{1.02 \times 10^{22}}{4}$ Unit cell

$= 0.255 \times 10^{22} = 2.5 \times 10^{21}$ unit cell.

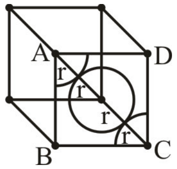
55. A metal crystallizes with a FCC-lattice, the edge of whose unit cell is x pm. The diameter of this metal atom would be _______ pm.

(a) 2x (b) $\frac{x}{\sqrt{2}}$

(c) $x\sqrt{2}$ (d) $\frac{\sqrt{2}}{x}$

AP EAPCET 20.08.2021 Shift-II

Ans. (b):



$\therefore$ Diameter = $\frac{AC}{2}$

$d = \frac{4r}{2}$

d = 2r ......(i)

Where r = radius

d = diameter

$\therefore$ we know that, when a = edge length

For FCC –

$4r = \sqrt{2}a$

$a = \frac{4r}{\sqrt{2}} \Rightarrow r = \frac{\sqrt{2}}{4}a = \frac{a}{2\sqrt{2}}$

putting these value in Eq^n. (i) we get

$d = 2r = \frac{a}{\sqrt{2}} = \frac{x}{\sqrt{2}}$

56. The number of octahedral voids per lattice site in a lattice is ______(Rounded off of the nearest integer)

JEE Main 26.02.2021,Shift-II

Ans.: 1

Assuming FCC

Number of lattice sites = 6 face-centre + 8 corners

= 14

Number of octahendral voids = 12 edge + 1 body centre

= 13

Per lattice site or ratio = $\frac{13}{14} = 0.92857 \simeq 1$

57. The number of translational degrees of freedom for NH_3 (g) is

(a) 4 (b) 5

(c) 3 (d) 9

TS-EAMCET 09.08.2021, Shift-I

Ans. (c) : Ammonia (NH_3) is a nonlinear molecule and has four atom i.e. N = 4.

$\therefore$ Translational degree of freedom for NH_3 = 3

- Rotational degree of freedom = 3
- Vibrational degree of freedom = 3N – 6

$= 3 \times 4 - 6 = 6$

Hence, The number of translational degrees of freedom for NH_3 is 3.

58. A certain element crystallises in a BCC lattice of unit cell edge length $27\overset{\circ}{A}$. If the same element under the same conditions crystallises in the FCC lattice, the edge length of the unit cell in $\overset{\circ}{A}$ will be___________. (Round off to the Nearest Integer).

[Assume each lattice point has a single atom]

$\left[\text{Assume}\sqrt{3} = 1.73, \sqrt{2} = 1.41\right]$

JEE Main 16.03.2021, Shift-I

Ans. 33 Å :

Given–

edge length $(a) = 27\overset{\circ}{A}(\text{For BCC})$

edge length $(a) = ?\ (\text{For FCC})$

Now,

relation between radius and edge length in BCC lattice–

For BCC unit cell,

$\sqrt{3}a = 4R$

$a = \frac{4R}{\sqrt{3}} = 27$

$R = 27\frac{\sqrt{3}}{4}$ Å

For FCC unit cell

$\sqrt{2}a = 4R$

$a = \frac{4}{\sqrt{2}}\left(27\frac{\sqrt{3}}{4}\right)$

$a = 27\frac{\sqrt{3}}{\sqrt{2}}$

a = 33.12 ≈ 33Å

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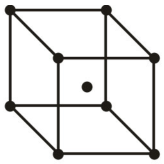
59. The coordination number of an atom in a body-centered cubic structure is ______.
[Assume that the lattice is made up of atoms]

JEE Main 24.02.2021, Shift-I

Ans. (8) : The body centred cubic (BCC) unit have one atoms at its body centre besides the ones that are at its corners. Each corner and body centre atom co-ordinated with the eight atom. Hence, the co-ordination number of BCC is 8.



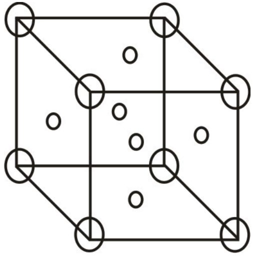
(BCC) Structure

60. The FCC - crystal contains how many atoms in each unit cell?

(a) 4 (b) 8
(c) 10 (d) 12

AP EAPCET 19-08-2021, Shift-II

Ans. (a) : Given - Face centred cubic (FCC)



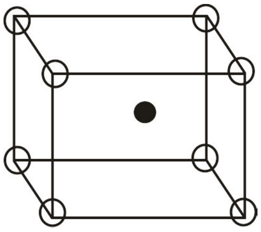
Total No. of atom in each unit cell =

$$= 8\times\frac{1}{8}+6\times\frac{1}{2}=1+3=4$$

61. The coordination number of an atom in a body centered cubic structure is.......
[Assume that the lattice is made up of atoms.]

[JEE Main 2021, 24 Feb Shift-I]

Ans. (8) :



The coordination number of number in a body centre cubic structure is 8.

62. Diamond has a three dimensional structure of C atoms formed by covalent bonds. The structure of diamond has face centred cubic lattice, where 50% of the tetrahedral voids are also occupied by carbon atoms. The number of carbon atoms present per unit cell of diamond is............

[JEE Main 2021, 20 July Shift-II]

Ans. (8) : Carbon atoms occupy FCC lattice paints as well as half of the tetrahedral voids therefore number of carbon atoms per unit cell = 8.

63. The parameters of the unit cell of a substance are a = 2.5, b = 3.0, c = 4.0, $\alpha = 90^0$, $\beta = 120^0$, $\gamma = 90^0$. The crystal system of the substance is

(a) hexagonal (b) orthorhombic
(c) monoclinic (d) triclinic

[JEE Main 2021, 27 July Shift-I]

Ans. (c) : Given that

a = 2.5, b=3.0 and c = 4.0,
$\alpha = 90^0$, $\beta = 120^0$, $\gamma = 90^0$.
When edge length $a \neq b \neq c$ and axial
Angle $\alpha = \gamma = 90^0$, $\beta = 120^0$ then
System is called monoclinic crystal system.

64. The empirical formula for a compound with a cubic close packed arrangement of anions and with cations occupying all the octahedral sites in A_xB. The value of x is.......(Integer answer)

[JEE Main 2021, 31 Aug Shift-II]

Ans. (1)
Anions forms CCP or FCC (A^-) = 4 A^- per unit cell.
cation occupy all octahedral void (B^+) = $4B^+$ per unit cell.
So, Empirical formula → $A_4\,B_4$
Empirical formula → AB → (x = 1)

65. The correct option for the number of body center unit cells in all 14 types of Bravais lattice unit cells is

(a) 3 (b) 7
(c) 5 (d) 2

(NEET-2021)

Ans. (a) : In the 14 type of Bravais lattices, body centred unit cell is present in cubic, tetragonal and orthorhombic crystal system. So in the body centred cubic possible variation in present in three crystal systems.

66. Iron exhibits BCC-structure at room temperature above 500°C, it transforms to FCC-structure. Find the ratio of the density of iron at room temperature to that at 500°C. (Assume the atomic radii and the molar mass of iron remain constant even with variation in temperature)

(a) $3\sqrt{3}:4\sqrt{2}$ (b) $\sqrt{3}:\sqrt{2}$
(c) $\sqrt{2}:\sqrt{3}$ (d) 10 : 92

AP EAPCET 23-08-2021 Shift-I

Ans. (a) :

$$\underset{\text{BCC}}{\text{Fe}} \xrightarrow[\text{500°C}]{\text{above}} \underset{\text{FCC}}{\text{Fe}}$$

(25°C)

Given, atomic radii and molar mass remain constant.

$$\therefore \text{ density } (\rho) = \frac{\text{No. of atom}\times\text{Molar mass}}{\text{Volume of unit cell}}$$

$$\rho = \frac{Z\times M}{a^3\,N_0}$$

For BCC, $4r = \sqrt{3}\,a \;\Rightarrow a = \dfrac{4r}{\sqrt{3}}$

@apna_pdf

and No. of atom (Z) = 2

and FCC, $4r = \sqrt{2}a \Rightarrow a = \dfrac{4r}{\sqrt{2}}$

and no. of atom (Z) = 4

$$\frac{\rho_{BCC}}{\rho_{FCC}} = \frac{2\times M}{\left(\frac{4r}{\sqrt{3}}\right)^3}\times\frac{\left(\frac{4r}{\sqrt{2}}\right)^3}{4M}$$

$$\frac{\rho_{BCC}}{\rho_{FCC}} = \frac{2}{\left(\sqrt{2}\right)^3}\times\frac{\left(\sqrt{3}\right)^3}{4}$$

$$\frac{\rho_{BCC}}{\rho_{FCC}} = \frac{3\sqrt{3}}{4\sqrt{2}}$$

So, ratio is $3\sqrt{3} : 4\sqrt{2}$

67. Which of the following is correct in the crystal lattice given below?

(a) Nearest neighbour distance in NaCl= $\dfrac{a}{\sqrt{2}}$

(b) Total volume of a unit cell in CCP= $\left(r\sqrt{2}\right)^3$

(c) Packing fraction of BCC is more than that of a FCC unit cell

(d) Nearest neighbour distance in CsCl= $a\dfrac{\sqrt{3}}{2}$

TS-EAMCET (Engg.), 07.08.2021 Shift-II

Ans. (d) : The nearest neighbours would be an atom at the corner and the one at the body center. The distance between them would be equal to half the length of the diagonal of the cube, that is $\sqrt{3}/2$ times the side length of the unit cell.

- Nearest neighbour distance in NaCl is a/2.
- Packing fraction of FCC is more than that of a BCC unit cell. They are respectively 0.74, 0.68.

68. In the face centered unit cell, the lattice points are present at —

(a) Only the corners of the unit cell

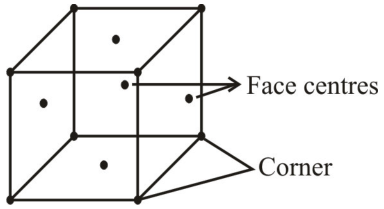
(b) The corners and the center of the unit cell

(c) The corners and the face centres of the unit cell

(d) Only the face centres of the unit cell

AP EAPCET 20.08.2021 Shift-I

Ans. (c) : In face centered unit cell atom/lattice point are present at corners and face centres of unit cell.



Unit cell of FCC

69. A compound crystallizes in a HCP arrangement. The total number of voids present in 0.5 mole of the crystal is

(a) 1.0 N
(b) 0.5 N
(c) 1.5 N
(d) 2.0 N

TS EAMCET 10.08.2021, Shift-II

Ans. (c) : In hexagonal close packed structure, there is 6 atom per unit cell.

Number of unit cell in HCP = $\dfrac{0.5}{6}\times 6.022\times 10^{23}$

(6 = Effective no. of HCP)

In one unit cell total void = 18 Octahedral, 12 Tetrahedral.

Total no. of void = $\dfrac{18\times 0.5\times 6.022\times 10^{23}}{6} = 9.033\times 10^{23}$

Total no. of voids in (N) = $\dfrac{9.003\times 10^{23}}{6.022\times 10^{23}} = 1.5\text{N}$

70. Calculate the coordination number of Na^+ in $NaC\ell$ crystal, given radius of Na^+ and $C\ell^-$ are 95 pm and 181 pm respectively.

(a) 8
(b) 4
(c) 6
(d) 12

AP EAMCET (Engg.) 18.09.2020, Shift-I

Ans. (c) : For $NaC\ell$ crystal

Radius ratio, $\dfrac{r_{Na^+}}{r_{C\ell^-}} = \dfrac{95}{181} = 0.5248$,

which is, in the range of 0.414 – 0.732.

So coordination number of Na^+ in $NaC\ell$ crystal = 6

71. In a monoclinic unit cell, the relation of sides and angles are respectively:

(a) $a = b \neq c$ and $\alpha = \beta = \gamma = 90^\circ$

(b) $a \neq b \neq c$ and $\alpha = \beta = \gamma = 90^\circ$

(c) $a \neq b \neq c$ and $\alpha = \gamma = 90^\circ \neq \beta$

(d) $a \neq b \neq c$ and $\alpha \neq \beta \neq \gamma \neq 90^\circ$

BITSAT-2020

Ans. (c) : Monoclinic crystal is one of the 7 crystal system. In monoclinic system, the crystal is described by vectors of unequal lengths,

So, we have. $a \neq b \neq c$ and $\alpha = \gamma = 90^\circ\ \beta = 120^\circ$

72. Which of the following statement is correct?

(a) Silicon doped with Arsenic impurity is a p-type semiconductor

(b) Amorphous solids are anisotropic in nature

(c) In the unit cell of rhombic sulphur, the axial distances are unequal and the value of each axial angle is 90°

(d) In MnO, all the domains are aligned in the same direction

GUJCET-2020

Ans. (c) : In the unit cell of rhombic sulphur, the axial distance are unequal and the value of each axial angle is 90^0 is correct.

Rhombic sulphur has a simple orthorhombic structure.

@apna_pdf

73. Which is mismatched for NaCl crystal?

(a) $\frac{r^+}{r^-} = 0.414$ to 0.732
(b) Coordination number = 6:6
(c) Edge of unit cell = $(r^+ + r^-)$
(d) Crystal structure = fcc **Manipal-2020**

Ans. (c) : Edge length of (NaCl) crystal unit cell

$$= 2\left(r^+_{Na^+} + r^-_{Cl^-}\right)$$

74. A match box exhibits

(a) cubic geometry
(b) monoclinic geometry
(c) orthorhombic geometry
(d) tetragonal geometry

CG PET -2019

Ans. (c) : A matchbox has the geometry as that of an orthorhombic lattice as the side a, b, c have different lengths and all of them have angles equal to 90°.

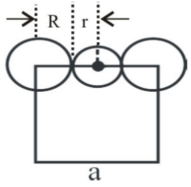
Orthorhombic geometry has $a \neq b \neq c$ and $\alpha = \beta = \gamma = 90^o$.

75. The radius of the largest sphere which fits properly at the centre of the edge of a body centred cubic unit cell is
(Edge length is represented by 'a')

(a) 0.134 a (b) 0.027 a
(c) 0.047 a (d) 0.067 a

[JEE Main 2019, 11 Jan Shift-II]

Ans. (d) :



From the figure –
a = 2 (R + r)
Properties at the centre of the edge of body centred cubic unit cell.
Now,

$$\frac{a}{2} = (R + r) \text{———}(1)$$

$$a\sqrt{3} = 4R \text{———}(2)$$

Using (1) and (2) we get –

$$\frac{a}{2} = \frac{a\sqrt{3}}{4} + r$$

$$a\left(\frac{2-\sqrt{3}}{4}\right) = r$$

r = 0.067a

76. 10 mL of 1 mM surfactant solution forms a monolayer covering 0.24 cm² on a polar substrate. If the polar head is approximated as a cube, what is its edge length?

(a) 2.0 pm (b) 0.1 nm
(c) 1.0 pm (d) 2.0 nm

[JEE Main 2019, 9 April Shift-II]

Ans. (a) : Milli moles = $10\times10^{-3} = 10^{-2}$

Moles = 10^{-5}

Number of molecules = $6\times10^{23}\times10^{-5}$

$= 6\times10^{23-5}$

$= 6\times10^{18}$

Surface area occupied by one molecule.

$$= \frac{0.24}{6\times10^{18}} = 0.04\times10^{-18}\,\text{cm}^2$$

$a^2 = 4\times10^{-20}$

$\therefore$ $a = 2\times10^{-10}$ cm

a = 2 pm

$1\text{pm} = 10^{-10}$ cm

77. An element has a face-centered cubic (FCC) structure with a cell edge of a. The distance between the centers of two nearest tetrahedral voids in the lattice is

(a) $\sqrt{2}a$ (b) a
(c) $\frac{a}{2}$ (d) $\frac{3}{2}a$

[JEE Main 2019, 12 April Shift-I]

Ans. (c) : The distance between the two nearest tetrahedral voids in FCC lattice is $\frac{a}{2}$. If a cube is divided into 8 minicubes one tetrahedral void is present at the centre of each minicube.

Distance between void at nearest distance is $= \frac{a}{4} + \frac{a}{4}$

$$= \frac{a+a}{4}$$

$$= \frac{2a}{4}$$

$$= \frac{a}{2}$$

78. The ratio of number of atoms present in a simple cubic, body centered cubic and face centered cubic structure are, respectively.

(a) 8: 1: 6 (b) 1: 2: 4
(c) 4: 2: 1 (d) 4: 2: 3

[JEE Main 2019, 12 April Shift-II]

Ans. (b) : Number of atom in simple cubic $= 8\times\frac{1}{8} = 1$

Number of atom in bcc $= 8\times\frac{1}{8} + 1$

$= 1 + 1$

$= 2$

Number of atom in FCC $= 8\times\frac{1}{8} + 6\times\frac{1}{2}$

$= 1 + 3$

$= 4$

Now

SC : BCC : FCC = 1 : 2 : 4 .

79. Which primitive unit cell has unequal edge lengths ($a \neq b \neq c$) and all axial angles different from 90°?

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(a) Hexagonal (b) Monoclinic
(c) Tetragonal (d) Triclinic

[JEE Main 2019, 10 Jan Shift-I]

Ans. (d) : In triclinic cell –
Edge length $a \neq b \neq c$ and axial angle
$\alpha \neq \beta \neq \gamma \neq 90^0$.

80. How many total constituent particles are present in simple cubic unit cell ?
(a) 1 (b) 3
(c) 4 (d) 2

MHT CET-02.05.2019, SHIFT-II

Ans. (a) : In simple cubic structure atoms present in only corner. There are eight (8) corner present in simple cubic and contribution is 1/8

So, Number of effective atom $= \frac{1}{8} \times 8$
$= 1$ atom.

81. B^- ions form a close packed structure. If the radius of B^- ion is 200 pm then the cation (A^+) having radii 88 pm can fit into
(a) tetrahedral hole (b) octahedral hole
(c) both of these (d) none of these

AMU-2019

Ans. (b) : Radius ratio $= \frac{r^+}{r^-} = \frac{88}{200} = 0.44$
As it lies in the range 0.414 – 0.732, hence cation A^+ can be fit into the octahedral hole of the crystal A^+B^-

82. Which among the following is the most symmetrical crystal system?
(a) Hexagonal (b) Cubic
(c) Triclinic (d) Orthorhombic

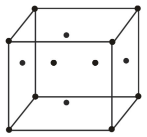
J & K CET-(2019)

Ans. (b) : Cubic is most symmetrical crystal system because their unit cell parameters as, $a = b = c$ and $\alpha = \beta = \gamma = 90$.

83. Consider a fcc lattice made of a metal cation (M^{6+}) and three oxide anions per unit cell. The resultant structure would have
(a) 3D network of edge shared Octahedra
(b) 3D network of corner shared Octahedra
(c) 2D network of edge shared Octahedra
(d) 2D network of corner shared Octahedra
(e) 3D network of face shared Octahedra

Kerala-CEE-2019

Ans. (b) :



Face centered cubic unit cell (FCC)
- cubic unit cell – 3D
- Face, $6 \times \frac{1}{2}$
- Corners, shared, $8 \times \frac{1}{8} = 1$

So, 3D network of corner shared octahedral.

84. The edge length of solid possessing cubic unit cell is $2\sqrt{2}r$ (structure I), based on hard sphere model, which upon subjecting to a phase transition, a new cubic structure (structure II) having an edge length of $\frac{4r}{\sqrt{3}}$ is obtained, where r is the radius of the hard sphere. Which of the following statements is true?
(a) Density of the structure II is the lower than structure I
(b) Density of structure II is higher than structure I
(c) The pore volume in structure I is 1.2 times higher than that of structure II
(d) The pore volume of both structures are equal
(e) The octahedral voids in structure I is transformed into tetrahedral voids in structure II

Kerala-CEE-2019

Ans. (a) : Structure I,
$a = 2\sqrt{2}r$ ...FCC
Structure II,
$a = \frac{4r}{\sqrt{3}} \Rightarrow$ BCC
So, FCC is denser than BCC and FCC has more porosity than BCC.
The number of atom in FCC is 4 and no. of atom in BCC is 2.

85. If a metal crystallises in bcc structure with edge length of unit cell 4.29×10^{-8} cm the radius of metal atom is
(a) 3.2×10^{-7} cm (b) 1.86×10^{-8} cm
(c) 1.07×10^{-7} cm (d) 1.07×10^{-8} cm

MHT CET-03.05.2019, SHIFT-I

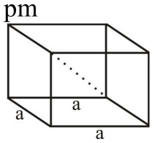
Ans. (b) : Given that–
Edge length (a) = 4.29×10^{-8} cm
In body centred cubic structure —

$$4r = \sqrt{3}a$$
$$r = \frac{\sqrt{3}}{4} \times a$$
$$r = \frac{\sqrt{3}}{4} \times 4.29 \times 10^{-8} \text{ cm}$$
$$r = \frac{1.73 \times 4.29 \times 10^{-8}}{4} \text{cm}$$
$$r = 1.86 \times 10^{-8} \text{ cm}$$

86. Edge length of a cube is 300 pm. Its body diagonal would be
(a) 600 pm (b) 423 pm
(c) 519.6 pm (d) 450.4 pm

Karnataka-CET-2018

Ans. (c) : Given that –
edge length 'a' = 300 pm



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body diagonal $= \sqrt{a^2+a^2+a^2}$

$= \sqrt{3a^2}$

$= \sqrt{3}\,a$

$= \sqrt{3}\times 300\,\text{pm}$

$= 1{\cdot}732 \times 300$ PM

$= 519{\cdot}6$ pm

87. Which among the following metals crystallise as a simple cube?

(a) Polonium (b) Iron

(c) Copper (d) Gold

MHT CET-2018

Ans. (a) : Polonium crystallizes as simple cubic crystal structure while Iron crystallizes as BCC unit cell, copper and gold crystallizes as FCC unit cell.

88. Zn converts from its melted state to its solid state, it has HCP structure, then the number of nearest atoms will be

(a) 6 (b) 8

(c) 12 (d) 4

UPTU/UPSEE-2018

Ans. (c) : In Zn is HCP structure, the number of nearest neighbours is 12, six are in the plane, 3 above the plane and 3 below the plane, so hexagonal closed packing has the coordination number of 12.

89. Which colour is observed when ZnO is heated?

(a) Yellow (b) Violet

(c) Green (d) Blue

[AIIMS-26 May, 2018(M)]

Ans. (a) : Zinc oxide is white in colour at room temperature. When it heating it loses oxygen and turns yellow.

90. A metal crystallizes with face centred cubic lattice. The edge of the unit cell is 408 pm. The diameter of the metal atom is

(a) 288 pm (b) 408 pm

(c) 144 pm (d) 204 pm

Assam CEE-2018

Ans. (a) :

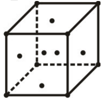
For FCC,

$$r = \frac{a}{2\sqrt{2}}$$

$$\because \text{ Diameter} = 2r = \frac{a}{\sqrt{2}}$$

$$\text{Diameter} = \frac{408}{1.414} = 288.5\text{pm}$$

91. The lattice point per unit cell in the figure



is

(a) 14 (b) $\frac{14}{6}$

(c) 4 (d) $\frac{8}{2}+\frac{6}{3}$

CG PET -2018

Ans. (c) : In given lattice is a FCC crystal lattice.

Number of atom per unit cell $= 8\times\frac{1}{8}+6\times\frac{1}{2}$

$= 1 + 3$

$= 4$

92. If the edge of a body centred unit cell is 400 pm, what will be the approximate radius of the atom present in it? (in pm)

(a) 200 (b) 141

(c) 173 (d) 924

GUJCET-2018

Ans. (c) : In the body centred unit cell , the radius (r) and edge length (a) are related by the expression —

$$4r = \sqrt{3}a$$

Given that —

edge length 'a' = 400 pm

$$r = \frac{\sqrt{3}}{4}a$$

$$r = \frac{\sqrt{3}}{4}\times 400\,\text{pm}$$

$$r = \frac{1.732\times 400}{4}\text{pm}$$

r = 173 pm

93. The limiting radius ratio for tetrahedral shape is

(a) 0.155 to 0.225 (b) 0 to 0.155

(c) 0.414 to 0.732 (d) 0.225 to 0.414

COMEDK-2018

Ans. (d) : The limiting radius of Tetrahedral shape is 0.225 to 0.414 due to three sphere touching one another and fourth sphere touches each other at one point only such that centre of the sphere are at the tetrahedral.

94. The crystal unit cell with parameter a = 3.1Å, b = 3.1Å, c = 5.2Å and $\alpha = \beta = \gamma = 90°$ belongs to–

(a) cubic crystal system

(b) triclinic crystal system

(c) monoclinic crystal system

(d) None of the above

BCECE-2018

Ans. (d) : The crystal unit cell with parameter

$a = 3.1\ \text{Å}, b = 3.1\ \text{Å}, c = 5.2\ \text{Å}$, and $\alpha = \beta = \gamma = 90^0$ belong to tetragonal crystal system and $a = b \neq c$ and $\alpha = \beta = \gamma = 90^0$. The bond parameter for other crystal system gives the other options as fallows.

(a) For cubic crystal system

$a = b = c,\ \alpha = \beta = \gamma = 90^o$

(b) For triclinic system

$a \neq b \neq c,\ \alpha \neq \beta \neq \gamma \neq 90^o$

(c) For monoclinic crystal system

$a \neq b \neq c,\ \alpha = \gamma = 90^o,\ \beta \neq 90^o$

95. The radius of sodium atom is 1.857 × 10^{-8} cm. If sodium crystal is a body centred, then the edge length of unit cell is

(a) 3.81 Å (b) 4.29 Å

(c) 2.37 Å (d) None of these

CG PET -2018

@apna_pdf

Ans. (b) : Given that –
Radius of sodium atom r = 1.857×10^{-8} cm.
In a body centered cubic unit cell

$$4r = \sqrt{3}\,a$$

Therefore

$$a = \frac{4r}{\sqrt{3}}$$

$$\Rightarrow 1.857\times 10^{-8} = \frac{\sqrt{3}}{4}a$$

$$\Rightarrow a = \frac{1.857\times10^{-8}\times4}{\sqrt{3}} \qquad \therefore \sqrt{3} = 1.732$$

$$a = 4.29 \times 10^{-8}\text{cm}$$

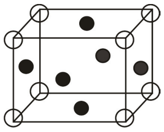
$$a = 4.29\ \overset{o}{A} \qquad \therefore 1\overset{o}{A} = 10^{-8}\,\text{cm}$$

96. A fcc crystal contains how many atoms in each unit cell?

(a) 4 (b) 6
(c) 2 (d) 5

HP CET-2018

Ans. (a) :



Number of atom in fcc crystal (at corners and face centres of cubic unit cell)

$$= 8\times\frac{1}{8}+6\times\frac{1}{2}$$

$$= 1 + 3$$

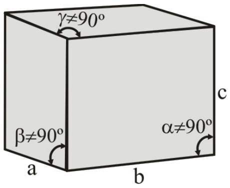
$$= 4$$

97. Crystal system of $CuSO_4$. $5H_2O$ is

(a) triclinic (b) trigonal
(c) cubic (d) tetragonal

JCECE - 2018

Ans. (a) : Crystal system of $CuSO_4\cdot5H_2O$ is triclinic. In the triclinic system, the crystal is described by vectors of unequal length. In addition, the angles between these vectors, must be different.



Triclinic system, Bravais lattice,

$$a \neq b \neq c \ \text{ and } \alpha \neq \beta \neq \gamma \neq 90°$$

98. If 'a' stands for the edge length of the cubic systems : simple cubic, body centred cubic and face centred cubic, then the ratio of radii of the spheres in these systems will be respectively,

(a) $\frac{1}{2}a:\frac{\sqrt{3}}{4}a:\frac{1}{2\sqrt{2}}a$ (b) $\frac{1}{2}a:\sqrt{3}a:\frac{1}{\sqrt{2}}a$

(c) $\frac{1}{2}a:\frac{\sqrt{3}}{2}a:\frac{\sqrt{3}}{2}a$ (d) $1a:\sqrt{3}a:\sqrt{2}a$

VITEEE-2017

Ans. (a) : Lattice arrangements in cubic cells between the edge length (a) of the cell and radius (r) of the sphere–

For simple cubic : $a = 2r$ or $r = \frac{1}{2}a$

For body centred cubic : $a = \frac{4}{\sqrt{3}}r$ or $r = \frac{\sqrt{3}}{4}a$

For face centred cubic : $a = 2\sqrt{2}\,r$ or $r = \frac{1}{2\sqrt{2}}a$

Thus, the ratio of radii of spheres for these will be–

$$\text{SC : BCC : FCC} = \frac{a}{2}:\frac{\sqrt{3}}{4}a:\frac{1}{2\sqrt{2}}a$$

99. A metal crystallises in a face centred cubic structure. If the edge length of its unit cell is 'a', the closest approach between two atoms in metallic crystal will be

(a) 2a (b) $2\sqrt{2}\,a$

(c) $\sqrt{2}\,a$ (d) $\frac{a}{\sqrt{2}}$

[JEE Main 2017]

Ans. (d) : For face centred cubic structure, the closest approach between two atom in metallic crystal will be equal to one half the length of the face diagonal. It will be

$$= \frac{1}{2}\times \text{ length of face diagonal} \text{———(1)}$$

But, length of face diagonal = $\sqrt{2}\,a$ ———(2)

Where, a is the edge of its unit cell.

From equation (1) and (2) ; the closest approach between two atom in metallic crystal will be –

$$=\frac{1}{2}\times\sqrt{2}\,a$$

$$=\frac{\sqrt{2}}{2}a$$

$$=\frac{\sqrt{2}}{\sqrt{2}\times\sqrt{2}}a$$

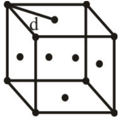
$$=\frac{a}{\sqrt{2}}$$

100. Cu crystallizes as face centered cubic lattice with edge length of 3.56Å. What will be the nearest distance between Cu atoms?

(a) 1.5Å (b) 2.5 Å
(c) 3.7Å (d) 4.8 Å

J & K CET-(2017)

Ans. (b) : Given that, edge length 'a' = 3.56 Å
For a face-centred cubic lattice, distance between nearest neighbour is given by:



d= nearest Cu atom distance

face diagonal length = $\sqrt{2}$a

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then $d = \frac{\sqrt{2}a}{2} = \frac{a}{\sqrt{2}}$

$$d = \frac{a}{\sqrt{2}}$$

$$d = \frac{3.56\,\overset{o}{A}}{\sqrt{2}}$$

$$d = \frac{3.56\,\overset{o}{A}}{1.414}$$

$$d = 2.5\text{Å}$$

101. A cubic unit cell of a metal with molar mass of 63.55 g mol^{-1} has an edge length of 362 pm. Its density is 8.92 g cm^{-3}.The type of unit cell is

(a) primitive
(b) face centred
(c) end centred
(d) body centred

JIPMER-2017

Ans. (b) : Given that $d = 8.92 \text{ g cm}^{-3}$

$M = 63.55\text{g mol}^{-1}$
$a = 362 \text{ pm} = 362 \times 10^{-10} \text{ cm}$
$N_A = 6.023 \times 10^{23} \text{ mol}^{-1}$
$1 \text{ pm} = 10^{-10} \text{ cm}$

$$\text{Density (d)} = \frac{Z \times M}{a^3 \times N_A}$$

$$Z = \frac{d \times N_A \times a^3}{M}$$

$$Z = \frac{8\cdot92 \times 6\cdot023 \times 10^{23} \times (362 \times 10^{-10})^3}{63.55}$$

$$Z = 4$$

The face centered cubic (FCC) has 4 atoms per unit cell.
∴ The metal crystallizes in FCC.

102. Which of the following crystal has unit cell such that $a \neq b \neq c$ and $\alpha \neq \beta \neq \gamma \neq 90^o$?

(a) $NaNO_3$
(b) K_2SO_4
(c) KNO_3
(d) $K_2Cr_2O_7$

Karnataka-CET-2017

Ans. (d) : $K_2Cr_2O_7$ has triclinic system , Bravais lattic, unit cell such that $a \neq b \neq c$ and $\alpha \neq \beta \neq \gamma \neq 90°$

- $NaNO_3$ has two crystal structure-rhombohedral and trigonal.
- K_2SO_4 and KNO_3 are orthorhombic crystal structure.

103. If ionic radius of Cs^+ and Cl^- are 1.69 Å and 1.81 Å respectively, the edge length of unit cell is:

(a) 4.04 Å
(b) 3.50 Å
(c) 7.00 Å
(d) None of these

Manipal-2017

Ans. (a) : Given that –

Radius of cation $(r^+) = 1.69$ Å
Radius of anion $(r^-) = 1.81$ Å

So, $(r^+ + r^-) = \frac{\sqrt{3}}{2}a$

⇒ $a = \frac{2(r^+ + r^-)}{\sqrt{3}}$

$$a = \frac{2(1.69 + 1.81)}{\sqrt{3}}$$

$$a = \frac{7}{\sqrt{3}}$$

$$a = \frac{7}{1.732}$$

$$a = 4.04 \text{ Å}$$

104. Which of the following *fcc* structures contains cations in the alternate tetrahedral voids?

(a) Na_2O
(b) ZnS
(c) CaF_2
(d) CaO

AMU-2016

Ans. (b) : In ZnS, S^{-2} (sulphide ions) are present at FCC position giving four sulphide ions per unit cell.
To comply with 1:1 stoichiometry, four Zn^{2+} ions must be present in four alternate tetrahedral voids out of eight tetrahedral voids present.

105. If the distance between Na^+ and Cl^- ions in NaCl crystal is X-pm, the length of edge of the unit cells (in pm)

(a) $\frac{X}{2}$
(b) X
(c) 2X
(d) 4X

BCECE-2016

Ans. (c) : In the fcc unit cell of NaCl, along a given edge, chloride ions present at corner. Sodium ion present at edge centre which is touch to each other.
Hence, the edge length $a = 2r_{ce}– = 2\,(r_{Na^+} + r_{Cl^-})$

Here, $(r_{Na^+} + r_{Cl^-})$ is the distance between sodium and chloride ions.
The length of the edge of the unit cell is twice the distance between sodium and chloride ions in sodium chloride crystal. It is 2x.

106. Match List I with List II and select the correct answer using the given codes.

List I **(Crystal system)**	**List II** **(Examples)**
A. Cubic	1. TiO_2
B. Tetragonal	2. Graphite
C. Hexagonal	3. $K_2Cr_2O_7$
D. Triclinic	4. ZnS

Codes

	A	**B**	**C**	**D**
(a)	2	3	4	1
(b)	3	4	3	2
(c)	4	2	1	4
(d)	4	1	2	3

CG PET- 2016

Ans. (d) :

(A) → 4, Zns (Cubic)
(B) → 1, TiO_2 (Tetragonal)
(C) → 2, Graphite (hexagonal)
(D) → 3, $K_2Cr_2O_7$ (Triclinic)

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107. The length of unit cell edge of a body- centred cubic metal crystal is 352 pm. The radius of metal atom is
(a) 162.4pm (b) 152.4 pm
(c) 142.4pm (d) 156.4 pm

CG PET- 2016

Ans. (b) : Edge length 'a' = 352 pm
In BCC unit cell.

$$\therefore \quad r=\frac{\sqrt{3}}{4}a$$
$$r=\frac{\sqrt{3}}{4}\times 352\text{pm}$$
$$r=\sqrt{3}\times 88\text{pm}$$
$$r = 152.4 \text{ pm}$$

108. The contribution of particle at the edge centre to a particular unit cell is
(a) $\frac{1}{2}$ (b) $\frac{1}{4}$
(c) 1 (d) $\frac{1}{8}$

Karnataka-CET-2016

Ans. (b) : The atom present at the edge centre of a unit cell is shared by a total of 4 unit cells.

So, the contribution of the edge centered atom = $\frac{1}{4}$.

109. In calcium fluoride having the fluorite structure, the coordination number for calcium ion (Ca^{2+}) and fluoride ion (F^-) are
(a) 4 and 2 (b) 6 and 6
(c) 8 and 4 (d) 4 and 8

(NEET-II-2016)

Ans. (c) : The fluorite structure, seen in calcium fluoride, has the calcium ions in a face centered cubic arrangement with the fluoride ions in all (8) of the tetrahedral holes. The fluoride ions have a coordination number of 4, and the calcium ions have a coordination number of 8.

110. Which statement is not true for metals?
(a) They form bcc structure
(b) They form hcp structure
(c) They form ccp structure
(d) They have low enthalpy of sublimation

CG PET- 2015

Ans. (d) : Enthalpy of sublimation is the enthalpy change when one mole of solid sublimes (i. e converts) directly into gaseous state at a temperature below it melting point.

$$\Delta_{sub}H = \Delta_{fus}H + \Delta_{vap}H$$

Metals have high enthalpy of sublimation.

111. A unit cell with edge length $a \neq b \neq c$ and axial angles $\alpha = \beta = \gamma = 90°$ is called
(a) cubic (b) tetragonal
(c) orthorhombic (d) hexagonal.

J & K CET-(2015)

Ans. (c) : The bravais lattices with orthorhombic systems obey the following equation –
- Edge length $a \neq b \neq c$ and axial angle $\alpha = \beta = \gamma = 90°$

112. The unit cell with crystallographic dimensions, $a \neq b \neq c$, $\alpha = \gamma = 90$ and $\beta \neq 90$ is
(a) triclinic (b) monoclinic
(c) orthorhombic (d) tetragonal

Karnataka-CET-2015

Ans. (b) : The unit cell with crystallographic dimensions
$a \neq b \neq c$, $\alpha = \gamma = 90°$ and $\beta \neq 90°$ is monoclinic.
- Triclinic unit cell has crystallographic dimensions $a \neq b \neq c$, $\alpha \neq \beta \neq \gamma \neq 90°$.
- Tetragonal unit cell has crystallographic dimensions. $a = b \neq c$, $\alpha = \beta = \gamma = 90°$.
- Orthorhombic unit cell has crystallographic dimensions $a \neq b \neq c$, $\alpha = \beta = \gamma = 90°$.

113. A binary solid has a primitive cubical structure with B^- ions constituting the lattice points and A^+ ions occupying 25% of its tetrahedral holes. The molecular formula of the crystal is
(a) A_2B (b) AB_3
(c) AB_2 (d) A_2B_3
(e) A_2B_5

Kerala-CEE-2015

Ans. (c) : Let number of octahedral holes in the lattice = x
∴ Number of tetrahedral holes in the lattice = 2x
∴ Number of tetrahedral void = 2 × number of octahedral voids
Now, A^+ ions occupy 25% of tetrahedral holes. Hence, number of tetrahedral holes occupied in lattice

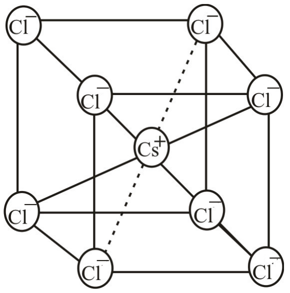
$$= 2x \times 25\%$$
$$= 2x \times 25 \times \frac{1}{100}$$
$$= \frac{2x}{4} = \frac{x}{2}$$

Since, number of octahedral holes = Number of lattice points.
∴ Number of octahedral holes = x
∴ Molecular formula of the crystal is
$A_{x/2}\,B_x$ or AB_2

114. The number of CsCl units per unit cell of it is
(a) 1 (b) 2
(c) 3 (d) 4

SRMJEEE – 2015

Ans. (a) : As we know CsCl has the body centred cubic structure in which one Cs^+ surrounded by 8 Cl^-.



Hence, number of CsCl units per unit cell is 1.

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115. Potassium dichromate belongs to which crystal system?

(a) Tetragonal (b) Orthorhombic
(c) Triclinic (d) Hexagonal
(e) Monoclinic

Kerala-CEE-2014

Ans. (c) : Potassium dichromate belongs to triclinic crystal system , which is the most asymmetric crystal system. For this systems intercepts, $a \neq b \neq c$ and crystal angle $\alpha \neq \beta \neq \gamma \neq 90^o$.

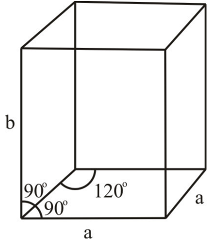
116. Which among the following solids crystallises as a face centred cube?

(a) Iron (b) Rubidium
(c) Uranium (d) Platinum

MHT CET-2014

Ans. (d) : Platinum solids crystallises as a face centred cubic while iron, rubidium and uranium are as body centred cubic crystal.

117. Ice crystallizes in a hexagonal lattice. At the low temperature, the lattice constants were a=4.53 $\overset{o}{A}$ and b=7.41 $\overset{o}{A}$ .How many H_2O molecules are contained in a unit cell? [d(ice)=0.92g/cm^3]



(a) 4 (b) 3
(c) 2 (d) 1

UPTU/UPSEE-2014

Ans. (a) : Given, $a = 4.53Å = 4.53 \times 10^{-8}$ cm

$b = 7.41Å = 7.41 \times 10^{-8}$ cm

Density (d) = 0.92 g cm^{-3}

$N_A = 6.023 \times 10^{23}$ mol^{-1}

Molar mass (M) = 18 g mol^{-1}

As we know that density (d) = $\frac{Z \times M}{VN_A}$

$$0.92 = \frac{Z \times 18}{(a^2b) \times 6.023 \times 10^{23}}$$

$$Z = \frac{0.92 \times (4.53 \times 10^{-8})^2 \times 7.41 \times 10^{-8} \times 6.023 \times 10^{23}}{18}$$

$Z = 4$

118. An ionic compound has a unit cell constituting of A ions at the corners of a cube and B ions on the centres of the faces of the cube. The empirical formula for the compound would be

(a) AB (b) A_2B
(c) AB_3 (d) A_3B

SRMJEEE – 2014

Ans. (c) : In one unit cell there are six faces present and each atom of face contribute with one another cubic unit cell. Similarly, corner atom contribute with 8 atom of another cubic unit cell.

$\therefore$ Number of A ions = $8 \times \frac{1}{8} = 1$

and number of B ions = $6 \times \frac{1}{2} = 3$

$\therefore$ Formula = AB_3

119. KF has NaCl-type structure. What is the distance between K^+ and F^- ions, the cell edge in cm is?

(a) 2 cm (b) $\frac{a}{2}$ cm
(c) 4a cm (d) $\frac{a}{4}$ cm

Assam CEE-2014

Ans. (b) : Since, for NaCl type unit cell , cations (K^+) ions are placed at edge center and anions (F^-) are placed at corner of the unit cell.

$\therefore$ Distance between K^+ and F^- = $\frac{1}{2} \times$ length of the edge (a).

120. What is the difference between the number of atoms per unit cell in face centerd cube and the number per unit cell in body centred cube?

(a) 2 (b) 1
(c) 4 (d) 6

GUJCET-2014

Ans. (a) : Number of atom in face centred cubic unit cell,

$$A_F = 8 \times \frac{1}{8} + 6 \times \frac{1}{2}$$
$$= 1 + 3$$
$$A_F = 4$$

Number of atoms in body centred cubic unit cell,

$$A_b = 8 \times \frac{1}{8} + 1 = 2$$

$\therefore$ Difference = $A_f - A_b = 4 - 2 = 2$

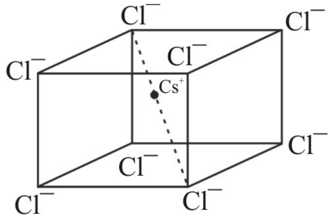
121. CsCl crystallises in body centered cubic lattice. If 'a' its edge length, then which of the following expressions is correct?

(a) $r_{Cs^+} + r_{Cl^-} = 3a$ (b) $r_{Cs^+} + r_{Cl^-} = \frac{3a}{2}$

(c) $r_{Cs^+} + r_{Cl^-} = \frac{\sqrt{3}}{2}a$ (d) $r_{Cs^+} + r_{Cl^-} = \sqrt{3a}$

[JEE Main 2014]

Ans. (c) :



In CsCl structure, Cs^+ ion is in contact with Cl^- ion at the nearest distance–

$$2r_{Cs^+} + 2r_{Cl^-} = \sqrt{3}\,a$$

@apna_pdf

$$2(r_{Cs^+}+r_{Cl^-})=\sqrt{3}\,a$$

$$r_{Cs^+}+r_{Cl^-}=\frac{\sqrt{3}}{2}a$$

122. Volume occupied by single CsCl ion pair in a crystal is 7.014 × 10^{-23} cm^3. The smallest Cs-Cs internuclear distance is equal to length of the side of the cube corresponding to volume of one CsCl ion pair. The smallest Cs to Cs internuclear distance is nearly

(a) 4.4 Å (b) 4.3 Å

(c) 4 Å (d) 4.5 Å

Karnataka-CET-2014

Ans. (c) : The volume of the unit cell is 7.014 ×10^{-23} cm^3.

According to the given condition

Edge length (a) = (volume of one CsCl ion pair)$^{1/3}$

$a = (7.014 \times 10^{-23} cm^3)^{1/3} = 4.124\times10^{-8}$

a = 4Å

123. The radius of an atom is 300 pm. If it crystallizes in a face-centered cubic lattice, the length of the edge of the unit cell is

(a) 488.5 pm (b) 848.5 pm

(c) 884.5 pm (d) 484.5 pm

COMEDK-2014

Ans. (b) : Given r = 300 pm

For fcc, $a = 2\sqrt{2}\ r$

a= $2\sqrt{2}\times300pm = 848.4pm$

124. The crystal lattice of electrovalent compound is composed of

(a) oppositely charged ions

(b) both molecules and ions

(c) molecules

(d) atoms.

J & K CET-(2014)

Ans. (a) : The regular arrangement of constituent of a crystalline solid in there dimensional space is called the crystal lattice or space lattice.

The crystal lattice of electrovalent compound composed of oppositely charged ions.

125. The existence of a substance in more than one solid modifications is known as

(a) Ismorphism (b) Polymorphism

(c) Amorphism (d) Allotropy

[AIIMS-2013]

Ans. (b) : The existence of a substance is more than one solid modifications is known as polymorphism. It is the ability of a solid material to exist in more than one state or crystal structure.

Polymorphism can potentially be found in any crystalline including polymers, minerals, and metals, and is related to allotropy, which refers to chemical elements.

126. CsBr crystallizes in a body-centred cubic unit lattice with an edge length of 4.287 $\overset{\circ}{A}$. How many molecules of CsBr will be present in the unit lattice?

(a) 1 (b) 2

(c) 3 (d) 4

AMU-2013

Ans. (a) : In CsBr unit cell structure Br^- ions are arranged in a simple cubic arrangement. In this arrangement the Br^- ions are present at all the corner of the cube. The Cs^+ ions occupy the cubic state i.e, Cs ions are present at the body centre of the cube. Number of Br^- ions = $8\times\frac{1}{8}$

= 1 ions per unit cell.

In Cs^+ ion in the body centre and its contribution per unit cell is 1.

Hence, there is one Br^- ion for each Cs^+ ion. There is one molecule of CsBr in the unit lattice.

127. Which of the following exists as covalent crystals in the solid state?

(a) Iodine (b) Silicon

(c) Sulphur (d) Phosphorus

[JEE Main 2013]

Ans. (b) : Silicon exists as a covalent crystal in solid state. It is network like structure, as seen in diamond.

128. KF has ccp structure. How many F^-ions and octahedral voids are there in this unit cell respectively?

(a) 4 and 4 (b) 4 and 8

(c) 8 and 4 (d) 6 and 6

JIPMER-2013

Ans. (a) : For KF, fcc structure, the anions occupy corners and face atom which contributes

$= 8\times\frac{1}{8} + 6\times\frac{1}{2}$

= 1 + 3

= 4

Since the charge must be balanced there must be 4 k^+ atoms that occupy octahedral voids.

So, F^- ions and octahedral voids are 4, 4.

129. The number of carbon atoms per unit cell of diamond unit cell is

(a) 6 (b) 1

(c) 4 (d) 8

(NEET-2013)

Ans. (d) : Diamond atoms are present in face – centred cubic (fcc) unit cell.

So, Total number of atoms in corner = $\frac{1}{8}\times8 = 1$

And total number of atoms in face centred = $\frac{1}{2}\times6 = 3$

Then, total atom at corner and face center = 1+ 3 = 4C. atom

Here carbon atoms occupies the corners face center and also half of the tetrahedral voids. The number of carbon atoms per unit cell =

$$8\times\frac{1}{8}+6\times\frac{1}{2}+8\times\frac{1}{2}=8$$

So, 8 atoms are presence in diamond unit cell.

130. Two ions A^+ and B^- have radii 104 and 200 pm respectively, in a cubic close packed crystal of compound AB. The co-ordination no. of A^+ is

(a) 4 (b) 8

(c) 6 (d) 3

COMEDK-2012

@apna_pdf

Ans. (c) : Given that,
Radius of A^+ = 104 pm
Radius of B^- = 200 pm

So, radius ratio= $\frac{r^+}{r^-} = \frac{104}{200} = 0.52$pm

It lies in the range of 0.414 to 0.732, then the coordination number is 6.

131. The crystal structure of solid Mn(II) oxide is
(a) NaCl structure
(b) Fe_2O_3 structure
(c) CaF_2 structure
(d) Na_2O structure

J & K CET-(2012)

Ans. (a) : The crystal structure of solid Mn(II) oxide is NaCl structure.
- Iron (III) oxide structure – Fe_2O_3.

132. Silver iodide is used for producing artificial rain because AgI
(a) is easy to synthesize
(b) has crystal structure similar to ice
(c) is insoluble in water
(d) is easy to spray at high altitude

Karnataka-CET-2012

Ans. (b) : Solid silver iodide is preferred as a nueteator for artificially stimulated rain because its crystal lattice parameters are close to those of ice, and for that reason are more effective than other salt in causing small ice crystals in clouds to melt.

133. The number of nearest neighbours around each particle in a face centred cubic unit cell is:
(a) 4
(b) 6
(c) 8
(d) 12

MPPET - 2012

Ans. (d) : In the face centred cubic lattice, the atoms are present at the corner of the cubic lattice as well as on the face centres. The nearest neighbours = 12

Cubic System	**No. of Neighbour atom**
Simple cubic unit cell (SC)	6
Body centred cubic unit cell (BCC)	8
Face centred cubic unit cell (FCC)	12
(Hexagonal centred cubic unit cell (HCP)	12

134. The radius ratio of a substance is 0.32. The coordination number of the substance is
(a) 8
(b) 3
(c) 6
(d) 4

COMEDK-2011

Ans. (d) : Given, radius ratio is 0.32 lies in the range of 0.225 to 0.414 . Thus the co-ordination number is 4.

135. Tetragonal crystal system has the following unit cell dimensions
(a) $a = b = c, \alpha = \beta = \gamma = 90°$
(b) $a = b \neq c, \alpha = \beta = \gamma = 90°$
(c) $a \neq b \neq c, \alpha = \beta = \gamma = 120°$
(d) $a = b \neq c, \alpha = \beta = 90°, \gamma = 120°$

VITEEE- 2011

Ans. (b) : The dimensions of the tetragonal crystal system are $a = b \neq c$ and $\alpha = \beta = \gamma = 90°$. Hence, two edge length are equal and all the angles are 90°.

136. The number of unit cells present in 39 g of potassium if it crystallizes as body centred cube is (N= Avogadro number, At. wt. of potassium= 39)
(a) $\frac{N}{4}$
(b) $\frac{N}{2}$
(c) $\frac{N}{3}$
(d) N

AP-EAMCET- (Engg.)-2011

Ans. (b) : Given that,
Potassium has BCC system.
$\therefore$ In BCC system 2 atoms are present in 1 unit cell.

Number of moles $= \frac{39}{39} = 1$ mol

Since, 1 mole of atoms = 6.022×10^{23} atoms = N

$\therefore$ N number of atoms are present in $\frac{N}{2}$ unit cells.

137. In zinc blende structure, the coordination number of the cation is
(a) 4
(b) 6
(c) 8
(d) 12

J & K CET-(2011)

Ans. (a) : Zinc blende (ZnS) has FCC structure. It is an ionic crystal having 4 : 4 coordination number.
S^{2-} form FCC lattice and Zn^{2+} has alternate tetrahedral voids. Hence, in zinc blende structure, the coordination number of cation is 4.

138. Assertion (A) White tin is an example of tetragonal system.
Reasoning (R) for a tetragonal system a=b=c and $\alpha = \beta = \gamma \neq 90^\circ$. The correct answer is
(a) (A) and (R) are true and (R) is the correct explanation of (A).
(b) Both (A) and (R) are true and (R) is not the correct explanation of (A).
(c) (A) is true but (R) is not true.
(d) (A) is not true but (R) is true.

AP-EAMCET- (Engg.) - 2010

Ans. (c) : White tin is an example of tetragonal system. For a tetragonal system, one side is not equal to other while all angles are equal i.e. $a = b \neq c$ and $\alpha = \beta = \gamma = 90°$.

139. A metal has bcc structure and the edge length of its unit cell is 3.04Å. The volume of the unit cell in cm^3 will be
(a) $1.6 \times 10^{-21} cm^3$
(b) $2.81 \times 10^{-23} cm^3$
(c) $6.02 \times 10^{-23} cm^3$
(d) $6.6 \times 10^{-24} cm^3$

BCECE-2010

Ans. (b) : Edge length 'a' = 3.04 Å
= 3.04×10^{-8} cm
Volume of unit cell (v) = a^3
= $(3.04 \times 10^{-8} cm)^3$
= $2.81 \times 10^{-23} cm^3$

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140. If the radius of K^+ and F^- are 133 pm and 136 pm respectively, the distance between K^+ and F^- in KF is

(a) 269 pm (b) 134.5 pm
(c) 136 pm (d) 3 pm

JCECE - 2010

Ans. (a) : Distance between K^+ and F^- in KF

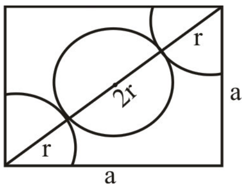
$$= r_{K^+} + r_{F^-} = 133 + 136 = 269 \text{ pm}$$

141. If a be the edge length of the unit cell and r be the radius of an atom then for FCC arrangement, the correct relation is

(a) $4a = \sqrt{3}\,r$ (b) $4r = \sqrt{3}\,a$
(c) $4r = \sqrt{2}\,a$ (d) $4r = \dfrac{a}{\sqrt{2}}$

JIPMER-2010

Ans. (c):



In the face diagonal, the length of the face diagonal will be equal to

$$\Rightarrow a^2 + a^2 = (r + 2r + r)^2$$
$$2a^2 = (4r)^2$$
$$\sqrt{2a^2} = 4r$$
$$\sqrt{2}\,a = 4r$$

142. Coordination numbers of Zn^{2+} and S^{2-} in the crystal structure of wurtzite are

(a) 4,4 (b) 6,6
(c) 8,4 (d) 8,8

[AIIMS-2010]

Ans. (a) : Coordination numbers of Zn^{2+} and S^{2-} in the crystal structure of wurtzite are 4,4. Sulphide ions occupies CCP while zinc ions occupy alternate tetrahedral voids. Number of formula units per unit cell is 4.

143. The radius of Na^+ is 95 pm and that of Cl^- ion is 181 pm. Hence, the coordination number of Na^+ will be

(a) 4
(b) 6
(c) 8
(d) unpredictable

VITEEE- 2010

Ans. (b) :

$$\text{Radius ratio} = \frac{\text{Radius of cation, } r^+}{\text{Radius of anion } r^-} = \frac{95}{181} = 0.525$$

As this value lies in between 0.414 – 0.732, thus, the coordination number of Na^+ ion will be 6.

144. The number of Na^+ ions filling all octahedral voids in NaCl structure is

(a) 9 (b) 12
(c) 13 (d) 14

CG PET- 2010

Ans. (c) : Since, there is one octahedral void at the body centre and 12 octahedral voids at the midpoint of axis in NaCl crystal, the total number of octahedral voids = 1 + 12

= 13

Thus , $13Na^+$ ion are present in the NaCl structure.

However, the number of effective octahedral voids in NaCl is 4.

145. Lithium forms body-centred cubic structure. The length of the side of its unit cell is 351 pm. Atomic radius of the lithium will be

(a) 75 pm (b) 300 pm
(c) 240 pm (d) 152 pm

[AIEEE 2010]

Ans. (d) : In the body centred cubic structure.

$$\text{Radius (r)} = \frac{\sqrt{3}}{4}a$$

Given that –

Edge length 'a' = 351 pm

So,

$$r = \frac{\sqrt{3}}{4} \times 351 \text{ pm}$$
$$r = \frac{1.732}{4} \times 351 \text{ pm}$$
$$r = 152 \text{ pm}$$

146. The edge length of a face centered cubic cell of an ionic substance is 508 pm. If the radius of the cation is 110 pm, the radius of the anion is

(a) 288 pm (b) 398 pm
(c) 618 pm (d) 144 pm

[AIEEE 2010]

Ans. (d) : For the ionic substance in face centred cubic arrangement.

Given that –

Radius of cation (r^+) = 110 pm

Edge length (a) = 508 pm

$\therefore \quad 2(r^+ + r^-) = \text{edge length}$

$\Rightarrow \quad 2(r^+ + r^-) = a$

$\Rightarrow \quad (110 + r^-) = \dfrac{a}{2} = \dfrac{508}{2}$

$\Rightarrow \quad 110 + r^- = 254$

$r^- = 254 - 110$

$r^- = 144$

147. The space lattice of graphite is

(a) cubic (b) tetragonal
(c) rhombic (d) hexagonal

[AIIMS-2009]

Ans. (d) : Graphite is composed of layers of carbon atoms that are arranged in 6-membered, hexagonal rings. These rings are attached to one another on their edges. Carbon atoms in these ring are in the sp^2 hybridized state.

148. Edge length of a cube is 400 pm, its body diagonal would be

(a) 566 pm (b) 600 pm
(c) 500 pm (d) 693 pm

JCECE - 2009

@apna_pdf

Ans. (d) : Given that –

edge length 'a' = 400 pm

The body diagonal = $\sqrt{3}$ a

$= \sqrt{3} \times 400$

$= 1.732 \times 400 = 693$ pm

149. In NaCl crystal each Cl^- ion is surrounded by

(a) $4Na^+$ ions (b) $6Na^+$ ions

(c) $1\ Na^+$ ion (d) $2\ Na^+$ ions

UPTU/UPSEE-2009

Ans. (b) : Sodium chloride (NaCl) crystal consists of Na^+ and Cl^- ions. Each Na^+ ion is surrounded by six Cl^- ions and each Cl^- ion is surrounded by six Na^+ ions. Thus, in sodium chloride, Na^+ as well as Cl^- ions have the coordination number of 6.

150. Arrangement of Sulphide ions in Zinc blende is.........

(a) FCC (b) BCC

(c) HCP (d) Simple cubic

GUJCET-2008

Ans. (a) : Sulphide ion in zinc blende are present at the corners as well as at the centre of each face of the cube. So, the arrangement of sulphide ion in zinc blend is FCC.

151. For AX ionic crystal to exist in BCC structure, the ratio of radii $\left(\frac{r_{cation}}{r_{anion}}\right)$ should be

(a) between 0.41 and 0.73

(b) greater than 0.73

(c) less than 0.41

(d) equal to 1.0

J & K CET-(2008)

Ans. (b) : In the body centred cubic (bcc) structure the ratios of radii $\left(\frac{r_{cation}}{r_{anion}}\right)$ lies in between 0.732 – 1.00.

Hence, The ratio or radii for bcc structure is greater than 0.73.

In the BCC structure cubic avoid present then cubic avoid radii ratio = 0.732 -1.0

152. An ionic compound is expected to have tetrahedral structure if r_+/r_- lies in the range of

(a) 0.414 to 0.732 (b) 0.225 to 0.414

(c) 0.155 to 0.225 (d) 0.732 to 1

KARNATAKA-CET, 2008

Ans. (b) :

Radius ratio (r_+ /r_-)	**Structure**
< 0.155	linear
0.155 – 0.225	planar triangular
0.225 – 0.414	tetrahedral
0.414 – 0.732	octahedral
0.732 – 1	bcc

153. A compound is formed by elements A and B. This crystallizes in the cubic structure where the A atoms are the at the corners of the cube and B atoms are at the body centres. The simplest formula of the compound is :

(a) AB (b) A_6B

(c) A_8B_4 (d) AB_6

KARNATAKA-CET, 2008

Ans. (a) : Since, A atoms are present at the corners of the cube,

Number of A atoms per unit cell = $8 \times \frac{1}{8} = 1$

Number of B atoms per unit cell = 1

($\because$ present at the body centre of the cube)

Hence, the formula of the compound = AB

154. KCl crystallises in the same type of lattice as does NaCl. Given that $r_{Na^+}/r_{Cl^-} = 0.55$ and $r_{k^+}/r_{Cl^-} = 0.74$. Calculate the ratio of the side of the unit cell for KCl to that of NaCl.

(a) 1.123 (b) 0.0891

(c) 1.414 (d) 0.414

(e) 1.732

Kerala-CEE-2008

Ans. (a): In the NaCl type structure, $r^+ + r^- = \frac{a}{2}$ where a is the edge length of the unit cell.

So,

$$= \frac{a_{KCl}}{a_{NaCl}} = \frac{r_{K^+} + r_{Cl^-}}{r_{Na^+} + r_{Cl^-}}$$

$$= \frac{\frac{r_{K^+}}{r_{Cl^-}} + 1}{\frac{r_{Na^+}}{r_{Cl^-}} + 1}$$

$$= \frac{0.74 + 1}{0.55 + 1} = \frac{1.74}{1.55}$$

$= 1.123$

155. The radius ratio in CsCl is 0.93. The expected lattice structure is

(a) tetrahedral (b) square planar

(c) octahedral (d) body-centred cubic

UPTU/UPSEE-2008

Ans. (d) : The ratio of the radius of the cation to the radius of the anion is called radius ratio. From this ratio the structure of lattice can be determined by using the following table.

r_c/r_a	**Arrangement**
0.155 – 0.225	Planar triangular
0.414 – 0.732	Octahedral
0.732 – 1.0	Body centred cubic
0.225 – 0.414	Tetrahedral

Here, the radius ratio of CsCl is 0.93 hence its lattice structure is body-centred cubic.

156. NH_4Cl crystallises in a body centred cubic lattice with edge length of unit cell equal to 387 pm. If the radius of the Cl^- ion is 181 pm, then radius for NH_4^+ ion is

(a) 154.1 pm (b) 92.6 pm

(c) 366.3 pm (d) none of these,

SRMJEEE – 2008

Ans. (a) : Given - crystal type = BCC

a = 387 pm

r_{Cl^-} = 181 pm

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$r_{NH_4^+} = ?$

Now, from the relation of radius and edge length –

$$r = \frac{\sqrt{3}}{2}a$$

$$r = \frac{\sqrt{3}}{2} \times 387\,\text{pm}$$

$$r = 335.142\text{ pm}$$

$$\because \quad r_{NH_4^+} + r_{Cl^-} = 335.142\text{ pm}$$

$$r_{NH_4^+} = 335.142 - 181$$

$$r_{NH_4^+} = 154.1\text{ pm}$$

157. A cubic close packed (ccp) structure contains 'N' atoms. The tetrahedral and octahedral voids, respectively, will be

(a) N and N (b) 2N and 2N

(c) 2N and N (d) N and 2N

AMU – 2007

Ans. (c) **:** In cubic close packed (CCP) arrangement, there is two tetrahedral and one octahedral voids corresponding to each atoms, the tetrahedral and octahedral voids respectively will be 2N and N.

Number of tetrahedral voids per atom in lattice

$= N \times 2 = 2N$

Number of octahedral voids per atom in lattice

$= N \times 1 = N$

158. The crystalline structure of NaCl is

(a) hexagonal close packing

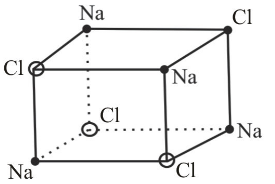
(b) face centered cubic

(c) square planar

(d) body centred cubic

J & K CET-(2007)

Ans. (b) :



Sodium Chloride (NaCl) has face centred cubic structure. It contains $4Na^+$ and $4Cl^-$ ions. Each Na^+ ion is surrounded by $8Cl^-$ ions and each Cl^- ion is also surrounded by $8Na^+$ ions.

159. The cubic unit cell of Al (molar mass 27 g mol^{-1}) has an edge length of 405 pm. Its density is 2.7g cm^{-3}. The cubic unit cell is

(a) face centred (b) body centred

(c) primitive (d) edge centred

(e) simple

Kerala-CEE-2007

Ans. (a) : Given that –

Molar mass (M) = 27 g mol^{-1}

Edge length (a) = 405 pm

$= 4.05 \times 10^{-10}$ cm

Density (d) = 2.7 g cm^{-3}

So, $$d = \frac{Z \times M}{a^3 \times Na}$$

$$Z = \frac{d \times a^3 \times Na}{M}$$

$$Z = \frac{2 \cdot 7 \times (405 \times 10^{-10})^3 \times 6.023 \times 10^{23}}{27}$$

$$Z = 4$$

The FCC (face centred cubic) unit cell contain 4 atom.

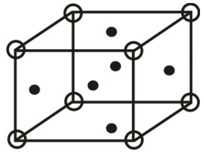
160. In a face centred cubic lattice, a unit cell is shared equally by how many unit cells?

(a) 4 (b) 2

(c) 6 (d) 8

CG PET -2007

Ans. (c) : In a face centred cubic (FCC) unit cell. Consist of 6 faces. So, it is equally shared by 6 unit cell.



161. AB is an ionic solid. The ionic radii of A$^+$ and B$^-$ are r_c and r_a respectively. Lattice energy of AB is proportional to

(a) $\frac{r_c}{r_a}$ (b) $(r_c + r_a)$

(c) $\frac{r_a}{r_c}$ (d) $\frac{1}{(r_c + r_a)}$

A.P.EAMCET-2006

Ans. (d) : Given that,

Ionic radii of $A^+ = r_c$

Ionic radii of $B^- = r_a$

Lattice energy $(U) \propto \frac{q_c q_a}{r_c + r_a}$

So, lattice energy of AB is $U_{AB} \propto \frac{1}{(r_c + r_a)}$

162. Sodium metal crystallizes at room temperature in a body centred cubic lattice with a cell edge a = 4.29 Å. The radius of sodium atom is:

(a) 1.40 (b) 2.65

(c) 1.85 (d) 2.15

AP-EAMCET (Medical), 2006

Ans. (c) : Given data :

$a = 4.29$Å

$r_{Na} = ?$

For BCC lattice, the relation between radius of atom and edge length can be written as-

$$r = \frac{\sqrt{3}}{4}a$$

or $$r = \frac{\sqrt{3}}{4} \times 4.29\text{Å}$$

$$r = 1.85\text{Å}$$

163. Assertion: Graphite is an example of tetragonal crystal system.

Reason: For a tetragonal system, $a = b \neq c, \& \alpha = \beta = 90^\circ, \gamma = 120^\circ$

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(a) If both Assertion and Reason are correct and the Reason is a correct explanation of the Assertion.
(b) If both Assertion and Reason are correct but Reason is not a correct explanation of the Assertion.
(c) If the Assertion is correct but Reason is incorrect.
(d) If both the Assertion and Reason are incorrect.
(e) If the Assertion is incorrect the Reason is correct.

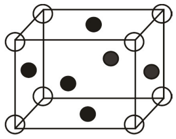
[AIIMS-2006]

Ans. (c) :
A :– Graphite is an example of hexagonal crystal system for which $\alpha = \beta = 90^o$ and $\gamma = 120^o$ and $a = b \neq c$. So, assertion is false.
R:– For tetragonal system, $a = b \neq c$ and $a = \beta = \gamma = 90$.
So, reason are incorrect.

164. The rank of a face centred cube unit cell is
(a) 1 (b) 2
(c) 4 (d) 6

AMU–2006

Ans. (c) : Face centered cubic with atoms at the corners as well as 6 face of the cube.

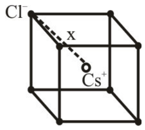


FCC Contribution $= 8\times\frac{1}{8}+\frac{1}{2}\times 6$
$= 1 + 3$
$= 4$

165. Interionic distance for CsCl crystal is
(a) a (b) $\frac{a}{2}$
(c) $\frac{\sqrt{3}}{2}a$ (d) $\frac{2a}{\sqrt{3}}$

CG PET -2006

Ans. (c) : The interionic distance for caesium chloride is between the Cs^+ cation present at the body center and Cl^- anion present at the corner which is equal to half the length of diagonal.



x = intreionic distance
body diagonal length $= \sqrt{3}a$
$x = \frac{\sqrt{3}a}{2}$

166. How many space lattices are obtained from the different crystal systems?
(a) 7 (b) 14
(c) 32 (d) 230

CG PET -2006

Ans. (b) : There are 7 type of crystal lattice while space lattice is 14 type are obtained from the different crystal system.

167. The radius ratio $\left[\frac{r^+}{r^-}\right]$ of an ionic solid $(A^+B^-)$is 0.69. What is the coordination number of B^-?
(a) 6 (b) 8
(c) 2 (d) 10

J & K CET-(2006)

Ans. (a) : Permitted coordination number for the ratio value 0.414 – 0.732 is 6.

Sr. No.	Limiting Value of radius ratio (r^+/r^-)	Coordination no. of cation	Structural arrangement
1	0 -0.155	2	Linear
2	0.155-0.225	3	Planner triangular
3	0.225 -0.414	4	Tetrahedral
4	0.414 - 0.732	6	Octahedral
5	0.732 - 1.00	8	Cubic

168. In CsCl type of structure co-ordination of Cs^+ and $Cl^-$are :
(a) 6,6 (b) 6,8
(c) 8,8 (d) 8,6

UPTU/UPSEE-2005

Ans. (c) : In CsCl, cesium ions forms the simple cubic arrangement and chloride (Cl^-) ion occupy the interstitial sites such that each cesium ion is surrounded by 8 chloride ions and each cesium ions surrounded by 8 cesium ion, hence the coordination is 8:8.

169. Structure of NaCl crystal is
(a) tetragonal (b) cubic
(c) orthorhombic (d) monoclinic

CG PET -2004

Ans. (b) : For the sodium chloride (NaCl) the chloride ions are arranged in a cubic structure (Called face centred cubic) and sodium ions occupy octahedral voids between them. Each Sodium ion is surrounded by 6 chloride ions.

170. Bravais lattices are of
(a) 8 types (b) 12 types
(c) 14 types (d) 9 types

CG PET -2004

Ans. (c) : A Bravais lattice is a mathematical construct, designed to describe the underlying periodicity of a crystal.
There are 14 types of Bravais lattice.

171. A solid is made of two elements X and Z. The atoms Z are in CCP arrangement while the atom X occupy all the tetrahedral sites. What is the formula of the compound?
(a) XZ (b) XZ_2
(c) X_2Z (d) X_2Z_3

UPTU/UPSEE-2004

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Ans. (c) :
CCP arrangement has 4 atom. Atom Z are in CCP arrangement so total atom of Z = 4.
Tetrahedral sites are double of total number of atom present in the unit cell.
So,

Tetrahedral sites present = 2 × 4
= 8

X occupy tetrahedral sites, so total number of X present = 8
Formula of compound is $X_8 Z_4$ or X_2Z.

172. In which of the crystals of ionic compounds would you expect maximum distance between the centres of cations and anions?

(a) LiF (b) CsF
(c) CsI (d) LiI

J & K CET-(2003)

Ans. (c) : The ionic radii of Cs^+ is highest among the given cations and ionic radii of I^- is highest among the given anions. Therefore, the maximum distance between the centers of cations and ions occurs in CsI.

173. What is the coordination number of sodium Na_2O?

(a) 6 (b) 4
(c) 8 (d) 2

[AIIMS-2003]

Ans. (b) : The coordination number of Na in Na_2O is 4. Na^+ ion is surrounded by four oxide ions and O_2^- ion is surrounded by eight Na^+ ions.
Hence, the coordination number of Na in Na_2O is 4.

174. What is the coordination number of body centred cube?

(a) 8 (b) 6
(c) 4 (d) 12

UP CPMT-2003

Ans. (a) : The unit cell of body centred cube has one atom at each of the eight corners and one atom at the centre of body.
∵ the atom at centre is in contact with 8 other atoms
∴ the coordination number in bcc = 8

175. An AB_2 type structure is found in

(a) NaCl (b) CaF_2
(c) Al_2O_3 (d) N_2O

[AIIMS-2002]

Ans. (b) : If we break the AB_2 type structure then we get :

$AB_2 \rightleftharpoons A^{2+} + 2B^-$

Similarly, if we break CaF_2 then

$$CaF_2 \rightleftharpoons Ca^{2+} + 2F^-$$

∴ AB_2 type of structure is present in CaF_2.

176. To which of the crystal systems does TiO_2(titanium oxide) belongs?

(a) tetragonal (b) cubic
(c) hexagonal (d) monoclinic

J & K CET-(2001)

Ans. (a) : Tetragonal crystal lattice result from stretching a cubic lattice along becomes a rectangular prism with a square base and a height.
In tetragonal Bravais lattices related are

$$a = b \neq c \text{ and } \alpha = \beta = \gamma = 90°$$

titanium dioxide (body-centered tetragonal)
the titanium cations have a coordination number of 6 meaning they are surrounded by octahedron of 6 oxygen atoms. The oxygen anions have a co-ordination number of 3 resulting interregional planar coordination.

177. When Zn converts from melted state to its solid state, it has hcp structure, then find the number of nearest atoms.

(a) 6 (b) 8
(c) 12 (d) 4

(NEET-2001)

Ans. (c) : Zn is in hcp structure and has co–ordination number of 12.
It means the number of nearest neighbours is 12, six are in the plane, 3 above the plane and 3 below the plane.

178. What is the crystal structure of cesium chloride?

(a) Body centred cubic (b) Face centred cubic
(c) Tetrahedral (d) Octahedral

A.P.EAMCET-2000

Ans. (a) : In cesium chloride crystal lattice, the chloride ion (Cl^-) are present at each corner and Cs^+ are present at body centre cubic lattice. The crystal structure of CsCl is body centered cubic.

179. Each unit cell of NaCl consists of 6 chlorine atoms and

(a) 13 Na atoms (b) 14 Na atoms
(c) 8 Na atoms (d) 6 Na atoms

J & K CET-(2000)

Ans. (d) : Each unit cell of NaCl consist of 6 chlorine atoms and 6 sodium atom. For NaCl each Na^+ is surrounded by $6Cl^-$ ion at the corners of a regular octahedron and similarly each Cl^- ion is surrounded by Na^+ ion .

180. The range of radius ratio (cationic to anionic) for an octahedral arrangement of ions in an ionic solid is

(a) 0 – 0.155 (b) 0.155 – 0.225
(c) 0.225 – 0.414 (d) 0.414 – 0.732

J & K CET-(1998)

Ans. (d) : • If the radius ratio is less than 0.155, the coordination number is 2. The position of anions around cation will be linear.

- $\frac{r\oplus}{r-} = 0.155 - 0.225$ for triangular void
- $\frac{r+}{r-} = 0225 - 0.414$ for tetrahedral void
- $\frac{r+}{r-} = 0.414 - 0.732$ for octahedral void.

181. CsBr crystal has BCC structure. It has an edge length of 4.3 Å. The shortest interionic distance between Cs^+ and Br^- ions is

(a) 3.72 Å (b) 1.86 Å
(c) 7.44 Å (d) 4.3 Å

J & K CET-(1998)

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Ans. (a) : Given that –
edge length 'a' = 4 ·3 Å
In body centred cubic (bcc) unit cell

$$4r = \sqrt{3}\,a$$

$$r = \frac{\sqrt{3}}{4}a$$

$$r\ \frac{\sqrt{3}}{4}\times 4.3\,\text{Å}$$

$$r = \frac{1.732\times 4.3}{4}\,\text{Å}$$

$$r = 1{\cdot}86\ \text{Å}$$

Now,
The shortest interionic distance
R = 2r
R = 2 ×1.86
R = 3.72 Å

182. In crystals of which one of the following ionic compounds would you expect maximum distance between centres of cations and anions?
(a) CsI
(b) CsF
(c) LiF
(d) LiI

(NEET-1998)

Ans. (a) : The ionic radii of Cs^+ is highest among the given cations and ionic radii of I^- is highest among the given anions, therefore the maximum distance between the centers of cations and anions occurs in CsI.

183. In CsCl structure, each Cs^+ ion is surrounded by
(a) 4 Cl^- ions
(b) 6 Cl^- ions
(c) 8 Cl^- ions
(d) 12 Cl^- ions

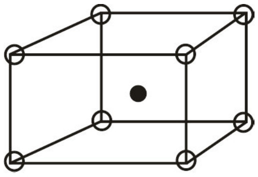
J & K CET-(1997)

Ans. (c) : In CsCl type structure, Cs^+ and Cl^- ions have 8:8 co–ordination; i.e. each Cs^+ is surrounded by 8 Cs^+ ion.

184. The intermetallic compound LiAg crystallizes in cubic lattice in which both lithium and silver have coordination number of eight. The crystal class is
(a) face-centred cube
(b) simple cube
(c) body-centred cube
(d) none of these.

(NEET-1997)

Ans. (c) : The intermetallic compound Li–Ag crystallizes in a cubic lattice in which both lithium and silver have a coordination number of 8. The crystal class is body – centred cubic. The coordination number of simple cubic, body – centred cubic, hexagonal closed packing and face – centred cubic are 6, 8, 12 and 12 respectively.
The structure of bcc.



185. Assertion: In crystal lattice, size of the cation is larger in a tetrahedral hole than in an octahedral hole.
Reason: The cations occupy more space than anions in crystal packing.
(a) If both Assertion and Reason are true and the Reason is a correct explanation of the Assertion
(b) If both Assertion and Reason are true but Reason is not a correct explanation of the Assertion
(c) If Assertion is true but the Reason is false
(d) If both Assertion and Reason are false

AIIMS-1996

Ans. (d): In crystal lattice tetrahedral void is smaller than the octahedral void because the concerned geometry. Anion are larger in size than cations so anions occupy more space.
It means assertion and reason both are incorrect so option (d) is correct.

186. The fcc crystal contains how many atoms in each unit cell?
(a) 6
(b) 8
(c) 4
(d) 5

(NEET-1996)

Ans. (c) : In face centred cubic unit cell. The atoms corner and face – centre. There are total eight (8) corner and each contribution is 1/8 and there are 6 face centre and each contribution is ½ .
So,

$$\text{Number of atom in fcc} = \frac{1}{8}\times 8 + \frac{1}{2}\times 6$$
$$= 1 + 3$$
$$= 4.$$

The total number of atoms in fcc unit cell is 4.

187. In the fluorite structure, the coordination number of Ca^{2+} ion is
(a) 4
(b) 6
(c) 8
(d) 3

(NEET-1993)

Ans. (c) : In fluorite structure each Ca^{2+} ion is surrounded by eight F ion . Thus , the coordination number of Ca^{2+} is eight, In fluorite structure each F^- ion is surrounded by four Ca^{2+} ion whereas each Ca^{2+} is surrounded by eight F^- ions, giving a body centred cubic arrangement thus the coordination number of Ca^{2+} and F^- are 8 and 4.

188. For orthorhombic system axial ratio are a≠b≠c and the axial angles are
(a) $\alpha = \beta = \gamma \neq 90°$
(b) $\alpha = \beta = \gamma = 90°$
(c) $\alpha = \gamma = 90°,\ \beta \neq 90°$
(d) $\alpha \neq \beta \neq \gamma \neq 90°$

NEET-(1991)

Ans. (b) : In the orthorhombic crystal system have axial ratios are $a \neq b \neq c$ and axial angles are $\alpha = \beta = \gamma = 90^0$.
It means all the edges lengths are unequal while all the axial angles are equal.

@apna_pdf

189. Iron crystallizes in several modifications. At about 911°C, the bcc 'α' form undergoes a trasition to fcc 'γ' form. If the distance between the two nearest neighbours is the same in the two forms at the transition temperature, the ratio of the density of iron in FCC form (ρ_2) to that of iron of BCC form (ρ_1) at the transition temperature

(a) $\frac{\rho_1}{\rho_2} = 0.918$ (b) $\frac{\rho_1}{\rho_2} = 0.718$

(c) $\frac{\rho_1}{\rho_2} = 0.518$ (d) $\frac{\rho_1}{\rho_2} = 0.318$

VITEEE-2017

Ans. (a) : Given that,

distance of BCC is (ρ_1)

distance of FCC is (ρ_2)

∴ Relation between edge length and radius

In BCC crystal structure,

$$4r = \sqrt{3}a$$

$$a = \frac{4r}{\sqrt{3}}$$

Therefore density $= \frac{Z \times M}{a^3}$

Where Z = no. of atom in unit cell

M = mass

$$\frac{\rho_1}{\rho_2} = \frac{2}{\left(\frac{4r}{\sqrt{3}}\right)^3} \times \frac{\left(\frac{4r}{\sqrt{2}}\right)^3}{4} = \frac{2}{4} \times \left(\frac{\sqrt{3}}{\sqrt{2}}\right)^3$$

$$\frac{\rho_1}{\rho_2} = 0.918$$

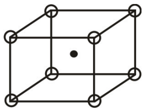
190. Number of atoms in the unit cells of Na (BCC type crystal) and Mg (FCC type crystal) are, respectively

(a) 4, 4 (b) 4, 2

(c) 2, 4 (d) 1, 1

JEE Main 2018

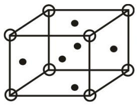
Ans. (c) : In BCC unit cell



Number of atoms in body centred cubic unit cell,

$$= 8 \times \frac{1}{8} + 1 = 2$$

In FCC unit cell



Number of atoms in FCC $= \frac{1}{8} \times 8 + \frac{1}{2} \times 6$

$= 1 + 3$

$= 4$

Therefore the correct option is (c).

3. Classification of Crystalline Solid

191. Which of the following is not correct for ionic crystals?

(a) They possess high melting point and boiling point

(b) All are electrolyte

(c) Exhibit the property of isomorphism

(d) Exhibit directional properties of the bond

Manipal-2019

Ans. (d) : Ionic crystal exhibit non-direction properties. of the bond.

192. Which of the following is a network crystalline solid?

(a) I_2 (b) AlN

(c) NaCl (d) Ice

Karnataka-CET-2019

Ans. (b) :

- I_2 is molecular crystalline solid.
- AlN is network crystalline solid.
- NaCl is crystalline solid.
- Ice is hexagonal crystalline solid.

193. Example of molecular solid is:

(a) $SO_2(s)$ (b) SiC

(c) C (graphite) (d) NaCl

[AIIMS-27 May, 2018(M)]

Ans. (a) : • Solid sulphur dioxide $SO_2(s)$ is a polar molecular solid. The comprised atoms or molecules are held together by stronger dipole – dipole interactions. They are soft and non – conductor of electricity.

- Silicon carbide (SiC) is covalent solid since the atoms of silicon are connected with carbon through covalent bonds.
- Graphite is covalent solid – strong covalent bonds are presents in between C atoms in graphite.
- NaCl (sodium chloride) is a ionic solid because they have cation (Na+) and anion (Cl^-).

194. Which of the following is a network solid?

(a) SO_2 (Solid)

(b) I_2

(c) Diamond

(d) H_2O (ice)

JCECE - 2013

Ans. (c) : Diamond is an example of network solid.

Any chemical compound in which covalent bond is present is known as network solid. The atoms in a continuous network extending throughout the material is called network solid or covalent network solid or atomic crystalline solids. Si, BN, SiO_2, Ge are other example of network solid.

@apna_pdf

195. Which one of the following is a covalent crystal?

(a) Rock salt (b) Ice

(c) Quartz (d) Dry ice

Karnataka-CET-2011

Ans. (c) : Covalent crystal are hard, frequently brittle materials such as diamond, silicon and silicon carbide. Molecular crystals are substances that have relative weak intermolecular binding.

In quartz, lattice points are made up of non-metal, and they are held by covalent bond. So, quartz is a covalent crystal.

196. Which of the following is a molecular crystal?

(a) Rock salt (b) Quartz

(c) Dry ice (d) Diamond

Karnataka-CET, 2010

Ans. (c) : Molecular crystals are substances that have relatively weak intermolecular binding, such as dry ice (solidified carbon dioxide), solid forms of the noble gases (e.g. Argon, Krypton and Xenon).

In dry ice (solid CO_2) constituents are molecules. The various molecules are held together through weak forces like dipole-dipole interaction, thus it is an molecular crystal.

197. Which of the following forms molecular solid?

(a) SO_2 (b) SiO_2

(c) SiC (d) Diamond

JIPMER-2004

Ans. (a) : In SO_2, molecules are bonded by weak van der Walls force. Hence, it is molecular solid.

198. A solid X melts slightly above 273 K and is a poor conductor of the heat and electricity. To which of the following categories does it belong?

(a) Ionic solid (b) Covalent solid

(c) Metallic solid (d) molecular solid

AMU–2001

Ans. (d) : Metals are good conductors of heat and electricity with variable melting points. Ionic solids are also good conductors of heat and electricity with very high melting point. Covalent solids are non-conductor of electricity and heat with very high melting points due to their strong bonding.

Molecular solids are poor conductors or heat and electricity and they have lower melting point than ionic solids.

199. In which crystal system, the length of each edge (edge length) is same?

(a) $BaSO_4$ (b) HgS

(c) $CaSO_4$ (d) ZnO

GUJCET-2017

Ans. (b) : $BaSO_4$ and $CaSO_4$ has a parallelepiped structure and ZnO has a hexagonal structure. So, in this molecules, the edge lengths are different whereas in HgS, it has a rhombohedral structure and same edge length. So, HgS (Mercury sulfide) is correct.

200. Cation and anion combines in a crystal to form following type of compound

(a) ionic (b) metallic

(c) covalent (d) dipole-dipole.

NEET-(2000)

Ans. (a) : Cation is a positively charged species and anion is a negatively charged species. We know that opposite charges always attract each other and this force of attraction is called the electrostatic force of attraction. It leads to the formation of ionic compound. An examples of ionic compounds is sodium chloride (NaCl) and copper sulphate ($CuSO_4$).

4. Packing Efficiency

201. Atoms of element X form hcp lattice and those of element Y occupy $\frac{2}{3}$ of its tetrahedral voids: The percentage of element X in the lattice is ________. (Nearest integer)

JEE Main-24.06.2022, Shift-I

Ans. (43) : Given,

Element X from hcp lattice element Y occupy $\frac{2}{3}$ of tetrahedral voids.

No. of atom X-atom 6

That means–

$$X = 6 \text{ [HCP lattice]}$$

$$Y = \frac{2}{3} \text{ X tetrahedral voids}$$

$$= \frac{2}{3} \times 12 = 8$$

$$\text{\% of element } X = \frac{\text{No.of X-atoms}}{\text{Total atom}} \times 100$$

$$= \frac{6}{14} \times 100 = 42.85$$

$$= 43\%$$

$$\text{\% of X in unit cell } = 42.857 \approx 43\%$$

202. Metal deficiency defect is shown by $Fe_{0.93}O$. In the crystal, some Fe^{2+} cations are missing and loss of positive charge is compensated by the presence of Fe^{3+} ions. The percentage of Fe^{3+} ions. The percentage of Fe^{2+} ions in the $Fe_{0.93}O$ crystals is_____. (Nearest integer)

JEE Main-27.06.2022, Shift-I

Ans. (84.94) : Metal deficiency defect is arises due to the absence of anions or the presence of extra cations at the interstitial sites

Here, Fe present in two oxidation state (+2) and (+3).

Number of $Fe^{2+} = x$

Number of $Fe^{3+} = 0.93 - x$

Then,

@apna_pdf

$$2x + 3(0.93 - x) = 2$$
$$2x + 0.93 \times 3 - 3x = 2$$
$$x = 0.79$$
$$\% \text{ of } Fe^{2+} = \frac{0.79}{0.93} \times 100$$
$$= 84.94\ \%$$

203. In a solid AB, A atoms are in ccp arrangement and B atoms occupy all the octahedral sites. If two atoms from the opposite faces are removed, then the resultant stoichiometry of the compound is A_xB_y. The value of x is——— [nearest integer]

JEE Main-26.06.2022, Shift-II

Ans. (3) : Given that,

Solid AB (ccp arrangement)

B atoms occupy octahedral voids

Stoichiometry of compound = A × By

$$A = \frac{1}{8} \times 8(\text{corner}) + \frac{1}{2} \times 4(\text{face center})$$
$$= 1 + 2 = 3$$

B = all octahedral voids = 4

Formula = A_3B_4

So, the value of x = 3

204. Total Volume of atoms present in a face-centred cubic unit cell of a metal is (r is atomic radius)

(a) $\frac{20}{3}\pi r^3$ (b) $\frac{24}{4}\pi r^3$

(c) $\frac{12}{3}\pi r^3$ (d) $\frac{16}{3}\pi r^3$

MHT-CET, 2016
BITSAT-2009
JIPMER-2008
BCECE-2008
JCECE-2007
[AIEEE 2006]

Ans. (d) : In a FCC lattice the number of atoms per unit cell = 4.

$$\text{Total volume of atoms} = \frac{4}{3}\pi r^3 \times 4$$
$$= \frac{16}{3}\pi r^3$$

205. The fraction of total volume occupied by the atoms present in a simple cube is

(a) $\frac{\pi}{3\sqrt{2}}$ (b) $\frac{\pi}{4\sqrt{2}}$

(c) $\frac{\pi}{4}$ (d) $\frac{\pi}{6}$

BITSAT-2011
NEET - 2007

Ans. (d) : Let the edge length of the cube be a and radius of atom be r.

Now, in simple cube, number of atoms present

$$= \frac{1}{8} \times 8 = 1$$

So, volume occupied = $1 \times \frac{4}{3}\pi r^3$

Now, in simple cube atoms at corner will touching each other.

$$\Rightarrow a = 2r \Rightarrow r = \frac{a}{2}$$

Volume of cube = a^3

So, fraction of total volume occupied

$$= \frac{\frac{4}{3}\pi r^3}{a^3}$$
$$= \frac{\frac{4}{3} \times \pi \times \left(\frac{a}{2}\right)^3}{a^3}$$
$$= \frac{4}{3} \times \pi \times \frac{1}{8}$$
$$= \frac{\pi}{6}$$

206. The fraction of the total volume occupied by the atoms in a simple cube is

(a) $\frac{\pi}{2}$ (b) $\frac{\pi}{4}$

(c) $\frac{\pi}{6}$ (d) $\frac{\pi}{8}$

TS EAMCET 05.08.2021, Shift-I

Ans. (c) : Let the edge length of the cube = a

and radius of atom = r

Now, in simple cube, number of atoms present = $\frac{1}{8} \times 8 = 1$

So, volume occupied = $1 \times \frac{4}{3}\pi r^3$

The relation between 'a' and 'r' in simple cubic –

$$a = 2r$$
$$\Rightarrow r = a/2$$

Volume of cube = a^3

So, fraction of total volume occupied $= \frac{\frac{4}{3}\pi r^3}{a^3}$

$$= \frac{\frac{4}{3} \times \pi \times \left(\frac{a}{2}\right)^3}{a^3} \Rightarrow \frac{4}{3} \times \pi \times \frac{1}{8} = \frac{\pi}{6}$$

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207. **Ga (atomic mass 70 u) crystallizes in a hexagonal close packed structure. The total number of voids in 0.581 g of Ga is -------×20^{21}. (Round off to the Nearest Integer). [Given : $N_A = 6.023\times10^{23}$]**

JEE Main 16.03.2021, Shift-II

Ans. (15) : For one atom, there will be two tetrahedral voids and one octahedral voids. Therefore, total three voids present in HCP lattice structure.

$\therefore$ Total number of atoms of Ga = $\dfrac{\text{Mass}}{\text{Molar mass}}\times N_A$

$$= \frac{0.581}{70}\times6.023\times10^{23}$$
$$= 4.99\times10^{21}$$

$\therefore$ Total number of voids = 3×total number of atoms

$$= 3\times4.99\times10^{21}$$
$$= 14.97\times10^{21}$$
$$\approx 15\times10^{21}$$

208. **The ratio of packing density in FCC, BCC, simple cubic and HCP, respectively is**

(a) 0.7 : 0.92 : 1.0 : 1.0
(b) 1.0 : 0.7 : 0.92 : 1.0
(c) 1.0 : 0.92 : 0.7 : 1.0
(d) 0.92 : 0.5 : 1.0 :0.92

TS-EAMCET 09.08.2021, Shift-I

Ans. (c) : Packing fraction of FCC, BCC, SC and HCP are 74%, 68%, 52% and 74% respectively.

Ratio $= \dfrac{74}{100}:\dfrac{68}{100}:\dfrac{52}{100}:\dfrac{74}{100}$

= 74 : 68 : 52 : 74

Ratio = 1 : 0.92 : 0.70 : 1.0

209. **Ga (atomic mass 70 u) crystallises in a hexagonal close packed structure. The total number of voids in 0.581 g of Ga is ....×10^{21}. (Round off to the nearest integer).**

[JEE Main 2021, 16 March Shift-II]

Ans. (15) **:** In hexagonal closed packing structure :

Per atom, there will be one octahedral void (OV) and two tetrahedral void (TV).

Therefore total three void per atom are present in HCP Structure. Therefore total number of atoms of Ga will be-

$$= \frac{\text{Mass}}{\text{Molar mass}}\times N_A$$

$$= \frac{0.581}{70}\times6.023\times10^{23}$$

$\approx 5 \times 10^{21}$

Now, total voids = 3 × total atoms

$$= 3 \times 5 \times 10^{21}$$
$$= 15 \times 10^{21}$$

So, answer is 15.

210. **The vacant space in body centered cubic (bcc) lattice unit cell is about**

(a) 32% (b) 10%
(c) 23% (d) 46%

Assam CEE-2020

Ans. (a) : Packing fraction of BCC Unit Cell is 68%, therefore the vacant space in BCC Unit cell is 32%

211. **An element has a body centered cubic (bcc) structure with a cell edge of 288 pm. The atomic radius is**

(a) $\dfrac{\sqrt{3}}{4}\times288\text{pm}$ (b) $\dfrac{\sqrt{2}}{4}\times288\text{pm}$
(c) $\dfrac{4}{\sqrt{3}}\times288\text{pm}$ (d) $\dfrac{4}{\sqrt{2}}\times288\text{pm}$

(NEET-2020)

Ans. (a) : In the body centred cubic crystal.

$$\sqrt{3}\,a = 4r$$

Given - Edge length 'a' = 288 pm
r = Radius of atom

So, $r = \dfrac{\sqrt{3}}{4}\times288\,\text{pm}$

212. **Which of the following is correct order of packing efficiency?**

(a) HCP = FCC > BCC > SC
(b) SC > BCC > HCP = FCC
(c) BCC > SC > HCP < FCC
(d) FCC = HCP > SC > BCC

AIIMS 25 May 2019 (Morning)

Ans. (a): Packing efficiency of HCP = 74%
Packing efficiency of FCC or CCP is also = 74%
Packing efficiency of simple cubic = 52% and packing efficiency of body centred cubic
(BCC) = 68%
So, HCP = FCC > BCC > SC

213. **What is the packing efficiency of arrangement in a body centred unit cell.**

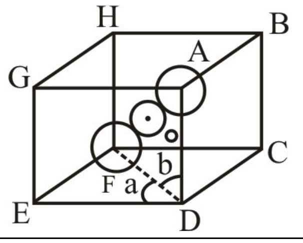
(a) 53.26% (b) 74.00%
(c) 68.00% (d) 64.00%

GUJCET-2019

Ans. (c) : Packing efficiency is defined as percentage of space occupied by constituent particles packet inside the lattice.

Consider edge length is 'a'

In bcc,



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$AC = \sqrt{AB^2 + BC^2} = \sqrt{a^2 + a^2} = \sqrt{2}\,a$

$AC = FD$

and $FD = \sqrt{AD^2 + FD^2} = \sqrt{2a^2 + a^2} = \sqrt{2}\,a$

Thus $\sqrt{3}\,a = 4r$

$$a = \frac{4r}{\sqrt{3}}$$

Volume of the unit cell $a^3 = \left(\frac{4r}{\sqrt{3}}\right)^3 = \frac{64r^3}{3\sqrt{3}}$

Now, Number of spheres per unit cell

$$= \frac{1}{8} \times 8 + 1$$

$$= 1 + 1 = 2$$

Thus volume of two spheres $= 2 \times \frac{4}{3}\pi r^3$

$$= \frac{8}{3}\pi r^3$$

$$\therefore \text{Packing efficiency} = \frac{\frac{8}{3}\pi r^3}{\frac{64r^3}{3\sqrt{3}}}$$

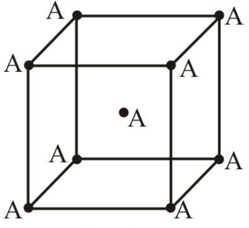
$$= \frac{8}{3}\pi r^3 \times \frac{3\sqrt{3}}{64r^3}$$

$$= \frac{\sqrt{3}\,\pi}{8}$$

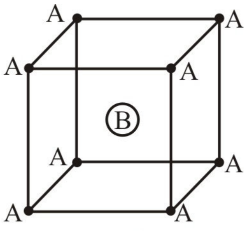
$$= 0.68$$

Thus , % Packing efficiency = 68%

214. Consider the bcc unit cells of solids 1 and 2 with the position of atoms as shown below. The radius of atom B is twice that of atom A. The unit cell edge length is 50% more in solid 2 than in 1. What is the approximate packing efficiency in solid 2?



Solid 1



Solid 2

(a) 65%
(b) 90%
(c) 75%
(d) 45%

[JEE Main 2019, 8 April Shift-II]

Ans. (b) : % packing efficiency

$$= \frac{\text{Volume occupied by atom}}{\text{Volume of unit cell}} \times 100$$

$$= \frac{\frac{4}{3}\pi r^3}{a^3} \times 100$$

Let radius of corner atom is r and radius of central atom is 2r.

So, $\sqrt{3}\,a = 2\,(2r) + 2r$

$\sqrt{3}\,a = 4r + 2r = 6r$

$$a = \frac{6}{\sqrt{3}}\,r$$

$$a = 2\sqrt{3}\,r$$

Now,

$$\%\text{ packing efficiency} = \frac{\frac{4}{3}\pi r^3 + \frac{4}{3}\pi (2)^3}{(2\sqrt{3}\,r)^3} \times 100$$

$$= \frac{\frac{4}{3}\pi (r^3 + 8r^3)}{8 \times 3\sqrt{3}\,r^3} \times 100$$

$$= \frac{4\pi \times 9r^3}{8 \times 8 \times 3\sqrt{3}\,r^3} \times 100$$

$$= 90.6\,\% \approx 90\,\%$$

215. Iron exhibits bcc structure at room temperature, Above 900°C, it transforms to fcc structure. The ratio of density of iron at room temperature to that at 900°C (assuming molar mass and atomic radii of iron remains constant with temperature) is

(a) $\frac{\sqrt{3}}{\sqrt{2}}$
(b) $\frac{4\sqrt{3}}{3\sqrt{2}}$
(c) $\frac{3\sqrt{3}}{4\sqrt{2}}$
(d) $\frac{1}{2}$

(NEET-2018)

Ans. (c) : We know that , $d = \frac{ZM}{a^3 \times N_A}$

For the bcc unit cell

$Z = 2$ and $a = \frac{4}{\sqrt{3}}\,r.$

So, density at room temperature (25°C) is–

$$d_{25^\circ C} = \frac{2M}{\left(\frac{4}{\sqrt{3}}r\right)^3 N_A} \qquad ....(1)$$

For FCC unit cell

$Z = 4$ and $a = \frac{4}{\sqrt{2}}\,r$

So, density at 900°C is–

$$d_{900^\circ C} = \frac{4M}{\left(\frac{4}{\sqrt{2}}r\right)^3 N_A} \qquad ....(2)$$

Dividing eq^n (1) with eq^n (2) we get –

@apna_pdf

$$\frac{d_{25^\circ C}}{d_{900^\circ C}} = \frac{\dfrac{2M}{\left(\dfrac{4}{\sqrt{3}}r\right)^3 N_A}}{\dfrac{4M}{\left(\dfrac{4}{\sqrt{2}}r\right)^3 N_A}} = \frac{1}{2}\times\left(\frac{\sqrt{3}}{\sqrt{2}}\right)^3 = \frac{3\sqrt{3}}{4\sqrt{2}}$$

216. A solid AB has NaCl structure. If the radius of cation A^+ is 170 pm, then the maximum possible radius of the anion B^- is

(a) 397.4 pm (b) 347.9 pm
(c) 210.9 pm (d) 410.6 pm

JIPMER-2017

Ans. (d) : In the NaCl type structure

$$\frac{r_{A^+}}{r_{B^-}} = 0.414 - 0.732$$

For maximum possible radius of B —

$$\frac{r_{A^+}}{r_{B^-}} = 0.414$$

$$\frac{170}{r_{B^-}} = 0.414$$

$$r_{B^-} = \frac{170}{0.414} = 410.6\,\text{pm}$$

217. The packing efficiency of simple cubic (sc), body centred cubic (bcc) and cubic close packing (ccp) lattices follow the order

(a) bcc < ccp < sc
(b) ccp < bcc < sc
(c) sc < ccp < bcc
(d) sc < bcc < ccp

TS-EAMCET-2016

Ans. (d) : For packing efficiency $= \dfrac{Z\times\frac{4}{3}\pi r^3}{a^3}\times 100$

Where, Z = Atom in lattice
r = Radius of atom
a = Edge length

For simple cubic packing efficiency = 52% (a = 2r)

For BCC packing efficiency = 68% ($4r = \sqrt{3}a$)

For FCC packing efficiency = 74% ($4r = \sqrt{2}a$)

So, the order is SC < BCC < FCC (CCP)

218. Which one of the following statements about packing in solids is incorrect?

(a) Coordination number in bcc mode of packing is 8.
(b) Coordination number in HCP mode of packing is 12
(c) Void space in CCP mode of packing 32%
(d) Void space in CCP mode of packing is 26%

[AIIMS-2016]

Ans. (c) : In the HCP arrangement of atoms occupies 74% of the available space and thus has 26% vacant space.

So, option (c) is incorrect.

219. The non stoichiometric compound $Fe_{0.94}O$ is formed when x % of Fe^{2+} ions are replaced by as many $\frac{2}{3}Fe^{3+}$ ions, x is

(a) 18 (b) 12
(c) 15 (d) 6

BITSAT-2016

Ans. (a) : x% of Fe^{2+} ions are replaced by as many $\frac{2}{3}Fe^{3+}$ ions.

The number of Fe^{3+} ions replacing x Fe^{2+} ion $= \dfrac{2x}{3}$

The vacancies of cations $= x - \dfrac{2x}{3} = \dfrac{3x-2x}{3}$

$= \dfrac{x}{3}$

But the non stiochiometric compound has formula $Fe_{0.94}O$

$$\frac{x}{3} = 1 - 0.94 = 0.06$$

x = 0.06 × 3 = 0.18 = 18%

220. If AgI crystallises in zinc blende structure with I ions at lattice points What fractions of tetrahedral voids occupies by Ag^+ ions?

(a) 25% (b) 50%
(c) 100% (d) 75%

[AIIMS-2014]

Ans. (b) : In AgI crystal, number of Ag^+ ion is equal to I^- ions. However, the number of tetrahedral voids are twice the number of atom forming the cubic lattice.

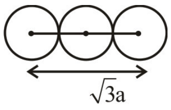
∴ Number of tetrahedral voids occupied by Ag^+ ion = 50%

221. CsBr has BCC structure with edge length 4.3 p.m. The shortest inter-ionic distance between Cs^+ and Br^- in p.m. is

(a) 7.44 (b) 3.72
(c) 4.3 (d) 1.86

Assam CEE-2014

Ans. (b) : Body diagonal



In BCC —

Inter ionic distance $= \dfrac{1}{2}$ of body diagonal

$= \dfrac{1}{2}\times\sqrt{3}a$

@apna_pdf

$$= \frac{1}{2} \times \sqrt{3} \times 4 \cdot 3$$
$$= 3 \cdot 72 \text{ Å}$$

222. If a is the length of the side of a cube, the distance between the body-centred atom and one corner atom in the cube will be

(a) $\frac{2}{\sqrt{3}}a$ (b) $\frac{4}{\sqrt{3}}a$
(c) $\frac{\sqrt{3}}{4}a$ (d) $\frac{\sqrt{3}}{2}a$

(NEET-2014)

Ans. (d) : We know that for bcc structure,

$$4r = \sqrt{3}\,a$$

Hence, $2r = \frac{\sqrt{3}}{2}a$

2r represents the distance between the body centered atom and one corner atom.

Thus, if 'a' represents the length of the side of a cube, the distance between the body-centered atom and one corner atom in the cube will be $\frac{\sqrt{3}}{2}a$.

223. Calculate the ionic radius of a Cs^+ ion, assuming that the cell edge length for CsCl is 0.4123 nm and that the ionic radius of a Cl^- ion is 0.181 nm.

(a) 0.176 nm (b) 0.231 nm
(c) 0.357 nm (d) 0.116 nm

UPTU/UPSEE-2014

Ans. (a) :

$$r_{cs} + r_{cl^-} = \frac{d_{body}}{2} = \frac{0.7141}{2}$$
$$= 0.3571 \text{ nm}$$
$$r_{cs^+} = 0.3571 - 0.181$$
$$= 0.176 \text{ nm}$$

224. A metal crystallises with a face-centred cubic lattice. The edge of the unit cell is 408pm. The diameter of the metal atom is

(a) 288pm (b) 408pm
(c) 144pm (d) 204pm

(NEET-2012)

Ans. (a) : In the face centered cubic unit cell —

$$r = \frac{a}{2\sqrt{2}}$$
$$a = 408 \text{ pm}$$
$$r = \frac{408}{2\sqrt{2}}$$
$$r = 144 \text{ pm}$$

Diameter = 2r = 2 × 144
= 288 pm

225. Gold has a face centred cubic lattice with and edge length of the unit cube of 407 pm. Assuming the closest packing, the diameter of the gold atom is

(a) 576.6 pm (b) 287.8 pm
(c) 352.5 pm (d) 704.9 pm

[AIIMS-2011]

Ans. (b) : Given that —
edge length 'a' = 407 pm.
For the FCC lattice,

$$4r = a\sqrt{2}$$
$$r = \frac{\sqrt{2}}{4}a$$

Where 2r = diameter

$$r = \frac{\sqrt{2} \times 407}{2}$$
$$r = \frac{1.414 \times 407}{4} \qquad \because (\sqrt{2} = 1.414)$$
$$r = 287 \cdot 8 \text{ pm}$$

226. Atom A possesses higher values of packing fraction than atom B. The relative stabilities

(a) A is more stable than B
(b) B is more stable than A
(c) A and B both are equally stable
(d) Stability does not depend on packing fraction

UP CPMT-2011

Ans. (b) : The atom which has lower value of packing fraction is stable. Hence, atom B is more stable than atom A.

The more negative the Packing fraction of an element the more stable should be the nucleus. On the other hand a positive packing fraction indicates that the nucleus should be less stable is that packing fraction is inversely proportional to the stability. So, the atom which has or lower value of packing fraction is stable.

227. Percentage of free space in cubic close packed structure and in body centred packed structure are respectively

(a) 30% and 26%
(b) 26% and 32%
(c) 32% and 48%
(d) 48% and 26%

[AIEEE 2010]

Ans. (b) : The percentage of the total space which is occupied by the particles in a certain packing is known as packing efficiency. In a closed packed structure the unit cell is FCC, that has particles on corners as well as the centre of all faces.

So, here Z = 4

Now, P.E. of CCP = 74%

So, vacant space = 100–74
= 26%

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When body centered packed structure, unit cell is Z = 2

So, P.E. of BCC = 68%

So, the vacant space = 100 – 68

= 32%

228. A solid AB has the NaCl structure. If radius of cation A^+ is 120 pm, the maximum possible value of the radius of the anion B^- is

(a) 240 pm (b) 60 pm

(c) 49.6 pm (d) 290 pm

JIPMER-2010

Ans. (d): For the NaCl crystal.

$$\frac{\text{Radius of cation}}{\text{Radius of anion}} = 0.414 \text{ to } 0.732$$

$$\frac{r_{A^+}}{r_{B^-}} = 0\cdot414 \qquad \text{(for max. } B^- \text{ radius)}$$

$$r_{B^-} = \frac{r_{A^+}}{0.414} = \frac{120}{0.414} = 290\,\text{pm}$$

229. AB crystallizes in a body-centered cubic lattice with edge length 'a' equal to 387 pm. The distance between two oppositely charged ions in the lattice is

(a) 335pm (b) 250pm

(c) 200pm (d) 300pm

(NEET-2010)

Ans. (a) : The distance between them would be

$$2r = \sqrt{3} \times \frac{a}{2}$$

$$2r = 387 \times \frac{\sqrt{3}}{2} = 335 \text{ pm approx.}$$

This would be the distance between two opposite charges.

230. A solid metal has ccp or fcc structure. The relation of side of cube (a) and radius of atom (r) will be

(a) $a = 2r$ (b) $a = 2\sqrt{2}\ r$

(c) $a = \frac{4}{\sqrt{3}}r$ (d) $a = \sqrt{\frac{3}{2}}r$

CG PET -2009

Ans. (b) : For the ccp or fcc structure

$$4r = \sqrt{2}\,a$$

$$a = \frac{4r}{\sqrt{2}}$$

$$a = 2\sqrt{2}\,r$$

231. Lithium metal crystallises in a body-centred cubic crystal . If the length of the side of the unit cell of lithium is 351 pm, the atomic radius of lithium will be

(a) 151.8pm (b) 75.5pm

(c) 300.5pm (d) 0.8pm

(NEET-2009)

Ans. (a) : In the body centred-cubic crystal

$$4r = \sqrt{3}\,a$$

Given that —

edge length (a) = 351 pm

So, $$r = \frac{\sqrt{3}}{4} \times a$$

$$r = \frac{\sqrt{3}}{4} \times 351\,\text{pm}$$

$$r = \frac{1.732 \times 351}{4}\ \text{pm}$$

$$r = 151.8 \text{ pm}$$

232. Copper crystallises in a face-centred cubic lattice with a unit cell length of 361 pm. What is the radius of copper atom in pm?

(a) 157 (b) 181

(c) 108 (d) 128

(NEET-2009)

Ans. (d) : Copper crystallizes in a fcc lattice

$$4r = \sqrt{2}\,a$$

$$r = \frac{\sqrt{2}}{4}a$$

Give edge length 'a' = 361 pm

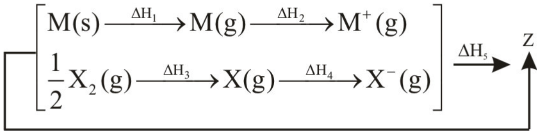
So, $$r = \frac{\sqrt{2}}{4} \times 361\,\text{pm}$$

$$r = \frac{1.414 \times 361}{4}\ \text{pm}$$

$$r = 127.61 \text{ pm}$$

$$r \simeq 128 \text{ pm}$$

233. Consider the Born-Haber cycle for the formation of an ionic compound given below and identify the compound (Z) formed.



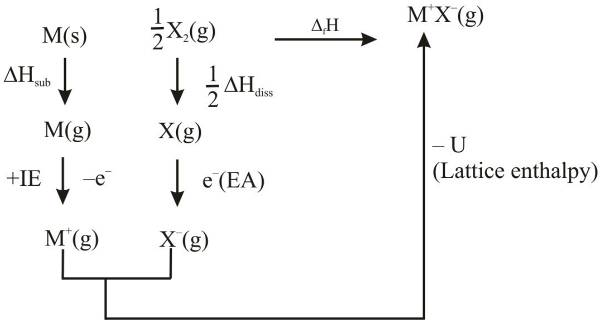
$M(s) \xrightarrow{\Delta H_1} M(g) \xrightarrow{\Delta H_2} M^+(g)$
$\frac{1}{2}X_2(g) \xrightarrow{\Delta H_3} X(g) \xrightarrow{\Delta H_4} X^-(g)$
ΔH_5
Z

(a) M^+X^- (b) $M^+X^-(s)$

(c) MX (d) $M^+X^-(g)$

Karnataka-CET, 2008

Ans. (a) : The Born-Haber cycle takes place as follows



Hence, Z is $M^+\ X^-(s)$

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234. Which of the following statements is not correct?

(a) The number of carbon atoms in a unit cell of diamond is 8.

(b) The number of Bravais lattices in which a crystal can be categorized is 14.

(c) The fraction of the total volume occupied by the atoms in a primitive cell is 0.48.

(d) Molecular solids are generally volatile.

(NEET-2008)

Ans. (c) : • The diamond contain 4 lattice points per unit cell but contains B atom per unit cell. It means option (a) is correct.

• There are 14 possible Bravais lattices in 3D space in which crystal can be categorized. It means option (b) is also correct.

• The fraction of total volume occupied by the atoms in the primitive cell is 0.52 whereas the void space is 0.48. It means option (c) is incorrect.

• Molecular solid are soft and volatile and have low melting points. It means option (d) is also correct.

235. If a stands for the edge length of the cubic systems: simple cubic, body-centred cubic and face-centred cubic, then the ratio of radii of the spheres in these systems will be respectively

(a) $\frac{1}{2}a : \frac{\sqrt{3}}{2}a : \frac{\sqrt{2}}{2}a$ (b) $1a : \sqrt{3}a : \sqrt{2}a$

(c) $\frac{1}{2}a : \frac{\sqrt{3}}{4}a : \frac{1}{2\sqrt{2}}a$ (d) $\frac{1}{2}a : \sqrt{3}a : \frac{1}{\sqrt{2}}a$

(NEET-2008)

Ans. (c) : In a simple cubic unit cell —

$$2r = a$$

$$r = \frac{a}{2}$$

In a body centred cubic (bcc) unit cell —

$$4r = \sqrt{3}\,a$$

$$r = \frac{\sqrt{3}}{4}a$$

In face-centred cubic (fcc) unit cell —

$$4r = \sqrt{2}\,a$$

$$r \frac{\sqrt{2}}{2\times\sqrt{2}\times\sqrt{2}}a$$

$$r = \frac{1}{2\sqrt{2}}a$$

Now, ratio is $\frac{1}{2}a : \frac{\sqrt{3}}{4}a : \frac{1}{2\sqrt{2}}a$

236. A metallic crystal having BCC type stacking pattern, what percentage of volume of this lattice is empty space?

(a) 68% (b) 32%

(c) 26% (d) 74%

GUJCET-2007

Ans. (b) : In this type of structure, total number of atoms is 2 and their volume is $2\times\frac{4}{3}\pi r^3$.

• Volume of the cube, a^3 will be equal to $\left(\frac{4r}{\sqrt{3}}\right)^3$ or

$$a^3 = \left(\frac{4}{\sqrt{3}}r\right)^3$$

Therefore,

$$\text{Packing fraction} = \frac{Z\times\text{Volume of sphere}}{\text{Total volume}}$$

$$= \frac{2\times\frac{4}{3}\pi r^3}{a^3}$$

$$= \frac{2\times\frac{4}{3}\times\pi\times\left(\frac{a\sqrt{3}}{4}\right)^3}{a^3}$$

$$= 68\%$$

$$\text{empty space} = 100 - 68$$

$$= 32\%$$

237. The 8:8 type of packing is present in

(a) MgF_2 (b) CsCl

(c) KCl (d) NaCl

VITEEE- 2007

Ans. (b) : 8 : 8 type of packing is present in CsCl. In this structure each Cs^+ ion is surrounded by ions and each ions is also surrounded by 8 Cs^+ ions.

6 : 6 type of packing is present in NaCl and KCl.

238. For an ionic crystal of the general formula AX and coordination number is 6, the value of radius ratio will be

(a) greater than 0.73

(b) in between 0.73 and 0.41

(c) in between 0.41 and 0.22

(d) less than 0.22

CG PET -2006

Ans. (b) : Since the general formula is AX with coordination number 6, the crystal could be considered as NaCl. Thus, it is evident that the ratio lies between 0.414 and 0.732 because of its octahedral structure.

The value ranging between 0.732 to 0.414 is obtained by dividing the radius of positive ion by that of negative ion.

239. The ionic radii of Rb^+ and I^- are 1.46Å and 2.16Å. The most probable type of structure exhibited by it is

(a) Cs*Cl* type (b) ZnS type

(c) Na*Cl* type (d) CaF_2 type

UPTU/UPSEE-2004

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Ans. (c) : Given that –

radius of cation (r^+) = 1.46 Å

radius of anion (r^-) = 2.16 Å

$$\frac{r^+}{r^-} = \frac{1.46}{2.16} = 0.676$$

Value in between 0.414 – 0.732

Hence, the structure of NaCl type.

240.The percentage of unoccupied volume in simple cubic cell is

(a) 52.40% (b) 32.00%

(c) 47.60% (d) 68.04%

MHT CET-02.05.2019, SHIFT-II

Ans. (c) : Volume occupied in simple cubic cell = 52.4

∴Volume remains unoccupied in simple cubic cell = 47.6 %.

241. What is number of tetrahedral voids per atom in a crystal lattice?

(a) 1 (b) 2

(c) 4 (d) 6

AMU–2003

Ans. (b) : $\frac{\text{Tetrahedral void}}{\text{Total number of atom}} = ?$

In unit cell –

Total number of atoms = n

Tetrahedral voids = 2n

Octahedral void = n

$$\frac{\text{Tetrahedral void}}{\text{Total number of atom}} = \frac{2n}{n} = 2$$

Number of Tetrahedral voids = 2 × number of atoms in the packing.

So, tetrahedral void is 2 per atom.

242. The pyknometric density of sodium chloride crystal is $2.165 \times 10^3 \text{kgm}^{-3}$ while its X-ray density is $2.178 \times 10^3 \text{kgm}^{-3}$ the fraction of unoccupied sites in sodium chloride crystal is

(a) 5.96 (b) 5.96×10^{-2}

(c) 5.96×10^{-1} (d) 5.96×10^{-3}

(NEET-2003)

Ans. (d) : Volume from pyknometric density = $\frac{M}{d}$

$$= \frac{M}{2.165 \times 10^3} \text{ m}^3 (\text{M in kg})$$

Molar Volume form X – ray density = $\frac{M}{d}$

$$= \frac{M}{2.178 \times 10^3} \text{ m}^3$$

$$\therefore \text{ Volume unoccupied} = \frac{M}{10^3}\left(\frac{1}{2.165} - \frac{1}{2.178}\right) \text{m}^3$$

$$= \frac{\left(\frac{0.013M \times 10^{-3}}{2.165 \times 2.178}\right)}{\left(\frac{M \times 10^{-3}}{2.165}\right)}$$

$= 5.96 \times 10^{-3}$

243. The edge length of face-centered unit cubic cells is 508 pm. If the radius of the cation is 110 pm, the radius of the anion is

(a) 144pm (b) 398pm

(c) 288pm (d) 618pm

(NEET-1998)

Ans. (a) : For FCC lattice (assuming cation in octahedral Void and anion in FCC)

a = 508 pm

$$(r^+ + r^-) = \frac{a}{2} = \frac{508}{2} = 254 \text{ pm}$$

$(r^+ + r^-) = 254$ pm

$r^- = 254 - r^- = 254 - 110 = 144$ pm

244. A metal has bcc structure and the edge length of its unit cell is 3.04Å. The volume of the unit cell in cm^3 will be

(a) $1.6 \times 10^{21} \text{ cm}^3$

(b) $2.81 \times 10^{-23} \text{ cm}^3$

(c) $6.02 \times 10^{-23} \text{ cm}^3$

(d) $6.6 \times 10^{-24} \text{ cm}^3$

VITEEE-2014

Ans. (b) : Given edge length of its unit cell of BCC is 3.04Å.

∴ Volume of unit cell (V) = a^3

$= (3.04 \times 10^{-8} \text{ cm})^3$

$= 2.81 \times 10^{-23} \text{ cm}^3$

245. The density of solid argon is 1.65 g per cc at –233°C. If the argon atom is assumed to be a sphere of radius 1.54×10^{-8} cm, what per cent of solid argon is apparently empty space? (Ar = 40)

(a) 16.5% (b) 38%

(c) 50% (d) 62%

AIPMT 1998

Ans. (d) : Given, radius of sphere = $1.54 \times 10^{-8} \text{ cm}^3$

Volume of one atom $= \frac{4}{3}\pi r^3$

$$= \frac{4}{3} \times 3.14 \times \left(1.54 \times 10^{-8}\right)^3$$

$$= 1.53 \times 10^{-23} \text{cm}^3$$

Volume of all atoms in 1.65 g Ar

$$= \frac{1.65}{40} \times 6.02 \times 10^{-23} \times 1.53 \times 10^{-23} = 0.380 \text{cm}^3$$

Volume of solid Ar containing in 1.65 gm = 1 cm^3

Empty space = 1 – 0.380 = 0.620

% of empty space = 62%

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5. Defects in Crystal

246. Given below are two statements: one is labelled as Assertion (A) and the other is labelled as Reason (R).

Assertion (a) : It a particular point defect, an ionic solid is electrically neutral, even if few of its cations are missing from its unit cells.

Reason (R) :

In an ionic solid, Frenkel defect arises due to dislocation of cation from its lattice site to interstitial site, maintaining overall electrical neutrality.

In the light of the aboves statements, choose the most appropriate answer from the options given below

(a) (A) is not correct but (R) is correct
(b) Both (A) and (R) are correct and (R) is the correct explanation of (A)
(c) Both (A) and (R) are correct but (R) is not the correct explanation of (A)
(d) (A) is correct but (R) is not correct

NEET-17.07.2022

Ans. (c) : It is a particular point defect. Electrical neutrality is essential condition. In Frenkel defect, it is dislocation from lattice site to interstitial position.

247. The incorrect statement about the imperfections in solids is:

(a) Schottky defect decreases the density of the substance.
(b) Interstitial defect increases the density of the substance.
(c) Frenkel defect does not alter the density of the substance.
(d) Vacancy defect increases the density of the substance.

JEE Main-28.06.2022, Shift-I

Ans. (d) : When some of the lattice sites are vacant, the crystal is said to have vacancy defect. This results decrease in density of the substance. So, the option (d) is incorrect statement.

248. Which one of the following will show both frenkel and Schottky Defect?

(a) NaCl (b) AgBr
(c) CrCl (d) KCl

Assam CEE-2021
JEE Main-08.01.2020-Shift-II
JIPMER-2019
GUJCET-2019
J&K CET-2010

Ans. (b) : AgBr schottky defect is shown in AgBr because cations and anions both get out of the lattice Ag^+ is quite small which is why it occupies interstitial sites easily this is the Frenkel defect.

The Radius ratio of AgBr is also intermediate, thus AgBr satisfies the exhibit both type of defects.

249. What type of crystal defect is indicated in the diagram below?

Na^+	Cl^-	Na^+	Cl^-	Na^+	Cl^-
	Cl^-		Cl^-	Na^+	Na^+
Na^+	Cl^-		Cl^-	Na^+	Cl^-
	Cl^-	Na^+	Cl^-	Na^+	Na^+

(a) Frenkel defect
(b) Schottky defect
(c) Interstitial defect
(d) Frenkel and Schottky defects

BCECE-2010
AIEEE-2004

Ans. (b) : Schottky defect is indicated in the diagram as equal number of sodium cation and chloride anion are missing.

In frenkel defect a cation or anion leaves its regular site and occupies interstitial position.

250. Due to Frenkel defect, the density of ionic solids

(a) decreases (b) increases
(c) does not change (d) changes

BITSAT-2013
CGPET-2012

Ans. (c) : Due to the frenkel defect, the density of ionic solid does not change. This defect does not impact the density of the solid as it involves only the migration of the ions within the crystal, these preserving both the volume and mass. The volume and mass due to the Schottky defect, the density of ionic solids decreases.

251. The flame colors of metal ions are due to

(a) Schottky defect
(b) Frenkel defect
(c) metal excess defect
(d) metal deficiency defect

CG PET- 2011
Manipal-2016

Ans. (c) : The flame colours of metal. Ions are due to metal excess defect. Due to presence of metal excess defect, the crystals have free electrons that can be excited to higher energy levels. This results in absorption spectra.

Note:– In metal excess of metal ions are present.

252. Which one of the following has frenkel defect?

(a) Sodium chloride
(b) Graphite
(c) silver bromide
(d) Diamond

MHT-CET-02.05.2019, Shift-III
CG PET -2005

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Ans. (c) : Frenkel defect is a defect which is created when an ion leaves its appropriate site in the lattice and occupies and interstitial site. A hole or vacancy is thus produced in the lattice. The cations and anions differ much in their sizes and the ions have low co-ordination numbers. Examples are Zns, AgBr, AgI, AgCl.

253. Which of the following defect is seen in FeO?

(a) Metal excess defect
(b) Metal deficiency defect
(c) Displacement defect
(d) Impurity defect

GUJCET-2016, 2015

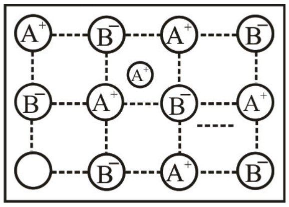
Ans. (b) : FeO shows metal deficiency defect. In crystal of FeO some Fe^{2+} cations are missing and the loss of positive charge is made up by the presence of required number of Fe^{3+} ions.

254. In a solid lattice, the cation has left a lattice site and is located at interstitial position, the lattice defect is

(a) interstitial defect
(b) vacancy defect
(c) Frenkel defect
(d) Schottky defect

JCECE-2012
J & K CET-(2005)

Ans. (c) :



Frenkel defect

In a solid lattice, the cation has left a lattice site and is located at interstitial position , the lattice defect is Frenkel defect. This defect is observed in compound having low coordination number and low radius ratio. It is also found in compounds having highly polarizing cation and an easily polarisable anion.

255. Schottky defect in a crystal is observed, when

(a) unequal number of cations and anions are missing from the lattice
(b) equal number of cations and anions are missing from the lattice
(c) an ion leaves it normal site and occupies and interstitial site
(d) density of the crystal is increased

Karnataka-CET-2016
AIPMT-1998

Ans. (b) : Schottky defect is observed when equal number of cations and anions are missing from the lattice. This defect changes the density as pair of ions are missing from the lattice.

256. The correct statement regarding defects in solids is

(a) Frenkel defect is a vacancy defect
(b) Schottky defect is a dislocation defect
(c) Trapping of an electron in the lattices leads to the formation of F-centre
(d) Schottky defect has no effect on density.

Kerala-CEE-29.08.2021
Karnataka CET-2021

Ans. (c) : The correct statement regarding defects in solids is trapping of an electron in the lattices leads to the formation of F-centre.

(1) Frenkel defect is a dislocation defect it arises due to a vacancy at cationic site the cations moves to another position between two layers and is surrounded by greater number of anions.

(2) Frenkel defect is a found in ZnS, AgBr, AgCl, AgI etc.

(3) Due to Schottky defects, the density of crystals decreases.

(4) Frenkel defect have no effect on the density of crystalline solids.

257. Find the correct statement about crystal defects,

(a) Schottky defect makes a crystal electrically charged.
(b) Frenkel defect alters the density of the crystal.
(c) Metal excess defect gives colour to the crystal.
(d) Metal deficiency defect can be found in the halides of alkali metals.

SRMJEEE – 2013, 2012

Ans. (c) : Schottky defect is basically a vacancy defects in ionic solids. In order to maintain electrical neutrality, the number of missing cations and anions are equal.

The Frenkel defect is shown by ionic solids. It does not change the density of the solid.

Metal deficiency defect can be found in transition metals which show variable valencies.

258. Identify the incorrect statement regarding crystals having Frenkel defect:

(a) Frenkel defects are observed where the difference in sizes of cations and anions is large.
(b) The density of crystals having Frenkel defect is less than that of a pure perfect crystal.
(c) An ionic crystal having Frenkel defect may also contain schottkey defect.
(d) Alkali halides don't usually have Frenkel defect.

AP EAPCET 25.08.2021, Shift-II

Ans. (b) : Frenkel defect observes the difference in size of cations and anions is large. An ionic crystal having Frenkel defect may also contain schottky defect and alkali halides don't usually have Frenkel defect are correct.

@apna_pdf

259. An excess of potassium ions makes KCl crystal appear violet or lilac in colour because ______

(a) of the presence of impurities
(b) some of the anionic and cationic sites are vacant
(c) some of the anionic vacancies are occupied by unpaired electron
(d) some of the cationic vacancies are occupied by unpaired electron

AP- EAPCET- 07-09-2021, Shift-I

Ans. (c) : When KCl crystals are heated. It leads the deposition of potassium ion on the surface of KCl. The Cl^- ions diffuse to the surface of crystal and loss electron by potassium atom to form K^+ ion released electron occupied anionic site which is known as F-centre and impart colour to the crystal.

260. KBr is doped with 10^{-5} mole percent of $SrBr_2$. The number of cationic vacancies in 1 g of KBr crystal is...........10^{14} (Round off to the nearest integer)
[Atomic mass : K = 39.1u, Br = 79.9u, N_A = 6.023 × 10^{23-}

[JEE Main 2021, 17 March Shift-II]

Ans. (5) : For every Sr^{2+} ion, 1 cationic vacancy is created.

Hence, number of Sr^{2+} ion = Number of cationic vacancies.

Since the mole percentage of $SrBr_2$ doped is 10^{-5} is to that of total moles of KBr.

Hence,

$$\text{Number of cationic vacancy} = \frac{10^{-5}}{100}\times\frac{1}{119}\times N_A$$

$$= \frac{1}{119}\times10^{-7}\times6.022\times10^{23}$$

$$= 5 \times 10^{-2}\ 10^{-7} \times 10^{23}$$

$$= 5 \times 10^{14}$$

$$= 5$$

261. Given below are two statements.
Statement-I Frenkel defects are vacancy as well as interstitial defects.
Statement-II Frenkel defect leads to colour in ionic solids due to presence of F-centres.
Choose the most appropriate answer for the statements from the options given below.

(a) Statement I is false but Statement II is true.
(b) Both statement I and Statement II are true.
(c) Statement I is true but statement II is false.
(d) Both Statement I and statement II are false.

[JEE Main 2021, 26 Aug Shift-I]

Ans. (c) : Frenkel defect is a type of defect is shown by ionic solids. the smaller in (usually cation) is dislocated from its normal site to an interstitial site.

It creates a vacancy defect at its original site and an interstitial defect at it new location.

F - centre is formed in metal excess defect, which is a non -stoichiometric defect.

262. The defect produced due to the presence of extra cations at interstitial sites is called____.

(a) metal excess defect
(b) Schottky defect
(c) metal deficiency defect
(d) Frenkel defect

AP EAMCET (Engg.) 17.09.2020, Shift-II

Ans. (a) : When a metal contains extra cations (metal ion) in the interstitial site of its lattice. We observe metal excess defect. It is a non-stoichiometric defect.

263. When $CaCl_2$ is added to AgCl crystal, the defect introduced is

(a) Frenkel defect only
(b) Schottky defect only
(c) No change
(d) Both Frenkel and Schottky defects

AP EAMCET (Engg.) 21.09.2020, Shift-I

Ans. (b) : When mixing AgCl and $CaCl_2$, each added ion of Ca^{2+} replaces Ag^+ as they have similar radii. Since, the charge of Ca and Ag is of +2 and +1 respectively, it leads to the formation of positive vacancies (Schottky defect).

It means that one mole of $CaCl_2$ provides one mole of Ag vacancies in crystal structure.

264. A metallic solid undergoes Frenkel defect. Its original mass, volume and density are M_0, V_0 and D_0 respectively. After Frenkel defect the mass, volume and density are M, V and D respectively. The variations of M, V and D after Frenkel defect are

(a) $M = M_0, V = V_0, D = D_0$
(b) $M < M_0, V < V_0, D < D_0$
(c) $M > M_0, V = V_0, D > D_0$
(d) $M = M_0, V < V_0, D > D_0$

AP EAMCET (Engg.) 21.09.2020, Shift-II

Ans. (a) : In Frenkel defect, atoms remain within the solid crystal. Only one vacancy is created. Density remains the same. Thus, $M = M_0$, $V = V_0$ and $D = D_0$.

265. A crystal is made up of metal ions M_1 and M_2 and oxide ions. Oxide ions form as ccp lattice structure. The cation M_1 occupies 50% of octahedral voids and the cation M_2 occupies 12.5% of tetrahedral voids of oxide lattice. The oxidation number of M_1 and M_2 are, respectively

(a) +2, +4
(b) +1, +3
(c) +3, +1
(d) +4, +2

[JEE Main 2020, 6 Sep Shift-II]

Ans. (a) : O^{2-} ions from ccp $\Rightarrow O_4$

$$M_1 = 50\%\ \text{Octahedral void} = \frac{50}{100}\times4=2$$

$$M_2 = 12.5\ \%\ \text{tetrahedral void} = \frac{12.5}{100}\times8=1$$

@apna_pdf

So formula is: $(M_1)_2 (M_2)_1 O_4$
Let change of M_1 and M_2 are + x and + y respectively. And O_4 has –8 charges. As crystal is neutral so metal must have + 8 charge in total.
$=2x + y = 8$ ——— (i)
From given option x = +2
y = +4

266. Schottky defect is shown by

(a) ionic substances in which the size of the cation is smaller than the of the anion
(b) ionic substances in which the cation are of almost similar sizes
(c) ionic substances in which the size of the cation is larger than of the anion
(d) non-stoichometric inorganic solids
(e) non-ionic substances

Kerala-CEE-2020

Ans. (b) : Schottky defect equal number of cationic and anionic vacancies are present. It is observed in cations and anions having similar size. The density of crystal decreases. It is observed in alkali halides (NaCl, CsCl) etc.

267. Which type of defect present in NaCl?

(a) Frenkel defect
(b) Schottky defect
(c) F-centre defect
(d) None of these

JIPMER-2019

Ans. (b) : Schottky defect is shown by ionic substance in which the cation and anion are of almost similar sizes. for example NaCl, KCl, CsCl and AgBr.

268. 1 mole of NaCl is doped with 10^{-5} mole of $SrCl_2$. The number of cationic vacancies in the crystal lattice will be

(a) 6.022×10^{18}
(b) 6.022×10^{15}
(c) 6.022×10^{23}
(d) 12.044×10^{20}

Karnataka-CET-2019

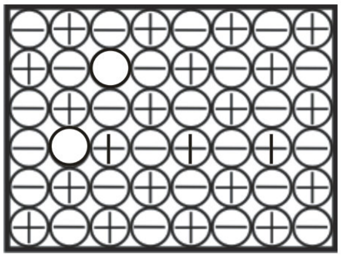
Ans. (a) : NaCl : 1 mole = 10^{-5} mole $SrCl_2$
1 mole NaCl doped with 10^{-5} mole $SrCl_2$ = Cation vacancies per mole of NaCl = 10^{-5} moles
1 mole = 6.022×10^{23} particle
$\therefore$ Cations vacancies = $6.022 \times 10^{23} \times 10^{-5}$
$= 6.022 \times 10^{18}$ per mole of NaCl

269. Which among the following statements is true about Schottky defect?

(a) In this defect cation and anion are lacking in stoichiometric proportion
(b) Formation of metal alloy is example of this defect
(c) In this cation or anion moves from regular site to place between lattice site
(d) In this regular cation is replaced by different cation

MHT CET-03.05.2019, SHIFT-I

Ans. (a) : The cation and anion are not in stoichiometric proportion in the schottky defect. In ionic solids, it's essentially a vacancy defect. The quantity of missing cations and anions must be equal to maintain electrical neutrality. The following illustration clearly depicts this follow–



270. Formula of nickel oxide with metal deficiency defect in its crystal is $Ni_{0.98}O$. The crystal contains Ni^{2+} and Ni^{3+} ion. The fraction of nickel existing as Ni^{2+} ions in the crystal is

(a) 0.96
(b) 0.04
(c) 0.50
(d) 0.3

(Odisha NEET-2019)

Ans. (a) : The formula is $Ni_{0.98}O$.
So, the ratio of Ni : O = 98 : 100
Thus, if there are 100 atom of oxygen then 98 atom of Ni.
Let x be the number of atoms of Ni^{2+}.
Number of atoms of $Ni^{3+} = 98 - x$
Charge on Ni = Charge on O.
Since oxygen has charge – 2
Therefore,
$2x + 3(98 - x) - 2 \times 100$
$2x + 294 - 3x - 200 = 0$
$x = 94$
Therefore,

$$\text{Fraction of } Ni^{2+} = \frac{\text{Atom of } Ni^{2+}}{\text{Tota number of atom}}$$

or $$\text{Fraction of } Ni^{2+} = \frac{94}{96} = 0.96$$

271. Assertion: Metal deficiency defect can be seen in FeO.
Reason : Li compound (LiCl) have violet colour due to F-center.

(a) In both Assertion and Reason are correct and the Reason is the correct explanation of Assertion.
(b) If both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.
(c) If Assertion is correct but Reason is incorrect.
(d) If both the Assertion and Reason are incorrect.

[AIIMS-27 May, 2018(M)]

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Ans. (b) : In the crystal of FeO, some Fe^{2+} ions are missing and the loss of positive charge is made up by the presence of the required number of Fe^{3+} ions. This however causes metal deficiency in the crystal.

272. Assertion: Conductivity of silicon increase by doping it with group -15 elements.

Reason: Doping means introduction of small amount of impurities like P, As or Bi into the pure crystal.

(a) In both Assertion and Reason are correct and the Reason is the correct explanation of Assertion.
(b) If both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.
(c) If Assertion is correct but Reason is incorrect.
(d) If both the Assertion and Reason are incorrect.

[AIIMS-27 May, 2018(M)]

Ans. (b) : When a silicon crystal is doped with a group - 15 elements, such as P, As, Sb or Bi the structure of the crystal lattice is left unchanged but an occasional atom with five valence electrons occupies a site that would normally be occupied by a silicon atom. The foreign atom uses four of its electrons in covalent bonding but the remaining fifth electron becomes delocalized and thus free to contribute to electrical conductance.

273. Assertion: Schottky defects is produced in solids when equal number of cations and anions are lost from lattice sites. This defect is observed in ionic crystals formed by cations and anions of nearly equal size

Reason: We observe Schottky defect in crytals of KCl, NaCl.

(a) In both Assertion and Reason are correct and the Reason is the correct explanation of Assertion.
(b) If both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.
(c) If Assertion is correct but Reason is incorrect.
(d) If both the Assertion and Reason are incorrect.

[AIIMS-26 May, 2018(E)]

Ans. (b) : Schottky defect is defect occurs. When oppositely charged ions leave their lattice site creating vacancies in such a way that electrical neutrality of crystal is maintained. It is generally seen in highly ionic compounds where a difference in size of cation and anion small.

So, an equal number of cations and anions vacancies are present in the crystals with Schottky Defect.

274. F- centre is

(a) anion vacancy occupied by unpaired electron.
(b) anion vacancy occupied by electron.
(c) cation vacancy occupeid by electron.
(d) anion present in interstitial site.

[AIIMS-26 May, 2018(M)]

Ans. (a) : The anionic sites occupied by unpaired electrons are called F- centers. Such defects also impart color to the crystals.

275. In which among the following solids, Schottky defect is not observed?

(a) ZnS (b) NaCl
(c) KCl (d) CsCl

MHT CET-2018

Ans. (a) : The Schottky defect is not observed in ZnS. The Schottky defect is observed in NaCl, KCl and CsCl. The Schottky defect is observed in solids in which cations and anions have almost equal size.

276. A type of defect observed in stoichiometric compounds in Schottky defect. Schottky defect occur mainly in ionic compounds where

(a) positive and negative ions are of different sizes
(b) positive and negative ions are of same sizes
(c) positive ions are small and negative ions are big
(d) positive ions are big and negative ions are small.

J & K CET-(2017)

Ans. (b) : Schottky defect occur mainly in ionic compound where positive and negative ions are of the same size. For example NaCl, KCl show this defect.

Frenkel defect occur mainly in ionic compound where positive and negative ions are of different size. for example, AgCl and Zns shown this defect.

277. The correct statement regarding defect in solids is

(a) Frenkel defect is usually favoured by a very small difference in the sizes of cations and anions
(b) Frenkel defect is a dislocation defect
(c) Trapping of proton in the lattice leads to the formation of F-centres
(d) Schottky defect has no effect on the physical properties of solids

Karnataka-CET-2017

Ans. (b) : Fenkel defect is favoured by a large difference is the size of cation and anion. When an ion is missing from its normal position and occupies an interstitial site between lattice points, Frenkel defect arises, hence it is dislocation defect.

The electron trapped in anion vacancies are referred to as F – centres.

@apna_pdf

Schottky defects arises when some atoms or ions are missing from their normal lattice points due to the presence of large number of vacancies in crystals, its density (i.e, physical property) is lowered.

278. Which is the incorrect statement ?

(a) Density decreases in case of crystals with Schottky defect.

(b) $NaCl_{(s)}$ is insulator, silicon is semiconductor, silver is conductor, quartz is piezoelectric crystal.

(c) Frenkel defect is favoured in those ionic compounds in which sizes of cation and anions are almost equal.

(d) $FeO_{0.98}$ has non-stoichiometric metal deficiency defect.

(NEET-2017)

Ans. (c,d) : Frenkel defect occurs in those ionic compounds in which size of cation and anion is largely different.

Non-stoichiometric defects due to metal deficiency is shown by Fe_xO where x = 0.93 to 0.96.

279. Which defect in any crystal lowers its density ?

(a) Schottky (b) Interstitial

(c) F-centre (d) Frenkel

UPTU/UPSEE-2016

Ans. (a): In schottky defect same number of cations and anion are missing from their lattice sites. This defect decreases the density of crystal.

280. Ionic solids with Schottky defect may contain in their structure

(a) cation vacancies only

(b) cation vacancies and interstitial cations

(c) equal number of cation and anion vacancies

(d) anion vacancies and interstitial anion

WB-JEE-2016

Ans. (c) : Schottky defect is found in ionic solids. But in ionic compound, we need to balance the electrical neutrality of the compound so an equal number of anions and cations will be missing from the compound.

- It reduces the density of the substance.
- In this , the size of cations and anions are of almost same.

281. Which of the following defects are present in AgBr and ZnS crystal systems?

(a) Frenkel and Schottky

(b) Schottky and Frenkel

(c) Frenkel and Frenkel

(d) Schottky and Schottky

AMU-2015

Ans. (b, c) : In case of Ag Br and ZnS, the cations Ag^+ and Zn^{2+} are small in size thus, some of these ions in the lattice shifts to the interstitial sites that arises Frenkel defect in these crystals.

AgBr shows both shottky and frenkel defects.

282. The correct statement regarding defects in crystalline solids is

(a) Frenkel defects decrease the density of crystalline solids

(b) Frenkel defect is a dislocation defect

(c) Frenkel defect is found in halides of alkaline metals

(d) Schottky defects have no effect on the density crystalline solids.

(NEET-2015)

Ans. (b) : (a) Frenkel defect have no effect on the density of crystalline solids.

(b) Frenkel defect is a dislocation defect.

It arises due to a vacancy at cationic site.

The cation moves to another position between the two layers and is surrounded by greater number of anions.

(c) Frenkel defect is a founded in ZnS, AgBr, AgI, AgCl etc.

(d) Due to schottky defect, the density of crystals decreases.

283. Schottky defect in crystals is observed when

(a) an ion leaves its normal site and occupies an interstitial site

(b) unequal number of cations and anions and missing from the crystal lattice

(c) equal number of cations and anions are missing from the crystal lattice

(d) there is large difference in size of positive and negative ions.

COMEDK 2014

Ans. (c) : In Schoottky defects in crystal is observed when equal number of cations and anions are missing from the crystal lattice.

284. When a cation leaves its normal position in the crystal and moves to some interstitial space, the defect in the crystal is known as

(a) Schottky defect

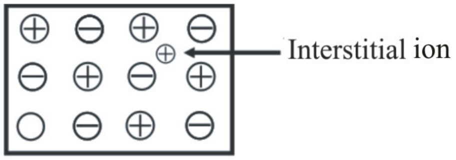
(b) F-centre

(c) Frenkel defect

(d) non-stoichiometric defect

J & K CET-(2013)

Ans. (c) : When a cation leaves its normal position in the crystal and moves to some interstitial space, the defect in the crystal is known as Frenkel defect.



Frenkel defect is also know as interstitial defect

285. Which kind of defects are introduced by doping?

(a) Dislocation defects

(b) Schottky defects

@apna_pdf

(c) Electronic defects
(d) Frenkel defects

JCECE - 2013

Ans. (c) : When electron rich or electron deficient impurity is added to a perfect crystal in introduces an electronic defect in them.

286. Which one of the following has Schottky defect?
(a) NaCl (b) AgCl
(c) FeS (d) ZnS

SRMJEEE – 2011

Ans. (a) : Schottky defect is shown by ionic substances in which the cation and anion are of almost similar sizes. Hence the correct option is A.

287. Assertion: Due to Frenkel defect, there is no effect on the density of the crystalline solid.
Reason : In Frenkel defect, no cation or anion leaves the crystal.
(a) In both Assertion and Reason are correct and the Reason is the correct explanation of Assertion.
(b) If both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.
(c) If Assertion is correct but Reason is incorrect.
(d) If both the Assertion and Reason are incorrect.

[AIIMS-2011]

Ans. (a) : A Frenkel defect is a type of defect in crystalline solid where in an atom is displaced from its lattice position to an interstitial site, creating a vacancy at the original site and an interstitial defect at the new location within the same element without any changes in chemical properties.

No cation and anion are leaving the crystal. Only the cation is moving from one place to another place within the crystal. So the density of crystalline solid will not change.

288. Which is not correct about the Schottky defects?
(a) Both cations and anions are missing from their lattice sites without affecting the stoichimetry of the stoichiometry of the compound.
(b) Because of the presence of holes the lattice energy decreases.
(c) The presence of holes causes the density of the crystal to decrease.
(d) The defect increase the electrical conductivity of the solid due migration of the ions into holes.

[AIIMS-2011]

Ans. (b) : If in an ionic crystal of type $A^+ B^-$ an equal number of cation and anions are missing from their lattice sites so that electrical neutrality , as well as stoichiometry , is maintained then this defect is called a Schottky defect, The presence of holes causes the density of the crystal to decreases. It is a vacancy defect (due to missing ions) and also a stochiometric defect, as the number of cation and anions remains the same. the energy needed to form a Schottky defect is very less but the production of defect of Schottky is an endothermic process. Hence the lattice energy increases. The defect increases the electrical conductivity of the solid due to a migration of the ions into the holes.

289. Frenkel defect is generally observed in
(a) AgBr (b) AgI
(c) ZnS (d) All of the above

VITEEE- 2010

Ans. (d) : When the size of cation is much smaller than the anion then Frenkel defect is observed. Frenkel defect is exhibited in ionic compound in which the radius ratio is low. Hence, AgBr, AgI and ZnS all exhibit Frenkel defect.

290. Extrinsic semi-conduction is due to
(a) purity of crystal
(b) low temperature
(c) thermal defect
(d) impurity in crystal.

SRMJEEE – 2010

Ans. (d) : Extrinsic semiconductors are semiconductors that are doped by a specific impurity which is able to deeply modify its electrical properties, making it suitable for electronic applications.

291. In stoichiometric defect, the ratio of positive and negative ions as indicated by chemical formula of the compound
(a) decreases
(b) increases
(c) changes by a factor of 2
(d) remains same

UPTU/UPSEE-2010

Ans. (d) : Stoichiometric defect, the ratio of positive and negative ions (stoichiometric) and electrical neutrality of a solid is not disturbed. It is also known as intrinsic or thermodynamic defects.

292. Which defect causes decrease in the density of crystal?
(a) Frenkel (b) Schottky
(c) Interstitial (d) F - centre

UPTU/UPSEE-2010

Ans. (b) : Schottky defect is found in ionic solids. But in ionic compound, we need to balance the electrical neutrality of the compound so an equal number of anions and cations will be missing from the compound.

- It reduces the density of the substance.
- In this , the size of cations and anions are of almost same.

@apna_pdf

293. Assertion : No compound has both Schottky and Frenkel defects.
Reason : Both defects change the density of the solid.

(a) In both Assertion and Reason are correct and the Reason is the correct explanation of Assertion.
(b) If both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.
(c) If Assertion is correct but Reason is incorrect.
(d) If both the Assertion and Reason are incorrect.

[AIIMS-2008]

Ans. (d) : AgBr have both Schottky and Frenkel defect. Only Schottky defect change the density of solid because anions or cations are missing and Frenkel defects have no change in density because they have same number of cations or anions only change the position of ions.

294. Schottky defects occurs mainly in electrovalent compounds where

(a) positive ions and negative ions are of different size
(b) positive ions and negative ions are of same size
(c) positive ions and small negative ions are big
(d) positive ions and big negative ions are small

VITEEE- 2008

Ans. (b) : When equal number of cations or anions are missing from their lattice sites than the defect is called Schottky defect. The defect is observe in highly ionic compound which have cation and anions of similar size e.g. NaCl, KCl etc.

295. With which one of the following elements Silicon should be doped so as to give p-type of semiconductor?

(a) Selenium
(b) Boron
(c) Germanium
(d) Arsenic

(NEET-2008)

Ans. (b) : P-type of semiconductor are obtained by doping sillcon or germanium with elements of group 13 like B, Al, Ga or silicon is doped with boron.

296. The structure of ionic compound with Schottky defects has

(a) same number of cationic and anionic vacancies
(b) anionic vacancy and interstitial anion
(c) cationic vacancies
(d) cationic vacancies and interstitial cation

CG PET -2007

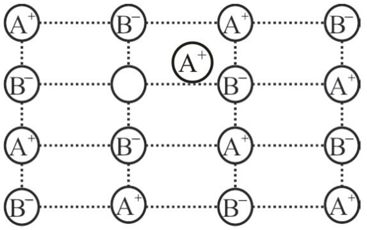
Ans. (a) : The structure of ionic compound with Schottky defects has same number of cationic and anionic vacancies.

297. An ion leaves its regular site occupy a position in the space between the lattice sites is called

(a) Frenkel defect
(b) Schottky defect
(c) Impurity defect
(d) Vacancy defect

VITEEE- 2007

Ans. (a) : In Frenkels defect an ion leaves its regular site and occupy a position in the space between the lattice sites.



298. Schottky defect is observed in the crystal of

(a) NaCl
(b) TiCl
(c) AgCl
(d) $MgCl_2$

AP - EAMCET (Medical) - 2007

Ans. (a) : Schottky defect is observed when equal number of cations and anions are missing from the Lattice. This defect observed in NaCl, KCl, AgBr.

299. If NaCl is doped with 10^{-4} mol % of $SrCl_2$, the concentration of cation vacancies will be ($N_A = 6.02\times10^{23}$ mol^{-1})

(a) 6.02×10^{16} mol^{-1}
(b) 6.02×10^{17} mol^{-1}
(c) 6.02×10^{14} mol^{-1}
(d) 6.02×10^{15} mol^{-1}

(NEET-2007)

Ans. (b) : Moles of $SrCl_2$ in 1 mole NaCl = $\frac{10^{-4}}{100} = 10^{-6}$ moles.

$\therefore$ One Sr^{+2} creates one cationic vacancies.

Concentration of the cationic vacancies produced by 10^{-6} moles of $SrCl_2$

$= 10^{-6} \times 6.023\times10^{23}$

$= 6.023\times10^{17}$ mol^{-1}.

300. Schottky defect in solids is due to

(a) a pair of cation and anion vacancies
(b) occupation of interstitial site by a pair of cation and anion
(c) occupation of interstitial site by a cation
(d) occupation of interstitial site by a anion

VITEEE- 2006

Ans. (a) : Schottky defects in solid is due to a pair of cation and anion vacancies. Equal number of cation and anion are missing which ensure electrical neutrality. Due to this defects the density of crystal decreases. Frenkel defects in solids is due to occupation of interstitial site by a cation or an anion. This defects does not affects the density of the crystal.

@apna_pdf

301. When electrons are trapped into the crystal in anion vacancy, the defect is known as:

(a) Schottky defect (b) Frenkel defect
(c) Stoichiometric defect (d) F-centres

JIPMER-2006

Ans. (d) : F-centres are the sites where anions are missing and instead electron are present. They are responsible for colour.

302. The appearance of colour in solid alkali metal halides is generally due to

(a) Interstitial positions (b) F-centres
(c) Schottky defect (d) Frenkel defect.

(NEET-2006)

Ans. (b) : The appearance of colour in solid alkali metal halides is generally due to F-centres.

303. Frenkel and Schottky defects are

(a) nucleus defects (b) non-crystal defects
(c) crystal defects (d) nuclear defects

JIPMER-2005

Ans. (c) : Frenkel and Schottky defect are called the crystal Defects.

304. Point defects are present in

(a) ionic solids (b) molecular solids
(c) amorphous solids (d) liquids

CG PET -2004

Ans. (a) : Point defects are where an atom is missing or is in an irregular place in the ionic solid lattice structure. Impurity atoms in a pure metal vacancies, and self interstitials are examples of point defects.

305. Density of a crystal remains unchanged as a result of:

(a) ionic defect (b) Schottky defect
(c) Frenkel defect (d) crystal defect
(e) point defect

Kerala-CEE-2004

Ans. (c) Density of crystal does not change in Frenkel defect as missing ions are present in the interstitial sites.

306. Which of the following statement is true?

(a) Some complex metal oxides behave as superconductor
(b) Zinc oxide can act as superconductor
(c) An impurity of tetravalent germanium in trivalent gallium creates electron deficiency
(d) A Frenkel defect is formed when an ion is displaced from its lattice site to and intersitial site

BCECE-2003

Ans. (d) : Frenkel defect is formed by displacement of ion from its lattice site to interstitial state.

307. Schottky defects defines imperfection in the lattice structure of

(a) Solid (b) Gas
(c) Liquid (d) Plasma

[AIIMS-2002]

Ans. (a) : A Schottky defect is a type of point defect in a solid crystal lattice.

308. Ionic solids, with Schottky defects, contain in their structure

(a) cation vacancies only
(b) cation vacancies and interstitial cations
(c) equal number of cation and anion vacancies
(d) anion vacancies and interstitial anions.

(NEET-1994)

Ans. (c) : Ionic solid with Schottky defect may contain in their structure, equal number of cation and anion vacancies,

In schottky defect, equal number of cation and anion are missing.

309. Schottky defect in crystals is observed when

(a) unequal number of cations and anions are missing from the lattice
(b) equal number of cations and anions are missing from the lattice
(c) an ion leaves its normal site and occupies an interstitial site
(d) density of the crystal is increased

Ans. (b) : It is schottky defect is observed when equal number of cations and anions are missing from the lattice site. This defect changes the density as a pair of ions are missing from the lattice.

6. Bragg's Equation

310. In Bragg's equation nλ = 2dsinθ, n represents :

(a) Number of moles
(b) The principal quantum number
(c) Avogadro's number
(d) Order of reflection

MPPET-2013

Ans. (d) : Bragg's equation,

$$\boxed{2d\sin\theta = n\lambda}$$

Where, n = order of reflection from solid
(n = 1, 2, 3, 4, etc.)
d = It is interplanar distance
θ = Angle between the wave vector of the incident plane wave
λ = Wavelength

311. X-rays of wavelength 1.14 Å in the first order reflection from a crystal, were reflected at an angle of 30°
The inter-planar distance in the crystal is (sin 30° = 0.5)

(a) 3.8 Å (b) 1.14 Å
(c) 0.342 Å (d) 2.28 Å

SRMJEEE – 2012

@apna_pdf

Ans. (b) : According to Bragg's law, 2d sinθ = n λ

Where, d = Interplanar distance

n = Order of reflection

λ = wave length.

$\therefore\ 2 \times d \times \sin 30° = 1 \times 1.14 \times 10^{-10} \Rightarrow d = 1.14\text{Å}$

312. The First order reflection (n = 1) from a crystal of the X-ray from a Copper anode tube (λ = 1.54 Å) occurs at an angle of 45º. What is the distance between the set of plane causing the diffraction?

(a) 0.1089 nm.

(b) 0.1089 m.

(c) 10.89 Å

(d) 1.089×10^{-9} m.

GUJCET-2011

Ans. (a): Given that

n = 1, λ = 1.54 Å, θ = 45º, d = ?

We know that Bragg's equation –

2d sinθ = nλ

$$d = \frac{n\lambda}{2\sin\theta} = \frac{1 \times 1.54\text{Å}}{2 \times \sin 45^\circ}$$

$$d = \frac{1.54\text{Å}}{2 \times 0.7071} = 1.089\text{Å}$$

or d = 0.1089 nm

313. For a crystal, the angle of diffraction (2θ) is 90° and the second order line has a d value of 2.28, Å the Wavelength (in Å) of X-rays used for Bragg's diffraction is

(a) 1.612

(b) 2.00

(c) 2.28

(d) 4.00

A.P.EAMCET-2008

Ans. (a) : Given that, $2\theta = 90^0$ or $\theta = 45^0$

d = 2.28Å , n = 2, λ = ?

We know that Bragg's equation-

$$\therefore \quad n\lambda = 2d\sin\theta$$

$$2 \times \lambda = 2 \times 2.28\text{Å} \times \sin 45^\circ$$

$$\lambda = \frac{2 \times 2.28\text{Å}}{2} \times \frac{1}{\sqrt{2}}$$

$$\lambda = 1.612\text{Å}$$

∴The wavelength of X - rays used for Bragg's diffraction is 1.612 Å.

314. The second order Bragg diffraction of X–rays with wavelength of 2.00Å from a set of parallel planes in a crystal occurs at 60°. The distance between the scattering planes in the crystal is

(a) 5.75 Å

(b) 2.00 Å

(c) 4.00 Å

(d) 2.30 Å

AMU – 2008

Ans. (d) : Bragg's law represent a relationship between the wavelength of the X-rays and the distance between the planes.

From the Bragg's equation–

nλ = 2d sinθ

$\therefore\ 2 \times 2 = 2 \times d \sin 60°$

$$\therefore\ 2d = \frac{4}{\sin 60^\circ}$$

$$\therefore\ 2d = \frac{4}{\sqrt{3}/2}$$

$$\therefore\ 2d = \frac{8}{\sqrt{3}}$$

$$\therefore\ d = \frac{8}{2\sqrt{3}} = \frac{4}{\sqrt{3}} = 2.30\text{Å}$$

315. The second order Bragg's diffraction of X-rays of wavelength 100 pm from a set of parallel lattice planes in a metal occurs at a grazing angle of 30°. The spacing between the successive scattering planes in the crystal is

(a) 50 pm

(b) 100 pm

(c) 150 pm

(d) 200 pm

SRMJEEE – 2007

Ans. (d) : Given that, n = 2

λ = 100 pm

θ = 30°

d = ?

Now, from Bragg's law :-

2dsinθ = nλ

$$\text{or} \quad d = \frac{n\lambda}{2\sin\theta}$$

$$d = \frac{2 \times 100\,\text{pm}}{2 \times \sin 30^\circ} = 200\,\text{pm}$$

316. The second order Bragg diffraction of X-rays with λ = 1.00Å from a set of parallel planes in a metal occurs at an angle 60°. The distance between the scattering planes in the crystal is

(a) 2.00 Å

(b) 1.00 Å

(c) 0.575 Å

(d) 1.15 Å

(NEET-1998)

Ans. (d) :

Given that –

Wavelength (λ) = 1.00 Å

Angle of diffraction (θ) = 60^0

Order of diffraction (n) = 2

According to Bragg’s equation

2d sinθ = nλ

$$d = \frac{n\lambda}{2\sin\theta}$$

$$d = \frac{2 \times 1\text{Å}}{2 \times \sin 60} \qquad \therefore\ \sin 60 = \frac{\sqrt{3}}{2}$$

$$d = \frac{2 \times 1\text{Å}}{2 \times \frac{\sqrt{3}}{2}}$$

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$$d = \frac{2\times 1 Å}{\sqrt{3}} \qquad \therefore \sqrt{3} = 1.732$$

$$d = 1.15 Å$$

The distance between the scattering planes in the crystal is d = 1.15 Å.

317. Bragg's law is given by the which of the following equation?

(a) $n\lambda = 2\theta \sin\theta$ (b) $n\lambda = 2d \sin\theta$

(c) $2n\lambda = d \sin\theta$ (d) $n\frac{\theta}{2} = \frac{d}{2}\sin\theta$

VITEEE-2003

Ans. (b) : Bragg's Law, $n\lambda = 2d \sin\theta$

$$d_{hkl} = \frac{a}{\sqrt{h^2+k^2+l^2}}$$

Where λ = Wavelength of the x - ray

n = Positive integer

d = Distance between the lattice planes

θ = Incident angle

a = Lattice parameter

7. Density of Unit Cell

318. Copper crystallizes in fcc unit cell with cell edge length of 3.608 × 10^{-8} cm. The density of copper is 8.92 g cm^{-3}. Calculate the atomic mass of copper.

(a) 65 u (b) 63.1 u

(c) 31.55 u (d) 60 u

NEET-17.07.2022

Ans. (b) : Given that,

Z = 4 (FCC)

$d = 8.92 \text{ g cm}^{-3}$

$N_A = 6.023 \times 10^{23}$

$a = 3.608 \times 10^{-8}$ cm

$$d = \frac{Z\times M}{N_A \times \text{Volume}}$$

$$8.92 = \frac{4\times M}{6.02\times 10^{23}\times(3.608\times 10^{-8})^3}$$

$$8.92 = \frac{4\times M}{6.02\times 10^{23}\times 46.97\times 10^{-24}}$$

M = 63.05

319. The distance between Na^+ and Cl^- ions in solid NaCl of density 43.1 g cm^{-3} is_____ × 10^{-10} m. (Nearest Integer) (Given: $N_A = 6.02\times 10^{23}$ mol^{-1})

JEE Main-25.06.2022, Shift-I

Ans. (1) : Given,

Density of solid NaCl = 43.1 cm^{-3}

$N_A = 6.02 \times 10^{23}$ mol^{-1}

Z (effective number of atoms in unit cell) = 4

Molecular mass (M) = 58.5 gm.

We know that –

$$\text{Density} = \frac{Z\times M}{N_A \times \text{Volume}}$$

$$43.1 = \frac{4\times 58.5}{6.02\times 10^{23}\times[a]^3}$$

$$a^3 = \frac{4\times 58.5}{6.02\times 10^{23}\times 43.1}$$

$$= 9\times 10^{-24}$$

$$a = 2.08\times 10^{-8} \text{ cm}$$

$$d_{Na^+ + Cl^-} = \frac{a}{2} = 1\times 10^{-10} \text{m}$$

320. What is the percentage of free space in body. centred cubic unit cell?

(a) 32% (b) 20%

(c) 34% (d) 28%

NEET-2015, 2008

J & K CET-(2014)

JIPMER-2014

Ans. (a) : We know that,

$$\text{Packing fraction} = \frac{V_{sphere}}{\text{Volume of the unit cell}}\times 100$$

For BCC,

$$\text{Packing fraction} = \frac{2\times\frac{4}{3}\pi r^3}{\left(\frac{4r}{\sqrt{3}}\right)^3}\times 100$$

$$= \frac{\sqrt{3}\pi}{8}\times 100$$

= 68% (volume occupied)

Fraction of free space in BCC = 100 – 68 = 32%

321. The cubic unit cell of a metal (molar mass =63.55g mol^{-1}) has an edge length of 362 pm. Its density is 8.92gcm^{-3}. The type of unit cell is

(a) primitive (b) face-centred

(c) body centred (d) end centred

CG PET -2017

AP-EAMCET (Engg.)-2009

Ans. (b) : Density (d)=8.92 g cm^{-3}

Edge length (a)= 362×10^{-10} cm

M= 63.55 g mol^{-1}

$$d = \frac{Z\times M}{a^3\times N_A}$$

$$Z = \frac{8.92\times 6.023\times 10^{23}\times\left(362\times 10^{-10}\right)^3}{63.55}$$

Z=4

∴ The metal crystallizes in face centred cell.

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322. A metal crystallizes in bcc lattice with unit cell edge length of 300 pm and density 6.15 gcm^{-3}. The molar mass of the metal is

(a) 50 gmol^{-1} (b) 60 gmol^{-1}
(c) 40 gmol^{-1} (d) 70 gmol^{-1}

Karnataka-CET-2021

Ans. (a) : We Know that –

$$\text{Density (d)} = \frac{Z \times M}{a^3 \times N_A}$$

Given that –

Edge length a = 300 pm

Density d = 6.15 gcm^{-3}

$N_A = 6.02 \times 10^{23}$

In bcc number of atom Z = 2

$$\text{So,} \quad M = \frac{d \times a^3 \times N_A}{Z}$$

$$M = \frac{6.15 \times (300 \times 10^{-10})^3 \times 6.02 \times 10^{23}}{2}$$

$M = 50$ gmol^{-1}

323. The unit cell of copper corresponds to a face centered cube of edge length 3.596 A with one copper atom at each lattice point. The calculated density of copper in kg/m^3 is......[Molar mass of Cu = 63.54 g ; Avogadro number = 6.022×10^{23}]

[JEE Main 2021, 25 Feb Shift-II]

Ans. (9077) : Given that,

Molar mass of Cu = 63.54g

$N_A = 6.022 \times 10^{23}$ mole^{-1}

a = 3.596 Å = 3.596×10^{-10} m

In FCC whit cell Z = 4

So,

$$d = \frac{Z \times M}{N_A \times a^3}$$

$$d = \frac{4 \times 63.54 \times 10^{-3}}{6.022 \times 10^{23} \times (3.596 \times 10^{-10})^3}$$

$$d = \frac{254.16}{6022 \times 10^{23} \times 46.50 \times 10^{-30}}$$

d = 9077 kg/m^3

324. A copper complex crystallising in a CCP lattice with a cell edge of 0.4518 nm has been revealed by employing X-ray diffraction studies. The density of copper complex is found to be 7.62 g cm^{-3}. The molar mass of copper complex is ......g mol^{-1}. (Nearest integer)
(Given : $N_A = 60.022 \times 10^{23}$ mol^{-1})

[JEE Main 2021, 22 July Shift-II]

Ans. (106) : Given that,

a = 0.4518 nm = 0.4518×10^{-7} cm

d = 7.62 gcm^{-3}

In CCP/FCC unit cell Z = 4

$N_A = 6.022 \times 10^{23}$mol^{-1}

$$\text{So,} \quad d = \frac{Z \times M}{a^3 \times N_A}$$

$$7.62 = \frac{4 \times M}{6.022 \times 10^{23} \times (0.4518 \times 10^{-7})^3}$$

M = 105.8 g/mol.

325. A metal crystaillses in BCC lattice with unit cell edge length of 300 pm and density 6.15 g cm^{-3}. The molar mass of the metal is

(a) 50 g mol^{-1} (b) 60 g mol^{-1}
(c) 40 g mol^{-1} (d) 70 g mol^{-1}

Kerala-CEE-29.08.2021

Ans. (a) : Given that –

Edge length (a) = 300 pm = 300 ×10^{-10} cm = 3 × 10^{-8} cm

Density (d) = 6.15 gcm^{-3}

Molar mass (M) = ?

Now, from the equation of density, we get –

$$d = \frac{Z \times M}{N_A \times a^3}$$

Where, d = density of the crystal

Z = 2 (Number of atom in BCC lattice)

M = Molecular mass

a = edge length

N_A = Avogadro number (6.023×10^{23})

$$\therefore M = \frac{\rho \times N_A \times a^3}{Z}$$

$$M = \frac{6.15 \times 6.023 \times 10^{23} \times 27 \times 10^{-24}}{2}$$

or M = 50 gmol^{-1}

326. A diatomic molecule X_2 has a body-centered cubic (bcc) structure with a cell edge of 300 pm. The density of the molecule is 6.17 g cm^{-3} . The number of molecules present in 200 g of X_2 is (Avogadro constant)
($N_A = 6 \times 10^{23}$ mol^{-1})

(a) 40N_A (b) 8N_A
(c) 4 N_A (d) 2 N_A

[JEE Main 2020, 5 Sep Shift-I]

Ans. (c) : Given,

Edge length (a) = 300 pm = 300 × 10^{-10} cm

Density (d) = 6.17 g cm^{-3}

For BCC, Z = 2

$$\text{Density } d = \frac{Z \times M}{a^3 \times N_A}$$

$$6.17 = \frac{2 \times M}{6.02 \times 10^{23} \times (300 \times 10^{-10})^3}$$

$$6.17 = \frac{2M}{6.02 \times 2.7}$$

2M = 6.17×6.02×2.7

@apna_pdf

$$M = \frac{6.17 \times 6.02 \times 2.7}{2}$$

$M = 50$ g/mol

$$\text{Number of moles} = \frac{\text{Mass}}{\text{Molar Mass}}$$

$$= \frac{200}{50}$$

= 4 mol.

Number of molecule = mole × N_A

$= 4 \times N_A$

327. An element with molar mass 2.7×10^{-2} kg mol^{-1} forms a cubic unit cell with edge length 405 pm. If its density is 2.7×10^3 kg m^{-3}, the radius of the element is approximately…….$\times 10^{-12}$ m (to the nearest integer).

[JEE Main 2020, 3 Sep Shift-I]

Ans. (143.21) : Given that,

$d = 2.7 \times 10^3$ $kgm^{-3} = 2.7$ g cm^{-3}

$a = 405$ pm $= 405 \times 10^{-10}$ cm

$m = 2.7 \times 10^{-2}$ kg $mol^{-1} = 27$g mol^{-1}

Volume $(a^3) = (405)^3 = (405 \times 10^{-10})^3$ cm^3

$N_A = 6.023 \times 10^{23}$ mol^{-1+}

$$\text{We know that, } d = \frac{ZM}{a^3 N_A}$$

$$Z = \frac{d \times a^3 \times N_A}{M}$$

$$= \frac{2.7 \times (405 \times 10^{-10})^3 \times 6.023 \times 10^{23}}{27} = 4$$

Hence, the nature of the cubic unit cell is CCP/FCC.

$$a = 2\sqrt{2}R \Rightarrow R = \frac{a}{2\sqrt{2}} = \frac{405 \times 10^{-10}}{2\sqrt{2}} = 143.21 \times 10^{-12}\,m$$

328. A metal crystallises in face centred cubic structure with metallic radius $\sqrt{2}\,\overset{o}{A}$. The volume of the unit cell (in m^3) is

(a) 4×10^{-10}
(b) 6.4×10^{-29}
(c) 4×10^{-9}
(d) 6.4×10^{-30}

Karnataka-CET-2020

Ans. (b) : Given that, $r = \sqrt{2}$ Å

$$\text{For FCC, atomic radius } (r) = \frac{\sqrt{2}a}{4}$$

$$\sqrt{2} \times 10^{-10} = \frac{\sqrt{2}a}{4}$$

$$\sqrt{2}a = 4 \times \sqrt{2} \times 10^{-10}$$

$$a = \frac{4 \times \sqrt{2} \times 10^{-10}}{\sqrt{2}}$$

$a = 4 \times 10^{-10}$ m

So, Volume of unit cell $(a^3) = (4 \times 10^{-10})^3$

$= 64 \times 10^{-30}$ m^3

$= 6.4 \times 10^{-29}$ m^3

329. The number of atoms in 2.4 g of body centred cubic crystal with edge length 200 pm is (density = 10g cm^{-3}, $N_A = 6 \times 10^{23}$ atoms/mol)

(a) 6×10^{22}
(b) 6×10^{20}
(c) 6×10^{23}
(d) 6×10^{19}

Karnataka-CET-2019

Ans. (a) : We know that,

$$\text{Density } d = \frac{Z \times M}{a^3 \times N_A}$$

Given that —

Density (d) = 10 g cm^{-3}

Edge length a= 200 pm

$N_A = 6 \times 10^{23}$ atoms/mol.

So

$$d = \frac{2 \times M}{(200)^3 \times 6 \times 10^{23}}$$

$$M = \frac{10 \times (200)^3 \times 10^{-30} \times 6 \times 10^{23}}{2}$$

M = 24

24 g contain → 6×10^{23}

2.4g contain → 6×10^{22} number of atoms

330. At 100ºC, copper (Cu) has FCC unit cell structure with cell edge length of x Å What is the approximate density of Cu (in g cm^{-3}) at this temperature?

[Atomic mass of Cu = 63.55u]

(a) $\frac{211}{x^3}$
(b) $\frac{205}{x^3}$
(c) $\frac{105}{x^3}$
(d) $\frac{422}{x^3}$

[JEE Main 2019, 9Jan Shift-II]

Ans. (d) : We know that –

$$\text{Density (d)} = \frac{Z \times M}{a^3 \times N_A}$$

In FCC unit cell, z = 4

So,

$$d = \frac{4 \times 63.55}{6.02 \times 10^{23} \times x^3 \times 10^{-24}}\,g/cm^3$$

[∴ 1 Å = 10^{-8} cm.]

$$d = \frac{63.55 \times 4 \times 10}{6.02 \times x^3}\,g/cm^3$$

$$d = \frac{422.26}{x^3}$$

$$d \simeq \frac{422}{x^3}$$

331. A solid having density of 9×10^3 kg m^{-3} forms face centred cubic crystals of edge length $200\sqrt{2}$ pm. What is the molar mass of the solid? (Avogadro constant = 6×10^{23} mol^{-1}, π = 3)

@apna_pdf

(a) 0.03050 kg mol^{-1}
(b) 0.4320 kg mol^{-1}
(c) 0.0432 kg mol^{-1}
(d) 0.0216 kg mol^{-1}

[JEE Main 2019, 11 Jan Shift-I]

Ans. (a) : Given that, $d = 9 \times 10^3$ kg m^{-3}

$a = 200\sqrt{2}$ pm $= 200\sqrt{2}\times10^{-12}$ m

$N_A = 6 \times 10^{23}$ mol^{-1}

We know the formula of density –

$$d = \frac{Z\times M}{a^3\times N_A}$$

For, FCC unit cell Z = 4

So, $$d = \frac{Z\times M}{a^3\times N_A}$$

$$9\times10^3 = \frac{4\times M}{(200\sqrt{2}\times10^{-12})^3\times6.0\times10^{23}}$$

$$4\times M = 9\times10^3\times(200\sqrt{2}\times10^{-12})^3\times6.0\times10^{23}$$

$$M = \frac{9\times10^3(200\sqrt{2}\times10^{-12})^3\times6.0\times10^{23}}{4}$$

M = 0.0305 kg.mol^{-1}

332. Each edge of a cubic unit cell is 400 pm long. If atomic mass of the element is 120 and its density is 6.25 g / cm^3, the crystal lattice is: (use $N_A = 6 \times 10^{23} mol^{-1}$)

(a) primitive
(b) body centered
(c) face centered
(d) end centered

BITSAT-2018

Ans. (b) : Given that, Unit cell length (a) = 400 pm $= 4\times10^{-8}$ cm

Molar mass (M) = 120 g mol^{-1}

Density (d) = 6.25 g cm^{-3}

$N_A = 6\times10^{23}$ mol^{-1}

$\therefore$ $$d = \frac{Z\cdot M}{N_A\times a^3}$$

or $$Z = \frac{d\times N_A\times a^3}{M}$$

$$Z = \frac{6\times10^{23}\times(4\times10^{-8})^3\times6.25}{120}$$

When, Z = 2 it means body centre cubic.

333. In a cubic lattice each edge length of the unit cell is 408.6 pm and density of the unit cell is 10.5×10^3 kgm^{-3} at weight 107. The crystal lattice is

(a) FCC (b) BCC
(c) CCP (d) Primitive

JCECE - 2018

Ans. (a) : Given that, a = 408.6 pm $= 4.086 \times 10^{-10}$ m

$d = 10.5 \times 10^3$ kg m^{-3}

$M = 107 = 1.07 \times 10^{-1}$ kg mol^{-1}

$N_A = 6.023\times10^{23}$ mol^{-1}

$$Z = \frac{d\times a^3\times N_A}{M}$$

$$= \frac{10.5\times10^3\times(4.086\times10^{-10})^3\times6.022\times10^{23}}{1.07\times10^{-1}}$$

Z = 4

It has FCC crystal lattice.

Note:–

Crystal lattice		**No. of atom**
SC	⟶	1
BCC	⟶	2
FCC	⟶	4
HCP	⟶	6

334. An atom forms face centred cubic crystal with density d = 8.92 g/ml and edge length a = 3.6 × 10^{-8} cm. The molecular mass of atoms in amu is

(a) 98 amu (b) 63 amu
(c) 32 amu (d) 93 amu

JIPMER-2018

Ans. (b) : Given that, Density (d) = 8.92 g/cm^3

Edge length (a) = 3.6×10^{-8} cm

Z = 4 (FCC)

The molecular mass of atom in a lattice can be calculated by using the formula.

$$d = \frac{Z\times M}{N_A\times a^3} \Rightarrow M = \frac{d\times N_A\times a^3}{Z}$$

$$M = \frac{8.92\times6.023\times10^{23}\times(3.6\times10^{-8})^3}{4}$$

M = 62.665g. mol^{-1} = 62.665 amu

335. An element has a body centered cubic structure with a unit cell edge length of 400 pm. Atomic mass of an element is 24 g mol^{-1}. What is the density of the element? ($N_A = 6 \times 10^{23}$ mol^{-1})

(a) 2.50 g cm^{-3}
(b) 1.80 g cm^{-3}
(c) 3.60 g cm^{-3}
(d) 1.25 g cm^{-3}

AP EAMCET-2017

Ans. (d): Given, for body centered cubic (Z) = 2

Edge length (a) = 400 pm
$= 400 \times 10^{-12}$ m
$= 400 \times 10^{-10}$ m

Atomic mass (M) = 24 g/mole

$\therefore$ density (d) $= \dfrac{Z\times M}{N_A a^3}$

@apna_pdf

$$= \frac{2\times 24\,g/mole}{6\times 10^{23}mol^{-1}\times(400\times 10^{-10})^3}$$

$$= \frac{48\times 10}{6\times 4\times 16}$$

$= 1.25\ gcm^{-3}$

336. Al (at. wt 27) crystallizes in the cubic system with a cell edge of 4.05 Å. Its density is 2.7 g per cm^3. Determine the unit cell type & calculate the radius of the Al atom.

(a) fcc, 2.432 Å (b) bcc, 2.432 Å

(c) bcc,1.432 Å (d) fcc,1.432 Å

BITSAT-2016

Ans. (d) : The density is given by the formula

$$\rho = \frac{Z\times M}{\text{Avogadro's no.}\times a^3}$$

$$2.7 g/cm^3 = \frac{Z\times 27\ g/mol}{6.02\times 10^{23}\times(4.05\times 10^{-8.}\ cm)^3}$$

$Z = 4$

The number of atom per unit cell Z = 4 Hence it is face centered cubic unit lattice.

Again, $4r = a\sqrt{2} = 4.05\text{Å}\times 1.414 = 5.727\text{Å}$

The radius of the Al atom = 1.442 Å,

Hence, the correct option is 'd'.

337. The density and edge length values for a crystalline element with FCC lattice are 10 g cm^{-3} and 400 pm, respectively. The number of unit cells in 32 g of this crystal is

(a) 8×10^{23} (b) 5×10^{22}

(c) 8×10^{22} (d) 5×10^{23}

J & K CET-(2016)

Ans. (b) : Given that,

Density of the unit cell = $10 g/cm^3$

Volume of the unit cell $(a^3)=(400\times 10^{-10})^3\ cm^3$

$= 64\times 10^{-24}\ cm^3$

So, Mass of unit cell = Volume × density

$= 64\times 10^{-24}\times 10$

$= 640\times 10^{-24}\ g$

Now, $640\times 10^{-24}\ g$ = 1 unit cell

$$\therefore \quad 32\ g = \frac{1}{640\times 10^{-24}}\times 32$$

$= 0.05\times 10^{24}$

$= 5\times 10^{22}$

338. An element crystallising in body centred cubic lattice has an edge length of 500 pm. If its density is 4gcm^{-3}, the atomic mass of the element (in g mol^{-1}) is (consider N_A= 6 × 10^{23})

(a) 100 (b) 250

(c) 125 (d) 150

(e) 50

Kerala-CEE-2016

Ans. (d) : Given that, edge length = 500pm

Density (d) = 4g cm^{-3}

$N_A = 6\times 10^{23}$

So, $$d = \frac{Z\times M}{a^3\times N_A}$$

For BCC, Z = 2

$$4 = \frac{2\times M}{(500\times 10^{-10})^3\times 6\times 10^{23}}$$

$$M = \frac{4\times(500\times 10^{-10})^3\times 6\times 10^{23}}{2}$$

$M = 150\ g\ mol^{-1}$

339. Lithium has a BCC structure. Its density is 530kg m^{-3} and its atomic mass is 6.94 g mol^{-1} calculated the edge length of a nnit cell of lithium metal.(N_A = 6.02 ×10^{23} mol^{-1})

(a) 527 pm (b) 264 pm

(c) 154 pm (d) 352 pm

(NEET-I-2016)

Ans. (d) : For BCC structure –

$d = 530\ kg\ m^{-3}$

Atomic mass = 6. 94gmol^{-1} = 6.94×10^{-3} kg mol^{-1}

$N_A = 6.02\times 10^{23}\ mol^{-1}$

For BCC, Z = 2

So, $$d = \frac{Z\times M}{N_A\times a^3}$$

$$530 = \frac{2\times 6.94\times 10^{-3}}{6.02\times 10^{23}\times a^3}$$

$$a^3 = \frac{2\times 694}{530\times 6.02\times 10^{28}}$$

$a^3 = 0.435\times 10^{-28} m$

$a = 3.52\times 10^{-10}\ m$

$a = 352\times 10^{-12}\ m = 352\ pm.$

340. Aluminium (atomic mass = 27) crystallises in a cubic system with edge length of 4Å, its density is 2.7 g cm^{-3}. The number of aluminium atoms present per unit cell is

(a) 5 (b) 6

(c) 4 (d) 2

(e) 3

Kerala-CEE-2015

Ans. (c) : Given that –

Density (d) = 2.7 g cm^{-3}

Mass (M) = 27 g/mol

We know that –

$$\text{Density (d)} = \frac{Z\times M}{a^3\times N_A}$$

Edge length (a) = 4Å = 4×10^{-8} cm

So, the number of aluminium atoms present per unit cell–

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$$(Z) = \frac{d \times a^3 \times N_A}{M}$$

$$Z = \frac{2.7 \times (4 \times 10^{-8})^3 \times 6.022 \times 10^{23}}{27}$$

$Z = 3.85$

$Z \simeq 4$

341. For two isomorphous crystals A and B, the ratio of density of A to that of B is 1.6 while the ratio of the edge length of B to that of A is 2. If the molar mass of crystal B is 200g mol^{-1}, then that of crystal A is

(a) 240 g mol^{-1} (b) 120 g mol^{-1}
(c) 80 g mol^{-1} (d) 160 g mol^{-1}
(e) 40 g mol^{-1}

Kerala-CEE-2015

Ans. (e) : Density of crystal $d = \frac{Z \times M}{a^3 \times N_A}$

So, $d \propto \frac{M}{a^3}$

Its density and molar mass of isomorphous crystal (A) and d_A and M_A, density and molar mass of isomorphous crystal B are d_B and M_B respectively.

Then, $\frac{d_A}{d_B} = \frac{M_A}{M_B} \times \left(\frac{a_B}{a_A}\right)^3$

Given $M_B = 200$ g / mol

$\frac{d_A}{d_B} = 1.6, \quad \frac{a_B}{a_A} = 2$

$m_A = \frac{1.6 \times 200}{8} = 40$ g / mol.

342. Argon crystallizes in FCC arrangement and the density of solid and liquid Ar is 1.59 g/cm^3 and 1.42/cm^3, respectively. The percentage of empty space in liquid Ar is–

(a) 34.84% (b) 43.8%
(c) 23.4% (d) 21.6%

BCECE-2015

Ans. (a) : Let the volume of solid (Ar) = 100 mL

Mass of solid Ar = V × d
= 100 × 1.59 g/cm^3
= 159 g

Volume of liquid Ar $= \frac{\text{Mass}}{d} = \frac{159}{1.4} = 113.57$ mL

$\therefore$ Argon crystallizes in FCC type lattice, the packing fraction = 0.74.

So, the actual volume occupied by Ar
= Packing fraction × Volume of solid Ar
= 0.74 × 100
= 74 mL

$\therefore$ % empty in liquid Ar $= \frac{(113.57 - 74) \times 100}{113.57}$

$= \frac{(39.57) \times 100}{113.57}$

= 34.84%

343. Ferrous oxide has a cubic structure. The length of edge of the unit cell is 5 Å and the density of the oxide is 4.0 g cm^{-3}. Then the number of Fe^{2+} and O^{2-} ions present in each unit cell will be

(a) four Fe^{2+} and two O^{2-}
(b) four Fe^{2+} and four O^{2-}
(c) two Fe^{2+} and four O^{2-}
(d) two Fe^{2+} and two O^{2-}

JIPMER-2015

Ans. (b) : Given that, a= 5 Å = 5 × 10^{-8}cm

$\therefore \quad V = (5 \times 10^{-8})^3$ cm^3

Molecular Mass, M = 56 + 16 = 72g

$\therefore \quad d = \frac{Z \times M}{N_A \times a^3}$

$\therefore \quad Z = \frac{d \times N_A \times a^3}{M}$

$Z = \frac{4 \times 6.023 \times 10^{23} \times (5 \times 10^{-8})^3}{72}$

$= 4.16 \approx 4$

Four molecules of ferrous oxide (FeO) per unit cell, it means that Fe^{2+} and O^{2-} ions are present in each unit cell.

344. Suppose the mass of a single Ag-atom is m. Ag metal crystallizes in FCC lattice with unit cell of length a. The density of Ag metal in terms of a and m is

(a) $\frac{4m}{a^3}$ (b) $\frac{2m}{a^3}$
(c) $\frac{m}{a^3}$ (d) $\frac{m}{4a^3}$

WB-JEE-2015

Ans. (a) : Given that,
Mass of single Ag–atom is = m
Unit cell length = a
For FCC, z = 4
So, Mass of unit cell = 4m.
Volume of unit cell = a^3

Density (d) $= \frac{\text{Mass of unit cell}}{\text{Volume of unit cell}}$

$= \frac{\text{No. of atoms} \times \text{Mass of each atom}}{\text{Volume of the unit cell}}$

$= \frac{4m}{a^3}$

345. An elemental crystal has a density of 8570 kg / m^3. The packing efficiency is 0.68. The closest distance of approach between neighbouring atom is 2.86 Å. What is the mass of one atom approximately?

@apna_pdf

(a) 93 amu (b) 39 amu
(c) 63 amu (d) 29 amu

BITSAT-2014

Ans. (a) : Given that –
The packing efficiency = 0.68
It means the given crystal lattice is in BCC.
So, number of unit cell (Z) is 2 .
BCC closest distance = 2r & 4r = $a\sqrt{3}$

$$a = \frac{4r}{\sqrt{3}} = \frac{2\times 2.86}{\sqrt{3}} = 3.30 \times 10^{-10}\,\text{m}$$

$$d = \frac{ZM/1000}{N_A \times a^3} \Rightarrow 8570 = \frac{2\times M}{6.02\times 10^{23}\times(3.30\times10^{-10})^3\times10^3}$$

$$M = \frac{8570\times6.02\times10^{23}\times(3.30\times10^{-10})^3\times10^3}{2} = 92.7\,\text{g/mol}$$

$\therefore$ Mass of 1 atom = 92.7amu ≅ 93 amu.

346. A metal has a FCC lattice. The edge length of the unit cell is 404 pm. The density of the metal is 2.72g cm^{-3} the molar mass of the metal is (N_A Avogardo's constant = 6.02×10^{23}mol^{-1})

(a) 27g mol^{-1} (b) 20 g mol^{-1}
(c) 40 g mol^{-1} (d) 30 g mol^{-1}

(NEET-2013)

Ans. (a) : The edge length of unit cell = 404 pm
Density (d) = 2.72g cm^{-3}
$N_A = 6.022 \times 10^{23}$ mol^{-1}
For FCC, Z = 4

$$d = \frac{ZM}{a^3\times N_A}$$

$$M = \frac{d\times a^3\times N_A}{Z}$$

$$M = \frac{2.72\times(404\times10^{-10})^3\times6.02\times10^{23}}{4}$$

M = 27 g mol^{-1}

347. A crystalline solid substance has a density of 10 g/cm^3 and the length of the edge of the unit cell (FCC) is $2.0\,\overset{\circ}{A}$. How many number of atoms are present in 200 g of the solid?

(a) 2×10^{23} (b) 1×10^{26}
(c) 1×10^{25} (d) 5×10^{27}

AP- EAMCET(Medical) -2010

Ans. (c): 1Å = 100 pm
Z = No. of atoms in FCC = 4
2Å = 200 pm

$$M = \frac{d\times a^3\times N_A\times10^{-3}}{Z}$$

$$= \frac{10\times(200)^3\times6.02\times10^{23}\times10^{-3}}{4}$$

mol. wt. = 12.04

$$\text{No. of atoms in 200 gram} = \frac{6.02\times10^{23}\times200}{12.04}$$

$= 1.0 \times 10^{25}$

348. Assertion: Stability of a crystal is reflected in the magnitude of its melting point.
Reason: The stability of crystal depends upon the strength of the interparticle attractive force.

(a) Both Assertion and Reason are correct and the Reason is the correct explanation of Assertion.
(b) Both Assertion and Reason are correct, but Reason is not the correct explanation for Assertion.
(c) If Assertion is correct but Reason is incorrect.
(d) If both the Assertion and Reason are incorrect.

[AIIMS-2009]

Ans. (a) : The stability of crystal depends upon the strength of the inter particle attractive force (force of attraction between the particle).
The melting point of a solids depends on the strength of the attractive force acting between constituent particles.
Since, the stability of a crystal gets reflected in magnitude of is melting point.

349. The cubic unit cell of a metal (molar mass = 63.55g mol^{-1}) has an edge length of 362 pm. Its density is 8.92g cm^{-3}. The type of unit cell is

(a) primitive
(b) face centred
(c) body centred
(d) end centred

VITEEE- 2009

Ans. (b) : Given, molar mass (M) = 63.55 g mol^{-1}
Edge length (a) = 362 pm = 362×10^{-10} cm
Density (d) = 8.92 g cm^{-3}
$N_A = 6.023\times10^{23}$ mol^{-1}

$$\text{Density, } d = \frac{MZ}{N_A a^3}$$

Where, Z = number of atoms in unit cell

$$\therefore Z = \frac{d\cdot N_A a^3}{M}$$

$$= \frac{8.92\times6.023\times10^{23}\times(362\times10^{-10})^3}{63.55}$$

= 4.0

Thus, metal has face centred unit cell.

350. CsBr crystallises in a body-centred cubic lattice. The unit cell length is 436.6 pm. Given that the atomic mass of Cs = 133 and that of Br = 80 amu and Avogardo number being 6.02×10^{23} mol^{-1}, the density of CsBr is

(a) 4.25 g/cm^3 (b) 42.5 g/cm^3
(c) 0.425 g/cm^3 (d) 8.25 g/cm^3

(NEET-2006)

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Ans. (d) : CsBr crystallises in a BCC

Unit cell length (a) = 436.6 pm

$= 436.6 \times 10^{-10}$ cm

Molecular weight of CsBr = 133+80 = 213 g mol^{-1}

For BCC, Z = 2

So, $d = \frac{Z \times M}{a^3 \times N_A}$

$$= \frac{2 \times 213}{\left(436.6 \times 10^{-10}\right)^3 \times 6.022 \times 10^{23}}$$

$= 8.49 \times 10^{-7} \times 10^7$ g/cm^3

$= 8.50$ g/cm^3

351. An element (atomic mass 100g/mol) having bcc structure has unit cell edge 400 pm. The density of element is (no. of atoms in bcc, Z = 2)

(a) 2.144g/cm^3

(b) 7.289 g/cm^3

(c) 5.188 g/cm^3

(d) 10.376 g/cm^3

[AIIMS-2002]

Ans. (c) : Given that –

Edge length (a) = 400 pm = 400 × 10^{-10} cm

Number at atom (Z) = 2

Molar Mass (M) = 100 g mol^{-1}

We know that –

$$d = \frac{Z \times M}{a^3 \times N_A}$$

$$d = \frac{2 \times 100}{(400 \times 10^{-10})^3 \times 6.023 \times 10^{23}}$$

$$d = \frac{2 \times 10^2}{64 \times 10^{-24} \times 6.023 \times 10^{23}}$$

$d = 5.188$g/cm^3

352. An element (atomic mass = 100 g mol^{-1}) having BCC structure has unit cell edge 400 pm. The density of element is

(a) 7.289 g/cm^3

(b) 2.144 g/cm^3

(c) 10.376 g/cm^3

(d) 5.188 g/cm^3

(NEET-1996)

Ans. (d) : Given that, Cell edge (a) = 400 pm

= 400 × 10^{-10} cm

M = 100 g mol^{-1}

For BCC, z =2

So, $d = \frac{Z \times M}{a^3 \times N_A}$

$$d = \frac{2 \times 100}{\left(400 \times 10^{-10}\right)^3 \times 6.023 \times 10^{23}}$$

$d = 5.188$ g/cm^3

353. Among the following the incorrect statement is

(a) Density of crystals remains unaffected due to Frenkel defect.

(b) In BCC unit cell the void space is 32%

(c) Density of crystals decreases due to Schottky defect.

(d) Electrical conductivity of semiconductors and metals increases with increase in temperature.

AIEEE-2012

Ans. (d) : For semiconductor, conductivity increase with increase in temperature because when temp rise it electron leave the valance band and goes in the conduction band.

For metal- conductivity of metal decrease with rise in temperature because when temperature increase electron start oscillating in there mean position and collide with free electron which lead to increase in resistivity.

8. Closed Packed structure

354. If in a crystal lattice of a compound, each corner of a cube is enjoyed by Sodium, each edge of a cube has Oxygen and centre of cube is enjoyed by Tungsten (W), then ...... formula.

(a) Na_2WO_4 (b) $NaWO_3$

(c) Na_3WO_3 (d) Na_2WO_3

AMU-2012

SRM JEE-2012

GUJCET-2011

Ans. (b): In a crystal lattice of a compound, sodium atom are present at the corners of the cube, therefore,

Effective number of Na atom in unit cell $= 8 \times \frac{1}{8} = 1$

Tungusten atoms are present at the cube centers then no. of atom in unit cell = 1

Oxygen atom are present at edge = $\frac{1}{4} \times 12 = 3$

Effective number of Oxygen atom = 3

∴ The formula of the compound = $NaWO_3$.

355. The atoms of element 'Y' form hexagonal close packing and the atoms of element X occupies $^2\!/_3$ portion of the number of tetraherdral voids. Write the formula of the compound formed by X and Y.

(a) X_2Y_3 (b) X_2Y

(c) X_3Y_4 (d) X_4Y_3

GUJCET-2014

AP EAMCET (Medical) – 2013

[AIEEE 2008]

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Ans. (d) : In HCP at corner = $\frac{1}{6}\times12 = 2$ atom

In HCP at face centre = $2\times\frac{1}{2} = 1$ atom

In HCP at centre = 3 atom

Total number of atoms in HCP = 2 + 1 + 3

= 6 atom

Total number of tetrahedral voids = 2 × number of atom forming lattice

= 2 × 6

= 12

So, number of atoms of X = $\frac{2}{3}\times12 = 8$

number of atoms of Y = 6

So, X : Y ⇒ X : Y

8 : 6 4 : 3

So, Formula is $X_4\,Y_3$

356. A solid compound formed by elements X and Y crystallises in a cubic structure in which the X atoms are at the corners of a cube and the Y atoms are at the face-centre. The formula of the compound is

(a) XY_3 (b) X_3Y

(c) XY (d) XY_2

CGPET-2007

(NEET-2004)

Ans. (a) :

Number of atoms at the corner of cube is X = $\frac{1}{8}\times8=1$

Number of atoms at face center is $Y=\frac{1}{2}\times6$

Y = 3

So, The formula of compound is $X\,Y_3$.

357. What is the number of octahedral void (s) per atom present in a cubic close-packed structure?

(a) 1 (b) 2

(c) 3 (d) 6

J & K CET-(2018)

NEET-2012

Ans. (a) : In cubic closed packing (CCP).

Number of atom = 4

Number of octahedral void = 4

Since number of octahedral void formed = number of atom in CCP.

∴ Number of octahedral voids per atom

$=\frac{4}{4}$

= 1 .

358. Atoms of element N form HCP lattice and those of the element M occupy 1/3rd of tetrahedral voids. What will be the formula of the compound formed by the elements M and N?

(a) M_4N_3 (b) M_3N_2

(c) M_2N_3 (d) M_3N

GUJCET-2022

[AIIMS-27 May, 2018(E)]

Ans. (c) : In HCP at corner = $12\times\frac{1}{6}$ = 2 atom

In HCP at face centre = $2\times\frac{1}{2}$ = 1 atom

In HCP at centre = 3 atom

Total number of atom in HCP = 2 + 1 + 3 = 6 atom

Total number of tetrahedral void = 2 × number of atom forming the lattice = 2 × 6

= 12

So, number of atom of M = $\frac{1}{3}\times12$

= 4

Number of atom of N = 6

So, M : N ⇒ M : N

4 : 6 2 : 3

So, formula is M_2N_3

359. Element 'B' forms CCP structure and 'A' occupies half of the octahedral voids, while oxygen atoms occupy all the tetrahedral voids. The structure of bimetallic oxide is:

(a) A_2BO_4 (b) AB_2O_4

(c) A_2B_2O (d) A_4B_2O

BITSAT-2021

JEE MAIN-2019-8 April Shift-I

Ans. (b) : Bimetallic oxide has CCP or FCC structure of unit cell. It has both octahedral voids and tetrahedral voids.

Atom B are present at corner and face centred of the unit cell.

So, the total number of atom in B = $8\times\frac{1}{8}+6\times\frac{1}{2}$

= 1 + 3

= 4

Number of octahedral voids = 4

A atoms present per unit cell = $\frac{1}{2}\times4$

= 2

Number of tetrahedral voids = 8

Oxygen atom present per unit cell = 8

∴ Formula = $A_2\,B_4\,O_8$ or AB_2O_4

360. Which set of characteristics of ZnS crystal is correct?

(a) Coordination number (4:4); ccp; Zn^{++}ion in the alternate tetrahedral voids.

(b) Coordination number (6:6); hcp; Zn^{++} ion in all tetrahedral voids.

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(c) Coordination number (6:4); hcp; Zn^{++} ion in all octahedral voids

(d) Coordination number (4:4) ; ccp; Zn^{++} ion in all tetrahedral voids

[AIIMS-2015]
AMU – 2009

Ans. (a) : ZnS has Zinc blende type structure. The S^{2-} ions are present at the corner of the cube and at the centre of each face. Zinc ions occupy half of the tetrahedral state. Each zinc ion is surrounded by four sulphide ions which are disposed towards the corners of a regular tetrahedron.

Hence, CN = 4:4; CCP; Zn^{+2} ion is the alternate tetrahedral voids.

361. In a close-packed body-centred cubic lattice of potassium, the correct relation between the atomic radius (r) and the edge-length (a) of the cube is

(a) $r = \frac{a}{\sqrt{2}}$
(b) $r = \frac{a}{\sqrt{3}}$
(c) $r = \frac{\sqrt{3}}{2}a$
(d) $r = \frac{\sqrt{3}}{4}a$

WB-JEE-2017
J&K CET, 2015

Ans. (d) : For BCC,

- 'a' to 'r' relation,

$$\boxed{4r = \sqrt{3}\,a \Rightarrow r = \frac{\sqrt{3}}{4}a}$$

- Avg. no. of atoms = 2
- Co-ordination No. = 8
- Atomic packing fraction = 0.68

Ex:– Tungeston (w), Chromium (Cr), Vanadium (V), Molbydinum (Mo), Tantalum.

362. The number of octahedral voids per lattice site in a lattice is.......
(Rounded off to the nearest integer)

[JEE Main 2021, 26 Feb Shift-II]

Ans. (1) : Assuming FCC

No. of lattice sites = 6 face centre + 8 corner = 14

No. of octahedral Voids = 13

Ratio = 13/14 = 0.92857

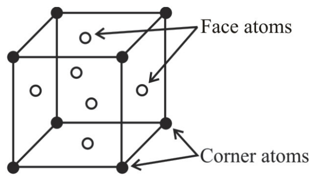
≈ 1 (nearest integer)

363. An alloy made up of A and B metals crystallizes in a lattice, where B atoms occupy the corners and A atoms occupy the face centers. The formula of the alloy

(a) AB_3
(b) A_3B
(c) A_2B_3
(d) A_3B_2

TS-EAMCET (Engg.), 06.08.2021

Ans. (b):



No. of A atoms (Z_A) = Total no. of atom at face $\times\frac{1}{2}$

$$= 6\times\frac{1}{2} = 3$$

No. of B atoms (Z_B) = Total no. of cornor $\times\frac{1}{8}$

$$= 8\times\frac{1}{8} = 1$$

Thus, the formula of an alloy = A_3B

364. Atoms of element X form hcp lattice and those of element Y occupy 75% of tetrahedral voids. What is the formula of the compound formed by elements X and Y?

(a) X_4Y_3
(b) X_3Y_4
(c) X_2Y_3
(d) X_3Y_2

GUJCET-2021

Ans. (c) : Given that, element 'X' forms hcp lattice so, the effective number of atoms in hcp lattice.

$$x = \frac{1}{6}\times12 + 2\times\frac{1}{2} + 3\times1$$

$$x = 6$$

Number of tetrahedral void = 2 × number of atom forming the lattice

$$= 2 \times 6$$
$$= 12$$

So, Number of atom Y = $\frac{3}{4}\times12 = 9$

Hence, the formula of compound is X_6Y_9 or X_2Y_3.

365. Right option for the number of tetrahedral and octahedral voids in hexagonal primitive unit cell are

(a) 12,6
(b) 8,4
(c) 6,12
(d) 2,1

(NEET-2021)

Ans. (a) :

Number of atom in hexagonal primitive unit cell = 6

Number of tetrahedral voids = 2 × Number of atoms per unit cell

= 2× 6

= 12

Number of octahedral void = Number of atoms per unit cell

= 6

So,

Option (a) (12, 6) is correct.

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366. In Chrysoberyl, a compound containing Beryllium, Aluminium and oxygen, oxide ions from cubic close packed structure. Aluminium ions occupy $\frac{1^{th}}{4}$ of tetrahedral voids and Beryllium ions occupy $\frac{1^{th}}{4}$ of octahedral voids. The formula of the compound is

(a) $BeAlO_4$ (b) $BeAl_2O_4$
(c) Be_2AlO_2 (d) $BeAlO_2$

Kerala-CEE-29.08.2021

Ans. (b) : Total number of atom present in ccp structure = 4

∴ No. of tetrahedral voids in ccp = 8

No. of octahedral voids in ccp = 4

∴ Molecular formula = $Be_{\frac{1}{4}\times4}Al_{\frac{1}{4}\times8}O_4$

Thus, the molecular formula = $BeAl_2O_4$

367. A mixed oxide having cubic closed packed structure has 1/8 part of the tetrahedral holes occupied by x^{2+} ions and ½ part of the octahedral holes of y^{3+} ions. The formula of the compound is

Assam CEE-2021

Ans. XY_2O_4 :

Let, the number O^{2-} ions in the crystal = N

∴ No. of tetrahedral voids = 2N

No. of octahedral voids = N

∴ No. of X^{2+} ions = $\frac{1}{8}\times2N=\frac{N}{4}$

No. of Y^{3+} ions = $\frac{1}{2}\times N=\frac{N}{2}$

$X^{2+}:Y^{3+}:O^{2-}=\frac{N}{4}:\frac{N}{2}:N=1:2:4$

Hence, the formula of the compound is XY_2O_4.

368. A compound made up of atoms of Y (anions) forming a CCP arrangement, where the element X (cations) occupies octahedral voids, The formula of the compound is

(a) XY_2 (b) X_3Y_2
(c) X_2Y (d) XY

TS EAMCET 10.08.2021, Shift-I

Ans. (d) : Since, atoms of Y forms CCP which is analogous to FCC.

So effective no. of atoms of Y in lattice = 4

No. of octahedral voids = No. of atoms form CCP = 4

So, effective no. of atoms of X in the lattice = 4

Then X : Y = 4 : 4 or 1 : 1

So the formula of the compound is XY.

369. The number of voids in 1 mole of a compounds forming a HCP structure are

(a) 1.8×10^{24} (b) 3.6×10^{24}
(c) 6.0×10^{23} (d) 7.2×10^{24}

TS-EAMCET (Engg.), 05.08.2021 Shift-II

Ans. (a) : In hexagonal close packed structure, there is 6 atoms per unit cell.

∴ Number of octahedral voids = 6

∴ Number of tetrahedral voids = 2 × 6 = 12

Total number of voids = 6 + 12 = 18

∴ Total number of voids per atom = $\frac{18}{6}=3$

∴ In 1 mole compound the total number of voids = $3\times1\times6.023\times10^{23}=1.8\times10^{24}$

370. A compound made up of elements A and B (with a general formula A_xB_y), where B form a hcp lattice and A occupy $2/3^{rd}$ of the tetrahedral voids. The formula of the compound is

(a) A_2B_2 (b) A_3B_4
(c) A_4B_3 (d) A_3B_3

TS EAMCET 04.08.2021, Shift-I

Ans. (c) : Given that,

Atom B form hcp lattice.

So, effective no. of atoms in unit cell

$$=12\times\frac{1}{6}+2\times\frac{1}{2}+1\times3$$

$$=2+1+3=6$$

Atom A occupy $2/3^{rd}$ of the tetrahedral voids.

So, no. of tetrahedral void = 2 × no. of atoms forming the lattice

= 2 × 6 = 12

Since, no. of atoms of A = $\frac{2}{3}\times12=8$

Hence, the formula of the compound is A_8B_6 or A_4B_3.

371. In a mixed oxide of 'A' and 'B', 'A' occupies all the octahedral voids while 'B' occupies $(2/3)^{rd}$ the tetrahedral voids. The molecular formula of this oxide is ______.

(a) $A_3B_4O_3$ (b) $A_3B_2O_3$
(c) A_3BO_3 (d) AB_2O_3

AP-EAMCET 25-08-2021 Shift - I

Ans. (a) : Let the no. of atom in mixed oxide structure = N

∴ Number of octahedral void = N

and Number of tetrahedral void = 2N

∵ A contains all octahedral void = N

and B contains $2/3^{rd}$ tetrahedral void $=\frac{2}{3}\times2N=\frac{4}{3}N$

∴ Molecular formula = $A_NB_{4/3N}O_N=A_3B_4O_3$

372. A compound is formed by cation C and anion A. The anions form hexagonal close packed (hcp) lattic and the cations occupy 75% of octahedral voids. The formula of the compound is

(a) C_4A_3 (b) C_2A_3
(c) C_3A_2 (d) C_3A_4

(NEET-2019)

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Ans. (d) : Anions (A) form hexagonal close packed (hcp) lattice , so

Number of anion (A) = 6

Number of octahedral void = Number of atoms in the closed packed structure = 6.

Cations (C) occupy 75% of octahedral void, so number of cations (C) = $6\times\frac{75}{100}$

$$= 6\times\frac{3}{4}=\frac{9}{2}$$

$\therefore$ The formula of compound = $C_{9/2}\,A_6$

$$= C_9\,A_{12} = C_3\,A_4.$$

373. A compound of formula A_2B_3 has the hcp lattice. Which atom forms the hcp lattice and what fraction of tetrahedral voids is occupied by the other atoms?

(a) hcp lattice-A, $\frac{2}{3}$ tetrahedral voids-B

(b) hcp lattice-A, $\frac{1}{3}$ tetrahedral voids-B

(c) hcp lattice-B, $\frac{1}{3}$ tetrahedral voids-A

(d) hcp lattice-B, $\frac{2}{3}$ tetrahedral voids-A

[JEE Main 2019, 10 Jan Shift-II]

Ans. (c) : Let B from hcp lattice

Number of B = 6

Tetrahedral void occupied = 2N

By atom

$$= 2\times 6$$
$$= 12$$

Number of atom in A = $\frac{1}{3}\times$ tetrahedral void

$$= \frac{1}{3}\times 12$$
$$= 4$$

Formula formed = A_4B_6 or A_2B_3

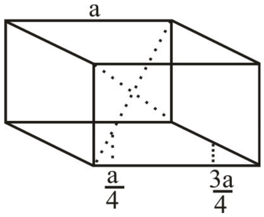
374. In FCC, distance between nearest tetrahedral voids is:

(a) $\frac{a}{2}$ (b) a

(c) $\sqrt{3}a/2$ (d) $\sqrt{3}a/4$

AIIMS 26 May 2019 (Evening)

Ans. (a):



Tetrahedral void = $\frac{3a}{4}-\frac{a}{4}$

$$= \frac{3a-a}{4}=\frac{2a}{4}$$
$$= \frac{a}{2}$$

375. General formula of solid in zinc blends structure is

(a) AB_2 (b) AB_3

(c) AB (d) A_2B

BITSAT-2019

Ans. (c) : Tetrahedral void present in alternate zinc blend.

$$= \frac{1}{2}\times 8 = 4$$

S^{2-} present in ccp = 4

$\therefore Zn_4S_4 = ZnS$ is AB type compound.

376. The number of tetrahedral voids present in 0.5 mol of HCP crystal structure is:

(a) 3.6×10^{23} (b) 9×10^{23}

(c) 3.6×10^{24} (d) 3×10^{22}

AIIMS 25 May 2019 (Morning)

Ans. (c): We know that,

In HCP, Z= 6

So, in tetrahedral voids = 2Z = 2 × 6 = 12

Tetrahedral void present in 0.5 mol = 12 × 0.5 mol

$$= 6\,N_A$$
$$= 6\times 6.02\times 10^{23}$$
$$= 3.6\times 10^{24}$$

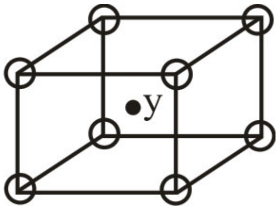
377. A compound formed by elements X and Y crystallises in the cubic structure, where X atoms are at the corners of a cube and Y atoms are at the centre of the body. The formula of the compounds is

(a) XY (b) XY_2

(c) S_2Y_3 (d) XY_3

WB-JEE-2018

Ans. (a) :



In the given compound; there must be 8 corners in cube. So, as the X atoms are at corners, so each of the X atom will contribute $\frac{1}{8}$ part toward a particular unit cell.

The number of X atom per unit cell = $\frac{1}{8}\times 8$

$$= 1$$

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While the Y atoms at the centre of body
So, The number of y atom = 1
Hence, the formula of compound is XY.

378. In a crystalline solid, having formula XY_2O_4, oxide ions are arranged in cubic close packed lattice while, cations X are present in tetrahedral voids and cations Y are present in octahedral voids. The percentage of tetrahedral voids occupied by X is

(a) 12.5% (b) 25%
(c) 50% (d) 75%

JIPMER-2018

Ans. (a) : In a cubic close packed lattice of oxide ions, there would be two tetrahedral and one octahedral void per oxide ion.
Since, the formula shows the presence of 4 oxide ions, the number of tetrahedral void is eight and that of octahedral void is four out of the eight tetrahedral void, one is occupied by X.

$\therefore$ Percentage of tetrahedral voids occupied = $\frac{1}{8}\times 100$

= 12.5 %

379. In a compound, atoms of element Y form ccp lattice and those of element X occupy 2/3rd of tetrahedral voids. The formula of the compound will be

(a) X_4Y_3 (b) X_2Y_3
(c) X_2Y (d) X_3Y_4

VITEEE-2018

Ans. (a) : There are eight tetrahedral voids per unit cell of ccp structure.
Hence, From the given data

Number of X atoms in a unit cell = $8\times\frac{2}{3}=\frac{16}{3}$

Number of Y atoms in a unit cell = 4

$\therefore$ Formula of compound $=X_{\frac{16}{3}}Y_4$

Formula of compound $=X_4Y_3$

380. In a face centred cubic arrangement of A and B atoms in which 'A' atoms are at the corners of the unit cell and 'B' atoms are at the face centres. One of the 'A' atoms is missing from one corner in unit cell. The simplest formula of compounds is

(a) A_7B_8 (b) A_7B_3
(c) AB_3 (d) A_7B_{24}

Karnataka-CET-2017

Ans. (d) : In fcc there are total 8 corners and each contributed 1/8 to the unit cell.
One of the A atom is missing from one corner unit cell.

So there are 7 A atom with total contribution = $7\times\frac{1}{8}$

$=\frac{7}{8}$

B atoms are at the face centres. There are six face centres. Each contributes one half to the unit cell.

Total contribution = $6\times\frac{1}{2}=3$

A: B = $\frac{7}{8}:3$

A : B = 7: 24
The simplest formula of compound is A_7B_{24}.

381. The number of tetrahedral and octahedral voids in CCP unit cell are respectively

(a) 4, 8 (b) 8, 4
(c) 12, 6 (d) 6, 12

TS EAMCET-2017

Ans. (b) : Number of atom in CCP (cubic close packing) $=\frac{1}{8}\times 8+\frac{1}{2}\times 6$

= 1 + 3
= 4 (atoms)

$\therefore$ Number of tetrahedral voids = 2n = 2 × 4 = 8
Number of octahedral voids = n = 4
Hence the option (b) is correct.

382. A crystalline solid is made up of X and Y atoms, X atoms, possesses CCP structure and Y atoms are arranged in tetrahedral voids. If all the atoms situated on a diagonal of one side are removed, what will be the molecular formula of the crystalline solid?

(a) X_3Y_2 (b) X_4Y_3
(c) X_2Y_3 (d) X_3Y_4

GUJCET-2017

Ans. (d) :

X	Y
Corner + face centre	Tetrahedral voids
$\left(8\times\frac{1}{8}\right)+\left(6\times\frac{1}{2}\right)$	(8 × 1)
4	8

When atoms on diagonal of one side removed

X	Y
$4-\left(4\times\frac{1}{8}+1\times\frac{1}{2}\right)$	8 – 4 (1)
4 – 1	4
3	4

$\therefore$ Formula is X_3Y_4

383. If a compound is firmed by X, Y and Z atoms and Z is present on the corners, Y is present $\frac{1}{2}$ tetrahedral voids and X atom in $\frac{1}{2}$ octahedral voids, which of the following will be the molecular formula of the compound?

@apna_pdf

(a) X_2Y_4Z (b) XYZ_4
(c) XYZ (d) X_2ZY

UPTU/UPSEE-2016

Ans. (a): $x = \frac{1}{2}$ of octahedral void

$= \frac{1}{2} \times 4$

$= 2$

$Y = \frac{1}{2}$ of tetrahedral void

$= \frac{1}{2} \times 8$

$= 4$

Z = corners

$= \frac{1}{8} \times 8$

$= 1$

So, the molecular formula of compound is $X_2\,Y_4\,Z$

384. If in a cubic cell, atoms A present at all corners and atoms B at the center of each face. What will be the molecular formula of the compound, if all the atoms present on one body diagonal are replaced by atom C?

(a) $A_3B_{12}C$ (b) $AB_{12}C_3$
(c) ABC_3 (d) $A_3B_{12}C_4$

UPTU/UPSEE-2016

Ans. (a): Atoms are present at corners,

Atoms A per unit cell = $8 \times \frac{1}{8}$

If atoms present on one body diagonal are replaced by atom C, then atoms A per unit cell = $\frac{6}{8} = \frac{3}{4}$

Atoms B are at centre of each face = $6 \times \frac{1}{2} = 3$

Atoms C at corners, atoms. C per unit cell will be

$= 2 \times \frac{1}{8} = \frac{1}{4}$

So, the molecular formula of compound

$A_{\frac{3}{4}}\,B_3\,C_{\frac{1}{4}}$ or $A_3\,B_{12}\,C$

385. If oxide ions are arranged in hcp and the aluminium ions occupy two thirds of octahedral voids. What will be the formula of the compound?

(a) AlO_3 (b) Al_2O_3
(c) $(Al_2O_3)_2$ (d) Al_3O_4

JIPMER-2016

Ans. (b) : For hcp arrangement of oxide ion:
Number of octahedral void for each oxide ion = 1
Number of tetrahedral voids for each oxide ion = 2
Al^{3+} occupies only 2/3 of octahedral voids.

Thus, number of Al^{3+} for each oxide ion = $\frac{2}{3}$

Ratio of oxide ion: Aluminium ion ⇒ 3: 2

So,

Formula of compound is $Al_2\,O_3$.

386. In which of the following compound, cations occupy alternate tetrahedral voids in cubic closed packing (ccp)?

(a) ZnS (b) NaCl
(c) Na_2O (d) CaF_2

JCECE - 2016

Ans. (a) : ZnS has fcc (ccp) type structure, in which S^{2-} ions occupy corner and face centre positions, while Zn^{2+} ions are placed at alternate tetrahedral voids.

387. The number of tetrahedral and octahedral void per unit cell of cubic closed packed structure is

(a) 4, 8 (b) 4, 4
(c) 8, 4 (d) 8, 8

J & K CET-(2015)

Ans. (c) : In CCP or FCC structure number of lattice points (z) = 4

∴ Number of octahedral void = Number of lattice point.

∴ Number of octahedral void = 4

And,

Number of tetrahedral void = 2×number of octahedral void

= 2×4

= 8

388. Assertion : In close packing of spheres, a tetrahedral void is surrounded by four spheres whereas an octahedral void is surrounded six spheres.

Reason : A tetrahedral void has a tetrahedral shape whereas an octahedral void has an octahedral shape.

(a) In both Assertion and Reason are correct and the Reason is the correct explanation of Assertion.
(b) If both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.
(c) If Assertion is correct but Reason is incorrect.
(d) If both the Assertion and Reason are incorrect.

[AIIMS-2015]

Ans. (c) : Tetrahedral void is so called because it is surrounded by four spheres tetrahedrally while octahedral void is so called because it is surrounded by six spheres Octahedrally.

389. Which of the following arrangements correctly represents hexagonal and cubic close packed structure respectively?

(a) ABAB……….and ACBACB………
(b) ABCABC……and ABAB………..

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(c) Both have ABCABC…….arrangement
(d) Both have ABAB…… arrangement

JIPMER-2015

Ans. (a) : Hexagonal closed packing arrangement , ABAB……….

- Cubic close packed (CCB or FCC) arrangement, ACB ACB…………

390. An alloy of Cu, Ag, Au is found to have a simple cubic close packed lattice. If the Ag atoms occupy the face centres and Au is present at the body centre, the formula of the alloy will be

(a) Cu_4Ag_4Au
(b) $CuAg_3Au$
(c) CuAgCu
(d) Cu_4Ag_2Au

JCECE - 2015

Ans. (b) : The number of Cu in the unit cell

$(8 \times \frac{1}{8}) = 1$

The number of Ag in the unit cell

$= (6 \times \frac{1}{2}) = 3$

The number of Au in the unit cell = 1 (body center = 1)

The formula of the alloy = $Cu_4\ Ag_3Au$

391. If same type of atoms are packed in hexagonal close packing and cubic close packing separately, then

(a) density of hcp will be greater than ccp
(b) density of hcp will be smaller than ccp
(c) density of hcp will be equal to ccp
(d) density of hcp and ccp will depend upon the temperature of the system.

COMEDK-2015

Ans. (c) : The density of hcp (hexagonal closed packing) will be equal to ccp (cubic closed packing) because, the percentage of packing efficiency in both hcp and ccp is 74% and free space is 26%.

∴ If same atoms are packed in hcp and ccp separately then density becomes equal in both crystals.

392. How many octahedral void (s) are present per atom in a cubic close-packed structure?

(a) 3
(b) 4
(c) 1
(d) 2

J & K CET-(2014)

Ans. (c) Position of octahedral voids = Edge centre and body centre.

Number of octahedral voids per unit cell in cubic close packing

$$= N_e \times \frac{1}{4} + N_b \times 1$$

$$= 12 \times \frac{1}{4} + 1 \times 1 = 4$$

⇒ Number of octahedral voids = 4

The total number of octahedral voids per atom present in a cubic close-packed structure is one as $\frac{4}{4} = 1$

393. A crystalline solid has A^- ions at the corners and face centres whereas B^+ ions are at the body centre and edge centres of the unit cell. The simplest formula of the compound will be

(a) A_2B
(b) AB_2
(c) AB_3
(d) AB

COMEDK 2014

Ans. (d) : In crystalline A^- ions present at corners and face centers

So, number of A^- ions $= 8 \times \frac{1}{8} + 6 \times \frac{1}{2} = 4$

In crystalline B^+ ions present at body centre and edge centers.

So, number of B^+ ions $= 1 + 12 \times \frac{1}{4} = 4$

Hence, simplest formula of the compound is

$= (A^-)_4 (B^+)_4 = AB$

394. A compound of copper and gold crystallizes in a cubic lattice in which the copper atoms occupy the centres of each of the cube faces and the gold atoms occupy the lattice point. The formula of compound is

(a) Au_3Cu
(b) $AuCu_3$
(c) Au_2Cu_3
(d) Au_3Cu_2

AMU-2013

Ans. (b) : Gold occupies corner of the unit cell. There are 8 corner and contribution of each corner is $\frac{1}{8}$.

So, total number of atom in Au $= \frac{1}{8} \times 8 = 1$

Copper occupies faces of cube. There are 6 faces and contribution of each face is $\frac{1}{2}$.

So, total number of atoms in Cu $= \frac{1}{2} \times 6 = 3$

Hence, the formula compound is $AuCu_3$.

395. The number of octahedral and tetrahedral holes respectively present in a hexagonal close packed (hcp) crystal of 'X' atoms are

(a) X, 2X
(b) X, X
(c) 2X, X
(d) 2X, 2X

AP-EAMCET (Engg.) 2013

Ans. (a) :
Number of octahedral voids in HCP is X
number of tetrahedral voids in HCP is 2X
Hence, the no. of octahedral and tetrahedral holes is X, 2X respectively.

@apna_pdf

396. Structure of a mixed oxide is cubic close packed (ccp). The cubic unit cell of mixed oxide is composed of oxide ions. One fourth of the tetrahedral voids are occupied by divalent metal A and the octahedral voids are occupied by a monovalent metal B. The formula of the oxide is

(a) ABO_2 (b) A_2BO_2
(c) $A_2B_3O_4$ (d) AB_2O_2

(NEET-Mains-2012)

Ans. (d) : It is given that the structure of mixed oxide is cubic closed packed.

Therefore, Number of O_2^- ions according to ccp = 4

So,

Number of tetrahedral voids = 8
and octahedral voids = 4

A ions occupy $\frac{1}{4}$th of tetrahedral voids = 2

B ions occupy all octahedral voids = 4

So,

$$A : B : O = 2 : 4 : 4$$
$$= 1 : 2 : 2$$

Then the formula of the oxide is AB_2O_2.

397. A compound formed by elements A and B crystallizes in the cubic structure where A atoms are at the corners of a cube and B atoms are at the face centres. The formula of the compound is–

(a) A_2B_2 (b) AB_3
(c) AB (d) A_3B

BCECE-2012

Ans. (b) : A occupies corner of the unit cell. there are 8 corner and contribution of 8 corner is $\frac{1}{8}$.

So, The total number of atom in A = $\frac{1}{8} \times 8 = 1$

B occupies face of cube. There are 6 faces and contribution of each faces is 1/2.

So, the total number of atom in B = $\frac{1}{2} \times 6 = 3$

Hence, the formula of compound is AB_3.

398. In a face-centred cubic lattice, atom A occupies the corner positions and atoms B occupies the face centred positions. If one atom of B is missing from one of the face centred points, the formula of the compound is

(a) A_2B (b) AB_2
(c) A_2B_2 (d) A_2B_5

[AIEEE 2011]

Ans. (d) : In the FCC lattice, atom (A) occupies the corner positions. There are 8 corner and each corner contributed 1/8 to the unit cell.

So, Total number of atom in A = $\frac{1}{8} \times 8 = 1$

Atom (B) occupies the face centre positions. There are six (6) face centre position. One atom of B is missing from one of the face centre position. Thus, there are 5 face centre positions that are occupies. Each such position contributed one half (1/2) to the unit cell.

So,

The total number of atom in B

$$= 6 \times 1/2 - 1 \times 1/2 = \frac{5}{2}$$

$$\because \quad A : B = 1 : \frac{5}{2} = 2 : 5$$

The formula of the compound is $AB_{2.5}$ or A_2B_5

399. A compound of 'A' and 'B' crystallizes in a cubic lattice in which 'A' atoms occupy the lattice points at the corners of the cube. The 'B' atoms occupy the centre of each face of the cube. The probable empirical formula of the compound is

(a) AB_2 (b) A_2B
(c) AB (d) AB_3

KARNATAKA-CET, 2009

Ans. (d) : A occupies corners, thus number of A atoms per unit cell = $8 \times \frac{1}{8} = 1$

B occupies face centres, thus number of B atoms per unit cell = $6 \times \frac{1}{2} = 3$

∴ The empirical formula of the compound is AB_3.

400. The unit cell of a binary alloy composed of A and B metals, has a ccp structure with A atoms occupying the corners and B atoms occupying centres of each face of the cube. If during the crystallization of this alloy, in the unit cell two A atoms are missed, the overall composition per unit cell is

(a) AB_6 (b) AB_4
(c) AB_8 (d) A_6B_{24}

J & K CET-(2009)

Ans. (d) : Permitted co–ordination number for ccp is 8 but two A atoms are missing.

So, number of A occupying the corner = 8 – 2 = 6

∴ Contribution of A = $6 \times \frac{1}{8} = \frac{6}{8}$

Contribution of B = $6 \times \frac{1}{2} = 3$

So, composition per unit cell is–

$A_{\frac{6}{8}}B_3$ Or A_6B_{24}.

@apna_pdf

401. A solid compound contains X, Y and Z atoms in a cubic lattice with X atom occupying the corners. Y atoms in the body centered positions and Z atoms at the face center unit cell. What is the empirical formula of the compound?

(a) XY_2Z_3	(b) XYZ_3
(c) $X_2Y_2Z_3$	(d) X_8YZ_6
(e) XYZ	

Kerala-CEE-2008

Ans. (b): Number of atoms of X in a unit cell = $\frac{1}{8} \times 8 = 1$

Number of atoms of Y in unit cell = 1

Number of atoms of Z in unit cell = $\frac{1}{2} \times 6 = 3$

So, empirical formula of the compound = XYZ_3

402. The coordination number in HCP is

(a) 6	(b) 12
(c) 18	(d) 24

[AIIMS-2007]

Ans. (b) : Co-ordination number is the number of ions that immediately surround an ion of the opposite charge within a crystal lattice.

The coordination number in HCP and CCP is 12.

403. The Ca^{2+} and F^- are located in CaF_2 crystal, respectively at face centered cubic lattice points and in

(a) tetrahedral voids
(b) half of tetrahedral voids
(c) octahedral voids
(d) half of octahedral voids

[AIIMS-2006]

Ans. (a) : The Ca^{2+} and F^- are located in CaF_2 crystal respectively at face – centred cubic lattice points and in tetrahedral voids. The calcium fluoride structure is also called fluorite structure. It is 8 : 4 arrangement, the coordination number Ca^{2+} and F^- ions is 8 and 4 ions respectively.

404. If z is the number of atoms in the unit cell that represents the closest packing sequence ..... ABCABC......, the number of tetrahedral voids in the unit cell is equal to:

(a) z	(b) 2z
(c) z/2	(d) z/4

[AIIMS-2005]

Ans. (b) : Number of tetrahedral voids = 2×N
Where N = number of atoms per unit cell
Hence number of tetrahedral voids = 2×z (z = N)

405. A substance Ax, By crystallises in a face centred cubic lattice in which A atom occupies each corner of cube and atom B occupies the centres of each face of the cube. Identify the correct composition of the substance A_xB_y.

(a) AB_3
(b) A_4B_3
(c) A_3B
(d) Composition cannot be specified

J & K CET-(2004)

Ans. (a) : A_x B_y crystallizes in a face –centered cubic (FCC) lattice.

A atoms occupy each corner of the cube. So, the number of atoms of A is $8\times\frac{1}{8} = 1$.

B atoms occupy the center of each face of the cube, so the number of atoms of B is $6\times\frac{1}{2} = 3$

Hence, the formula of compound is AB_3

406. The coordination number of the ions is the CsCl crystal lattice is

(a) 4:4	(b) 8:8
(c) 6:6	(d) 4:8

A.P.EAMCET-1991

Ans. (b) : In the crystal of CsCl , Cs^+ ion is surrounded by $8Cl^-$ and Cl^- ion is surrounded by $8Cs^+$. So, the coordination number of CsCl is 8:8.

407. An alloy of copper, silver, and gold is found to have copper atom constituting the CCP lattice. If silver atom occupy the edge centres and gold atom is present at body centred, the alloy has a formula

(a) Cu_4Ag_2Au
(b) Cu_4Ag_4Au
(c) Cu_4Ag_3Au
(d) CuAgAu

VITEEE-2015

Ans. (c) : Copper present in CCP (or FCC) lattice

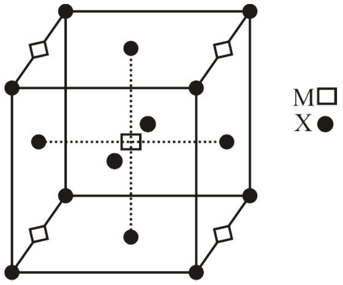
$$=\frac{1}{8}\times 8+6\times\frac{1}{2}=4$$

Silver atoms present in edged centred $=12\times\frac{1}{4}=3$

Gold atoms presents at body centred = 1

Hence, the formula is Cu_4Ag_3Au.

408. A compound M_pX_q has cubic close packing (CCP) arrangement of X. Its unit cell structure is shown below. The empirical formula of the compound is



@apna_pdf

(a) MX
(b) MX_2
(c) M_2X
(d) M_5X_{14}

AIEEE-2012

Ans. (b) : M is present in edge and centre.

So, No. of atoms in $M = 4\times\frac{1}{4}+1 = 2$

X is present in corner and face centered.

So, No. of atom in $X = 6\times\frac{1}{2}+8\times\frac{1}{8} = 4$

So, The formula is = $M_2X_4 = MX_2$.

9. Electrical Properties

409. What is impact on benzene in magnetic field?

(a) Strongly attract
(b) Weakly attract
(c) Strongly repel
(d) Weakly repel

[AIIMS-26 May, 2018(E)]

Ans. (d) : Benzene is diamagnetic substance. The impact of benzene on magnetic field so weakly repel.

410. p-type silicon is formed by adding a minute amount of an element with

(a) five valence electrons
(b) three valence electrons
(c) Six valence electrons
(d) four valence electrons.

COMEDK-2017

Ans. (b) : p-type silicon is formed by adding a minute amount of a trivalent element like boron or aluminum. It becomes a p-type silicon which means it remains electrically neutral but a vacancy for electron becomes available per boron atom. The three electrons of these elements form covalent bonds by neighbouring silicon atoms. This causes an electron vacancy in the crystal. Therefore, p-type silicon is formed with elements of three valence electrons.

411. Malleability and ductility of metals can be accounted due to

(a) the presence of electrostatic force
(b) the crystalline structure in metal
(c) the capacity of layers of metal ions to slide over the other
(d) the interaction of electrons with metal ions in the lattice

KARNATAKA-CET, 2008

Ans. (c) : Malleability and ductility metals can be accounted due to malleability and ductility depends on the hardness of metal.

The malleability and ductility of metals is due to this sliding capacity of the delocalised electrons.

412. If a pentavalent impurity is mixed in the crystal-lattice of germanium then the semiconductor formed will be

(a) p- type semiconductor
(b) n- type semiconductor
(c) (a) and (b) both
(d) None of the above

CG PET -2007

Ans. (b) : When an impurity atom with 5 valence electron (as arsenic) is introduced in a germanium crystal, it replaces one of the Germanium atoms four of the free valence electron of the impurity atom form covalent bond with each valence electron of four germanium atom and fifth valence electron becomes free to move in the crystal structure. These free electron acts as a charge carries such as an impure germanium crystal is called n-type semiconductor become in it charge carrier are negative (free electron).

413. If was mix a pentavalent impurity in a crystal lattice of germanium, what type of semiconductor formation will occur?

(a) n- type semiconductor
(b) P- type semiconductor
(c) Both (a) and (b)
(d) None of these

(NEET-1996)

Ans. (a) : Germanium crystal is called n–type semiconductor because in it change carriers are negative (free electron). When an impurity atom with 5 valence electron is introduced in a germanium crystal, it replaces one of the germanium atoms. Four of the five valence electrons of the impurity atom form covalent bond with each valence electron of four germanium atoms and fifth valence electron becomes free to move in the crystal structure. This free electron acts as a charge carrier.

414. On doping Ge metal with a little of In or Ga, one gets

(a) P- type semiconductor
(b) n- type semiconductor
(c) insulator
(d) rectifier.

(NEET-1993)

Ans. (a) : Doping of group 14 elements such as germanium with elements of group 13 gives size to P-type semi-conductors while doping using group 15 elements given p-type semi-conductors.